FINANCE FOR REDD?

AN ANALYSIS OF FACTORS INFLUENCING CLIMATE CHANGE MITIGATION FINANCE

Karen S. Meijer

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PREFACE

“What, another study?”, “Will you ever stop studying?”, “Great that you do what you find interesting!” These were some of the reactions that I received when I told people that more than 10 years after my graduation as civil engineer and less than 5 after my PhD defence in water resources management I decided to take up another Master study in International Public Management and Public Policy. Why did I decide to do this?

My inspiration has always been to contribute to a more equitable and sustainable use of natural resources. Throughout my work in river basin planning and reservoir operation projects in a variety of countries including Iran, Egypt, Mongolia and Zambia, I have always been intrigued by impediments to change. Regardless how good a river basin plan theoretically is, it proves to be largely a waste of time and effort when economic, political or cultural habits or incentives pull towards another direction. When we travel to a country to give advice we should be aware of the situation we enter into, and the perceptions and relationships that prevail, so that we can provide appropriate guidance that supports the creation of equitable and sustainable natural resources management. Realising my interest in understanding the institutional setting within countries and in the international arena, I decided to take the plunge and acquire some more in-depth knowledge in this field. The Master of International Public Management and Public Policy provided the ideal mixture of subjects, so the choice was easily made.

Having finalised my MSc thesis, I look back upon this challenging, interesting, pleasurable year and I realise how much I owe to the people who contributed to this. First of all, many thanks to prof. dr. Geske Dijkstra for critical comments and quick response to questions. I would like to thank prof. dr. Ko Colijn for acting as a second reader and providing useful comments. I am indebted to prof. dr. Joyeeta Gupta of the Free University of Amsterdam for suggesting to look at REDD finance and for initial discussions to define the scope of the research. I would also like to thank my ‘thesis group’ fellow students Julia Lubjuhn, Irene Petri and Bridget Scanlan for taking the time to read and comment upon my writings. I am grateful to Jolanda Hessels for suggestions for additional analysis. Moreover, I would like to thank all staff and 2011-2012 students for interesting classes, fun drinks and dinners and a great study trip!

And finally, many many thanks to Eelco for supporting me, when I was, once again (!), spending evenings, weekends and holidays studying. I have appreciated that a lot.

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SUMMARY

REDD stands for Reducing Emissions from Deforestation and Forest Degradation. Deforestation and Forest Degradation are estimated to account for 12% of global green house gas emissions that lead to global warming. To mitigate climate change it makes sense to not only reduce current emissions but also to avoid future emissions. Avoiding Deforestation and Forest Degradation should be part of this.

The Kyoto Protocol, as one of the United Nations Framework Convention on Climate Change main treaties, includes emission targets and measures that can be taken to meet these targets for the period 2007-2012. The Kyoto Protocol acknowledges the importance of avoiding deforestation, but does not include mechanisms to finance avoided deforestation or to generate emission credits and offsets through REDD. Since the Kyoto Protocol, REDD gained increased attention, and with the prospect of a new post-2012 agreement that could include REDD, investments are being made to build capacity and gain experience with the measurement, reporting and verification of REDD.

Currently, it is unclear whether the post-2012 climate agreements will contain binding emission targets. Without binding targets, the incentive for developed countries to invest in climate mitigation internationally in order to offset their own emissions is gone. Moreover, there is a possibility that binding targets will be included but that REDD is not included as mechanism to create offsets and tradable credits.

The question that this thesis seeks to answer is whether, in the event that there are either no binding targets or REDD cannot be used to meet these targets, public sector finance may be available to finance the avoidance of deforestation and forest degradation.

To answer this question, the research is composed of the answering of four sub-questions:

1. What are the characteristics of the REDD mechanism?
2. What factors influence a government's willingness to finance climate change mitigation?
3. To what extent can the factors explain financial contributions for climate change mitigation?
4. What does the relevance of the findings mean for finance of the REDD mechanism?

What are the characteristics of the REDD mechanisms?

REDD is basically a two-level mechanism. At the national level a variety of measures can be employed to reduce deforestation and forest degradation, depending on what the main driving forces are for deforestation, the importance of forests in local communities' livelihoods and land tenure. Measures can include compensation payments based on foregone benefits, area protection or education. At the international level, REDD is a payment for ecosystems scheme, in which developed countries pay developing countries to implement REDD measures.

Although REDD could potentially support not only the carbon sequestration service of forests but also the services forests provide through their role in regulating the hydrological cycle, supporting biodiversity and local livelihoods, the mechanism has some drawbacks as well. REDD does not take away international driving forces for deforestation – the demand for beef, palm oil, and timber. Furthermore, reducing deforestation in one place may easily lead to increased deforestation elsewhere. This is referred to as leakage. Another issue is whether avoided deforestation is additional. Would trees really have been cut without payments? These are some of the issues that prevented the inclusion of REDD as international offset mechanism so far. Moreover, land use rights of local communities and forest biodiversity need to be protected to avoid the conversion of forests into monocultures and the exclusion of communities from their source of livelihood.

Costs of REDD are estimate to be around 17-33 billion USD/year to halve deforestation by 2030, although lower estimates of 0.4 billion per year exists as well. Completely stopping deforestation and forest degradation in developing countries, leads to high marginal cost and total estimates of 148 billion USD/year. Without the possibility of using REDD as offsets, funding should come from the public sector and currently many proposals are made to generate revenue for international climate finance. The proposals mainly differ in the proposed distribution of cost over various sectors, countries and groups in society.

What factors influence a governments' willingness to finance climate change mitigation?

Following the main research question, one factor of interest is the role of agreed emission targets. Based on literature from international relations, cultural theory, domestic policy making and aid allocation, six additional factors were derived that were assumed to affect the level of a country's climate change mitigation financial contribution. Seven hypotheses were formulated regarding the amount of international climate change mitigation finance that countries contribute and subsequently tested empirically:

1. Higher required emission reductions to meet Kyoto Protocol targets will lead to more climate change finance in the international context.
2. Higher fossil fuel dependence will lead to more climate change mitigation finance in the international context.
3. Higher perceived impacts of climate change will lead to more climate change mitigation finance in the international context.

4. Involvement in clean technology development will lead to more climate change mitigation finance in the international context.
5. Higher wealth will lead to more climate change mitigation finance in the international context.
6. A larger number of non-'libertarian'/right wing seats in government will lead to more climate change mitigation finance in the international context.
7. Higher involvement in international environmental protection will lead to more climate change mitigation finance in the international context.

In addition two control variables, government expenditure and GDP growth were included in the analysis. Government expenditure is assumed to limit the allocation of financial resources for climate change mitigation, while growth is assumed to positively influence the part of financial resources spent in the international context.

To what extent can the factors explain financial contributions for climate change mitigation?

Climate change mitigation in the international context is operationalised as the gross disbursements made for the purpose of climate change mitigation through bilateral and multilateral aid. Data were collected for all countries, except Iceland and Luxembourg, that are listed in Annex II of the Kyoto Protocol, for which not only binding targets are set but who also have the responsibility to cover the cost of mitigation in developing countries. Data for the dependent variable were available as 2008-09 average and data for other variables were collected for these years or the most recent year preceding these years. The basis of the empirical analysis was formed by the four variables 'required emission reduction', 'fossil fuel dependence', 'government expenditure' and 'growth'. This model was analysed separately and in combination with other independent variables. Only the model that included as fifth variable the involvement in international environmental organisation was found to be significant (p-value 0.042).

Required emission reductions, defined as the reductions in emissions to be realised after 2008 in order to meet the agreed Kyoto Protocol targets in 2012, were found to be an important and significant (standard regression coefficient 0.468, p-value 0.063) predictor of international climate change mitigation finance. The most important predictor is however the involvement in international environmental organisations (standard regression coefficient 0.577, p-value 0.030). Dependence on fossil fuel is an important predictor as well (standard regression coefficient -0.451, p-value 0.036). Government expenditure and growth play less of a role and no significant relationships were found. Also for all other variables the analysis based on the available data set did not result in significant relationships.

The importance of required emission reductions for the level of international climate change mitigation finance could indicate that countries invest internationally in order to obtain emission offsets. If this is true, it may mean that without binding targets, the amount of international climate change mitigation finance may decrease. On the other hand, the relevance of involvement in international organisations indicates a willingness to contribute to climate change mitigation without direct benefits for the donating country. A negative relationship between fossil fuel dependence and climate change reveals that the assumption that a higher fossil fuel dependence would lead to more international climate change mitigation finance was not

confirmed. Although it can be understood that fossil fuel-dependent countries would oppose severe targets, once the targets are set it would make sense for these countries to fulfil a relatively large portion of their targets by purchasing offsets. Other mechanisms play a role here that, considering the role of this factor in explaining climate change mitigation finance, merit further analysis.

What does the relevance of the findings mean for finance of the REDD mechanism?

Most relationships between the factors identified and international public sector climate change mitigation finance can be expected to apply to REDD as well. If an increase in a factor means an increase in climate change mitigation finance, this will also mean an increase in REDD finance, particularly because REDD is a relatively cheap climate change mitigation measure.

The major exception to this rule are required emission reduction and involvement in clean technology. Without the possibility to use REDD for offsets, required emission reductions will not lead to REDD finance. And if countries finance mitigation because they hope to reap the benefits of increased demands for clean technology, they are likely to prefer technical climate mitigation measures over REDD.

The factors that best explain international climate change mitigation finance have opposite impacts on REDD. Since this thesis assumed that REDD cannot be used to generate emission offsets, the importance of required emission reductions in international climate change mitigation finance is negative for REDD finance. On the other hand, contributions made because of commitments to international environmental protection are likely to remain also without binding targets. The importance of involvement in international environmental organisations in explaining international climate change mitigation finance can therefore be understood as positive for REDD finance. A positive relationship between fossil fuel dependence and international climate change mitigation finance would have pointed towards buying of offsets that would not benefit REDD finance. The fact that a negative relationship was found is hence good news, although the underlying mechanism is not yet well understood. With these opposing forces, it can be assumed that without binding targets less public sector finance becomes available for international climate change mitigation, but that part of the funds that become available are likely to also be used for REDD. Whether finance will be sufficient is another question. Current disbursements for general climate change mitigation do not meet the estimated requirements for REDD, and REDD targets only part of global emissions. Additional finance is required, and will very much depend on choices made on type of revenue mechanisms that are currently begin proposed. If these mechanisms are implemented, the results of this study indicate that part of this finance may be used for REDD.

CONTENTS

1 INTRODUCTION

1.1 BACKGROUND

REDD: Reducing Emissions from Deforestation and Forest Degradation to mitigate climate change

REDD stands for 'Reducing Emissions from Deforestation and Forest Degradation'. It is estimated that around 12% of greenhouse gas emissions originate from deforestation and forest degradation (WRI, 2009, see Figure 1.1). Greenhouse gasses (GHG) emitted into the atmosphere by anthropogenic activities enhance the greenhouse gas effect which leads to global warming. This change in global climate is expected to result in sea level rise, more severe tropical storms, more frequent and severe rainfall and related floods, as well as more frequent and prolonged periods of drought (IPCC, 2007). With the large share of greenhouse gasses emanating from deforestation and forest degradation it makes sense to target measures to control climate change not only at reducing current emissions but also at preventing future emissions that may take place when trees are cut. In the global climate change discussions these emissions are recognized, yet no formal mechanisms are in place to facilitate and encourage the avoidance of deforestation and forest degradation.

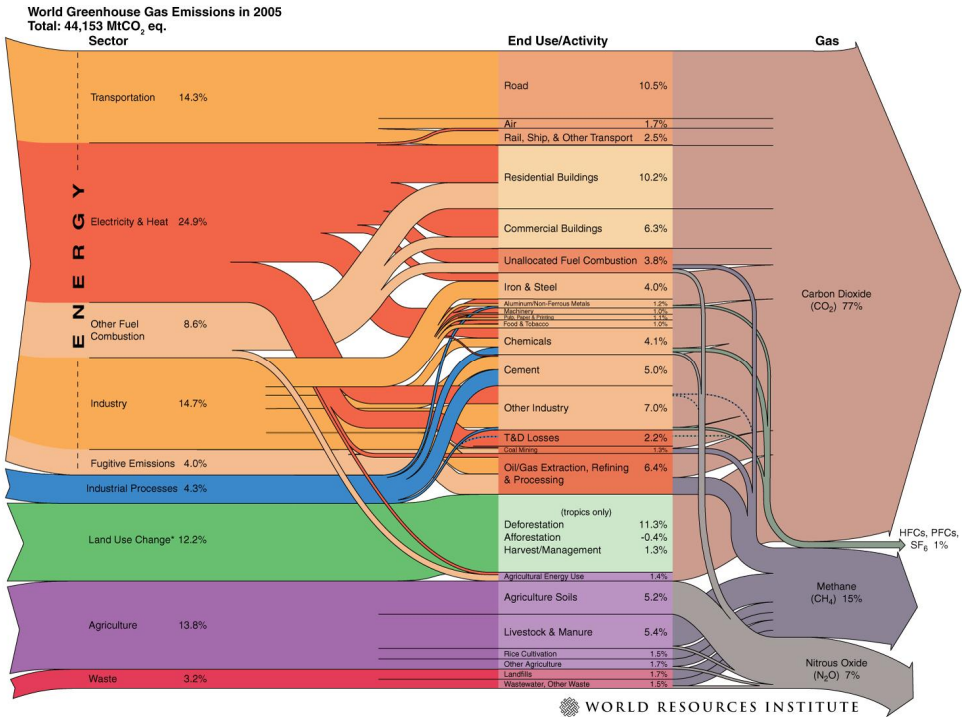

Figure 1.1 Global Greenhouse Gas Emissions – Update 2005 data (WRI, 2009)

International efforts to mitigate climate change

International efforts to deal with global climate change started with the signing of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 as one of the outcomes of the United Nations Conference on Environment and Development (UNCED), also known as the Earth Summit or as 'Rio'.

The policies to combat global climate change and its impacts can be divided in two groups: mitigation measures, aimed at reducing the emissions of GHGs and at increasing carbon storage, and adaptation measures, aimed at reducing the impacts of climate change induced phenomena such as sea level rise and increased frequency and severity of floods and droughts. An important step towards global mitigation efforts was made by the adoption of the Kyoto Protocol on December 11, 1997 during the Third Conference of the Parties (COP 3) of the UNFCCC.

The Kyoto protocol, which entered into force in 2005 and concerns agreements for the period 2007-2012, sets emission targets for all developed and transition countries and describes three types of measures that can be taken to reduce GHG emissions and meet the targets:

- International Emission Trading (IET) – International Emission Trading installs a cap of 'assigned amount units'(AAU) and allows trading of units between countries.
- Clean Development Mechanism (CDM) – the Clean Development Mechanism allows developed countries to make additional investments in developing countries to realize already proposed investments in a way that emit less greenhouse gasses. The prevented emissions can be used by the developed country to meet its emission targets. Afforestation activities (afforestation, reforestation and revegetation – ARR) can be implemented under the CDM, but avoided deforestation cannot.
- Joint Implementation (JI) – this mechanism is similar to that of the Clean Development Mechanism, but does not involve developing countries. The Joint Implementation projects are jointly implemented by two or more developed countries.

The Kyoto protocol distinguishes three groups of countries. Annex I countries (41 countries and the EU) include all developed countries and countries with economies in transition. For these countries binding emission reduction targets have been agreed upon. Annex II countries (23 countries) concern all developed countries, but not the countries in transition. The financing of climate change mitigation activities in developing countries is an Annex II countries' responsibility. All other countries, referred to as non Annex I countries, comprise the developing countries who under the Kyoto protocol only face voluntary targets.

Deforestation and forest degradation in international climate change agreements

Despite the large share of emissions assumed to originate from deforestation, international mechanisms to avoid deforestation as part of meeting emission targets were not included in the Kyoto protocol. The main reasons for this were confusion over the role of avoided deforestation in climate change mitigation and

technical issues related to the measurement, reporting and verification of avoided deforestation (Holloway and Giandomenico, 2009).

Since the Kyoto Protocol, mechanisms to avoid deforestation have increasingly received attention. In the Marrakesh Accords (COP 7, 2003), reducing emissions from deforestation is allowed within Annex I countries to meet a country's targets, but still not to generate eligible credits for trading (Holloway and Giandomenico, 2009). The Coalition for Rainforest Nations requested the renewed discussion of 'RED' (Reducing Emissions from Deforestation) at COP 11 (2005, Montreal). A second 'D' for Forest Degradation was added, because forest degradation was found to contribute 1/3 to 1/2 of the emissions from forest areas. This eventually led to the inclusion of REDD in the Bali Action Plan resulting from COP 13 (2007) with the following definition:

> "Policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries"

Later, the semicolon has been replaced by a comma, after which a plus sign has been added (REDD+)[1] (Holloway and Giandomenico, 2009). REDD+ is now the term most commonly used to indicate international efforts to reduce emissions from deforestation and forest degradation.

The Bali action plan does not make a decision on the implementation of the REDD mechanism but encourages all partners to support ongoing efforts and capacity building and explore further options for REDD. Up until now, no decision has been reached on the role of REDD in the follow up of the Kyoto protocol that should be negotiated this year at COP 18 in Doha, Qatar.

REDD as climate change mechanism

The main idea behind REDD as a climate change mechanism is that developed countries pay developing countries to take measures to avoid deforestation and forest degradation. Under the Joint Implementation and Clean Development Mechanism such international activities can be used to offset domestic emissions in the developed countries.

Currently, investments are being made for REDD for so-called REDD Readiness. This entails capacity building to implement local REDD measures and the gaining of experience to objectively assess the emissions avoided by these measures. REDD is however not yet included in climate agreements as mechanism for developed countries to obtain offsets to meet their emission targets. Moreover, there is a chance that the post-2012 agreements will not include binding targets.

[1] REDD++ has also been proposed. The second plus refers to emissions from *all* land use changes. This is also referred to as REALU – Reducing Emission from All Land Uses (Van Noordwijk *et al.*, 2009). Van Noordwijk *et al.* (2009) argue that the "whole-landscape" approach proposed by REULA will help avoid forest definition problems.

Therefore, a very relevant question is whether there will be a future for REDD in the case that there will be no binding targets or when REDD measures cannot be used to meet them. Why would countries be willing to pay for international forest protection without the possibility to offset their emissions? This thesis explores whether countries would be willing to pay for REDD, as a global payment for environmental services program, either through bilateral or multilateral means.

1.2 RESEARCH QUESTION

Avoiding deforestation and forest degradation is important to prevent large amounts of greenhouse gasses being emitted into the atmosphere. Avoiding deforestation and forest degradation requires financial resources, which should to a large extent come from developed countries. If the follow-up of the Kyoto Protocol will contain binding targets and REDD credits can be used to meet these targets, it can be expected that financial resources can be generated.

This thesis explores the event in which there are either no binding targets or REDD cannot be used to meet these targets. Will developed countries be willing to pay for the protection of global forest to prevent greenhouse gas emissions? The purpose of this thesis is to give insight in the motivations of countries to provide funds for global climate change mitigation. This information can inform policy makers and climate change negotiators on what is required to make REDD work financially.

The **main research question** this research seeks to answer is therefore formulated as:

> *Can public sector finance be expected for REDD when there are either no binding emission targets or when REDD measures cannot be used to meet such targets?*

1.3 RESEARCH SUB-QUESTIONS

REDD is a relatively recent mechanism that has not been fully elaborated. To provide insight in the circumstances under which REDD finance is likely, the empirical part of the research looks at explanatory factors for disbursements for climate change mitigation more generally.

The following research questions form the basis for the research, each of the questions is further explained below and coherence is depicted in Figure 1.2.

1. What are the characteristics of the REDD mechanism?
2. What factors influence a government's willingness to finance climate change mitigation?
3. To what extent can the factors explain financial contributions for climate change mitigation?
4. What does the relevance of the findings mean for finance of the REDD mechanism?
   This fourth research question answers the main research question.

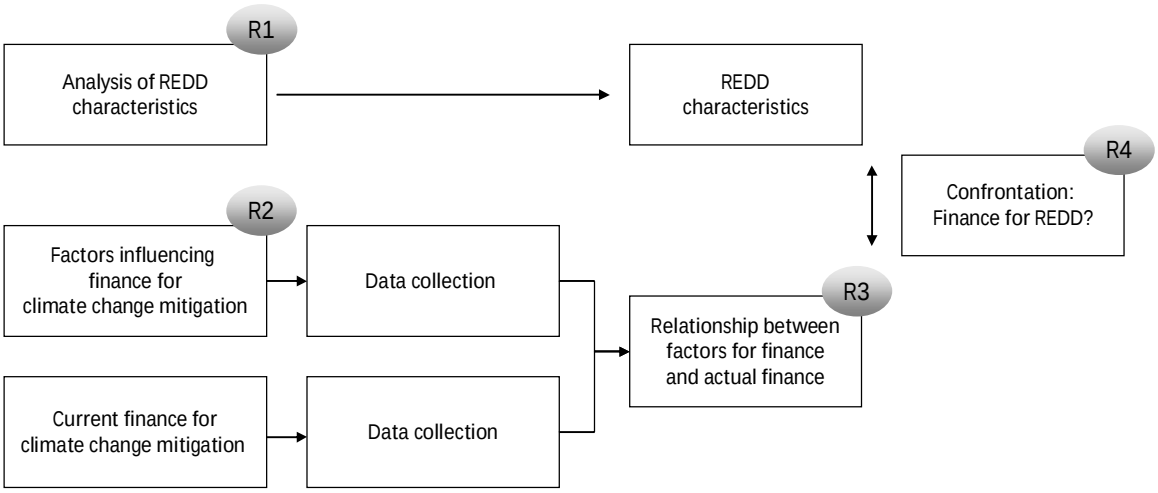

Figure 1.2 Relationship between the research questions (R refers to research question)

1.4 RESEARCH APPROACH

1. What are the characteristics of the REDD mechanism?

The first research question focuses on understanding REDD. Through literature analysis, insights are obtained regarding what measures can be taken at the national and at the international level to avoid deforestation and forest degradation. What are the cost of these measures and how can they be financed? Willingness to finance REDD may also depend on the perceived effectiveness and possible negative consequences of REDD. Attention will therefore also be paid to the main drawbacks or risks of REDD.

This research focuses necessarily on past climate finance. Once the factors/conditions that played a role in the past are identified, they will be confronted with the REDD characteristics to understand whether the conditions favourable in the past, will apply to REDD (research question 4).

2. What factors influence a government's willingness to finance climate change mitigation?

The global climate and forests can be considered global public goods. Depending on how they are framed, governments may have different reasons why they would be willing to pay to protect these global environmental goods. I explore these frames using literature from various fields to identify factors that may explain the contributions countries make for global environmental protection. The answering of the research question results in a set of hypotheses that will be tested empirically.

3. To what extent can the factors explain financial contributions for climate change mitigation?

Because REDD is relatively recent, the empirical component of the research focuses on the explanation of development aid targeted at climate change mitigation. A cross-sectional analysis has been carried out for all Annex II countries except Iceland and Luxembourg using publicly available data from various sources. The most recent years for which data were available were 2008-2009.

4. What does the relevance of the findings mean for finance of the REDD mechanism?

The results from the empirical analysis will be confronted with the procedures and conditions for the REDD mechanism to answer the main research question of whether REDD will be financially feasible.

All research questions are answered in separate chapters. In addition, the operationalisation of the empirical research based on the answering of research question 2 in order to answer research question 3 is included as a separate chapter on research design (Chapter 4).

1.5 RELEVANCE

Academic relevance

One of the conditions for academic relevance is the 'empirical testing of so far untested theoretical hypothesis' (Lehnert, Miller and Wonka, 2007). With regard to both REDD and other finance to mitigate climate change and protect forests, there does not seem to have been any publications that try to assess what factors explain the willingness to provide financial contributions in an international context.

The various reports and studies that can be found on climate change mitigation and adaptation finance either discuss the financial requirements (Stern, 2006; Eliasch, 2008) or analyze the various proposals for revenue generation for their distributional consequences and effectiveness in fund-raising (e.g. Global Canopy Programme, 2009; Keohane, 2009; Hof *et al.*, 2011). Dutschke *et al*. (2008) discuss the potential of different sources of finance for different types of forests.

Clemençon (2006) discusses the financial situation of the Global Environment Facility, the multilateral fund to support the Rio Conventions. He discusses the various frames that can be used to appeal to various constituencies to raise money to replenish the fund, but does not elaborate this in an analysis of the relevance of various possibly explaining factors. Hicks *et al*. (2008) present a detailed analysis of factors affecting environmental aid for the period 1988-1999. This thesis looks more specifically at aid for climate mitigation in more recent years.

The proposed study can therefore be understood to provide new insights and make a contribution to the academic literature.

Societal relevance

Despite international efforts, greenhouse gas emission levels in the atmosphere continue to increase. Climate change may have enormous impacts on life on earth. If the emissions that may originate from currently expected deforestation and forest degradation can be prevented or reduced, this is an important gain. Moreover, funds are being spent and capacities developed, which may have been a waste of time and money if REDD will not actually be implemented. This study may deliver a contribution to our understanding of what is needed to reduce emissions from deforestation and forest degradation and this way have relevance for society.

2 REDD CHARACTERISTICS

Areas are being deforested and forests are being degraded because either trees themselves have value as timber or fuel wood, or because the land on which they stand is more profitable when put to another use, particularly agriculture or construction. REDD should be appreciated as a two level mechanism (Angelsen, 2008). At *the national or subnational level* a variety of measures is possible to protect forests. At the *international level* REDD should be seen as a payment for ecosystem instrument. This chapter discusses the national and international measures and their possible drawbacks. Subsequently REDD finance is discussed and ways to generate revenue in relation to international agreements on REDD.

2.1 NATIONAL MEASURES TO AVOID DEFORESTATION AND FOREST DEGRADATION

To avoid deforestation and forest degradation at the national level, various measures can be taken. These range from regulatory measures in which areas are protected and all use prevented, to paying compensation costs for foregone benefits in a local payment for ecosystems scheme. Other options are suasion types measures in which people are educated about sustainable forest use. This can lead to community-based forest management in which communities can continue to live off forest benefits while also protecting it from degradation.

Which measure is the most suitable at the national level will depend on the forces that drive deforestation and forest degradation. The EU FP7 research project REDD ALERT has made an inventory of the various forces that drive deforestation and forest degradation based on a framework by Geist and Lambin (2002, in Gupta et al. 2010). A distinction is made between proximate drivers and underlying drivers. The proximate drivers describe the use of the forest: harvesting of timber and collection of fuel wood, or forest clearing for agricultural expansion or for creating construction areas. Underlying drivers are demographic, economic, technological, institutional and cultural factors that create the demand for timber, fuel, and cleared areas. These driving forces extend beyond the borders of developing countries to the developed world: there is globally a high demand for timber, for soy and biofuels, and for beef originating from former tropical forest areas. Gupta et al. (2010) therefore extend the framework by adding the level at which the drivers materialize: local, provincial, national and global. National measures that REDD aims for can only target the national and sub-national driving forces, but not the global driving forces. As a result, reducing deforestation and forest degradation in one location, may lead to increased deforestation and forest degradation elsewhere. This is referred to as leakage, and seen as one of the major drawbacks of REDD.

Another important issue in relation to REDD is land tenure. In many countries local communities use the forest, but do not own it (Sunderlin *et al.* 2009). Indigenous peoples oppose the commodification of their

ancestral lands, and fear they will lose their way of living. Climate change mitigation is primarily targeted at the carbon sequestration function in trees. Monocultures may have higher carbon sequestration capacities than natural forests. A risk of REDD is therefore that natural forests are replaced with monocultures, destroying natural ecosystems and other services of forests (the provision of various products, regulation of hydrological cycle, scenery). According to Overbeek and Núñez Mutter (2011) the Norwegian government proposed the conversion of 6000 hectares of biodiverse grassland into a tree plantation under REDD flag. Safeguards and Measurement, Reporting and Verification and procedures and techniques to prevent this are currently being elaborated (see for example IISD, 2001, Bernard and Minang, 2011).

2.2 INTERNATIONAL MEASURES TO AVOID DEFORESTATION AND FOREST DEGRADATION

The idea of REDD as international climate mitigation mechanism is that the global community, individual countries, companies or NGO's pay national or subnational authorities, that would be established as 'Designated National Authority' (DNA) to implement forest protection within their country, independent of the measures employed locally. "Payments for ecosystem services" is a policy instrument through which beneficiaries of ecosystem services pay the users of the ecosystem to alter their behaviour in such a way that a particular level of service is derived. Payments for ecosystem services schemes are in place at the river basin level, where downstream users (or governments) pay upstream users to practise particular land use to sustain hydrological services. There seems to be little experience with international payment for ecosystem services schemes (Huberman and Leipprand, 2006). Debt for nature swaps and eco-labelling could fall under this category. However, debt for nature swaps do not constitute ongoing (annually recurring payments), and eco-labelling leads to rather indirect payments.

It is still under discussion whether payments are preferably made to subnational actors/individual projects or to national designated authorities. The advantage of direct payment to subnational actors is an increased transparency in smaller projects. The disadvantage of payments at this level is increased risk of leakage to other parts of the country.

Other risks feared for are the creation of a new type of 'resource curse' and the possibility that the complexity of forest credits facilitates corruption and fraud (REDD-monitor, 2011). A further criticism of carbon markets more generally is the attitude it creates in developing countries (Lohman, 2012). There is no incentive to implement local environmental regulations: "the UN carbon offset market is providing incentives to government officials not to promulgate or enforce environmental laws. If their countries are allowed to remain "dirty" today, the reasoning goes, they will be able to make money by cleaning up tomorrow." Even worse, countries may choose to redesignate protected areas to 'development' areas in order to be eligible for REDD finance to avoid deforestation.

2.3 REDD FINANCIAL REQUIREMENTS

To avoid deforestation and forest degradation, measures need to be taken that can exist of establishing (and enforcing) protected areas, payments for sustainable forest management, or can have the form of education

and training. In addition, capacity needs to be developed to monitor forest areas and estimate carbon sequestration. The building of capacity and implementation of measures will require financial resources.

Updating earlier analysis for the Stern Review (Stern, 2006), the Eliasch Review (Eliasch, 2008) estimates the total ongoing emission reduction costs at 17-33 billion USD per year to halve annual global emissions from deforestation and forest degradation by 2030. These costs are the cost for buyers of REDD emission credits in compliance markets. The UNFCCC (2007) estimates a lower value of 12 billion USD/year based on opportunity cost of direct deforestation drivers. Much lower values of 0.4 billion USD/year and much higher values of up to 148 billion USD/year have been estimated as well (UNFCCC, 2007). These results greatly depend on assumptions made regarding deforestation drivers and related opportunity costs.

2.4 REDD FINANCIAL RESOURCES

Who should pay for the actual REDD mechanism and through what type of mechanism revenue is to be generated is still part of the international climate mitigation debate. Various revenue generation mechanisms have been proposed for climate mitigation funding by various countries and NGOs (Global Canopy Programme, 2009; an overview is included in Annex A). These proposals vary in terms of how costs are distributed over countries, sectors and societal groups, and whether revenue should be generated through carbon markets or other markets or not through markets at all.

Decisions on emission targets for the coming years and on the role of REDD in international climate mitigation will have a large impact on the type of revenue generation mechanism. If there are binding emission targets and countries are allowed to offset emissions through REDD credits, it can be assumed that countries are willing to pay for REDD credits. This is especially so, since avoiding deforestation is a relatively cost-efficient measure to reduce future greenhouse gas emissions (Stern, 2006). If these REDD credits can also be traded, additional investments in REDD measures to generate credits may be expected. If REDD cannot be used to generate credits for offsets or trading, the private sector is unlikely to play a large role, and REDD will require public funds to go ahead. Such public funds can come directly from contributions by countries, for example based on their GDP. Other proposals suggest introducing general or sector-specific taxes to raise public funds, auction emission rights (assigned amount units (AAU)) or charging a levy on transactions in either the carbon or other markets. In addition funds may come from civilians and companies who voluntarily offset their emissions, as well as from charities.

2.5 CONCLUSION

REDD as a climate change mitigation mechanisms entails two types of measures: national level measures to target deforestation drivers within the country, and international payments as instrument to influence REDD implementation at the national level. The international payments are estimated to amount to the order of tens of billions USD/year.

Depending on the role of REDD in international climate agreements, revenue for REDD can be generated through trading credits in compliance markets, or through public sector funding for which various proposals have been made ranging from auctioning emission targets, taxes and levies, and additional allocation from general government revenue. The private sector may play only a limited role in REDD. In addition charities and voluntary markets in which companies and civilians offset their CO2 use can contribute as well. Figure 2.1 summarizes the various flows of funds. The yellow area in this figure is the focus of this thesis.

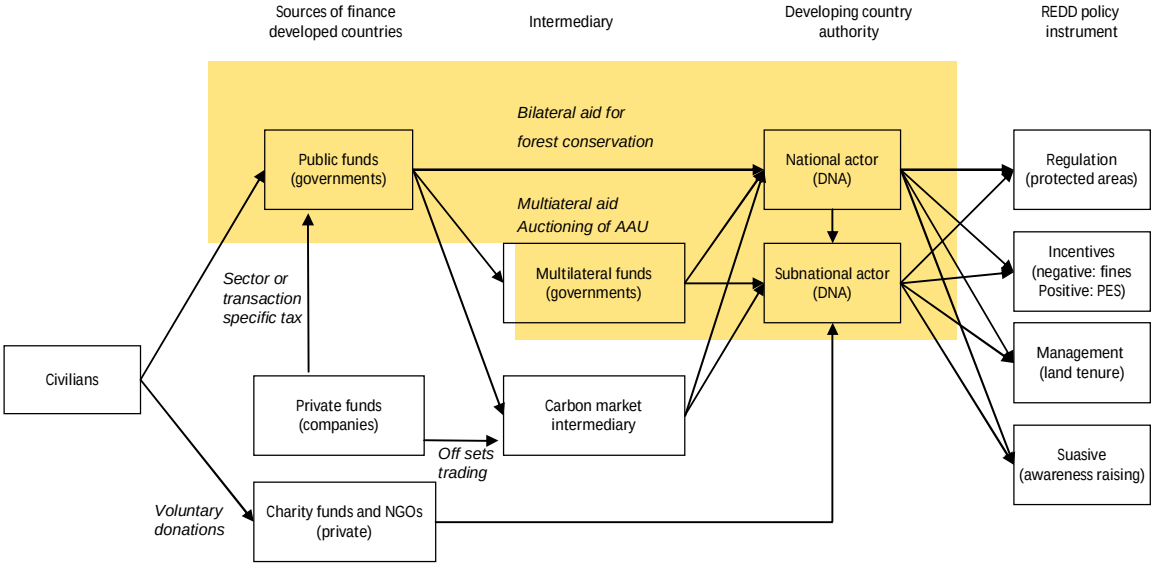

Figure 2.1 Elaboration of relationships between financial sources and REDD policy instruments (Source: see text)
(Abbreviation used: AAU = Assigned Amount Units, DNA = Designated National Authority, PES = Payment for Ecosystem Services)

REDD has various drawbacks and measurement, reporting and verification procedures as well as safeguards need to be established to ensure that payments for avoided deforestation and forest degradation indeed lead to reduced emissions without negative impacts on biodiversity and livelihoods. This involves also capacity building among national or subnational actors who receive the payments and implement measures locally.

3 FACTORS AFFECTING INTERNATIONAL PAYMENTS FOR CLIMATE CHANGE MITIGATION

The purpose of this chapter is to derive factors that could explain the willingness of countries to make payments for the mitigation of climate change in the international context. A first factor of interest is the amount of emission reductions still to be achieved under the Kyoto Protocol. The assumption underlying this research is that the absence of binding targets may impede financial contributions for climate change mitigation in the international context. The first hypothesis to test is therefore:

1. Higher required emission reductions to meet Kyoto Protocol targets will lead to more climate change finance in the international context.

Other factors are derived based on several theories. First of all international relations theories based on realist, neoliberal and social constructivist assumptions are discussed. Normative perceptions on climate change, originating from social constructivist thinking, are further explored using Cultural Theory. Subsequently, I discuss the influence of domestic actors and political systems in determining country's positions. I then move on to discuss the empirical literature on aid allocation with a specific focus on environmental aid. The chapter starts however with the discussion of the global climate and the role of forests in this as global public goods. This notion forms the basis for all international cooperation on climate change mitigation.

3.1 THE GLOBAL CLIMATE AS A GLOBAL PUBLIC GOOD

The global climate and the carbon sequestration service of forests can be considered global public goods. A public good is a good for which there is no possibility to exclude anyone from its use. Moreover the use of the good does not affect its availability for others, in other words, its use is non-rivalrous. Public goods distinguish from other goods based on these two conditions: excludability and rivalry. This leads to a matrix with four types of goods (See Table 3.1). Private goods are those for which use is rivalrous and individual users can be excluded. When users can't be excluded from rivalrous goods, the goods are referred to as common-pool resources. The abstraction of products from forests is an example of either private goods or common-pool resources, depending on land tenure. When users can be excluded but use will not affect availability, the term 'club-goods' is used. Forests as private parks form an example of this type of good.

The notion of a global good refers to the importance of goods beyond national borders. Benefits or negative impacts of a reduced availability of the good cannot be confined within specific areas. This also means that

the non-rivalry and non-excludability criteria not only apply to individuals but also to countries. The global climate is clearly a global public good.

Despite the fact that a global public good is non-rivalrous and use of the climate does not affect its availability, the climate can be altered by activities of individuals. Because the good is public, and no one can be excluded from its use, the protection of these types of goods is at risk from 'free-riding': the enjoyment of the benefits without contributing to its sustenance. This means that no country alone can maintain the quality of the global climate, and that its protection requires international cooperation. Countries will have two major reasons to cooperate: 1) utilitarian – it is in the country's own interest to help protect the global public good, and 2) equity – a responsibility to protect global goods for others and share the burden. These motivations will be further explored in the following sections.

Table 3.1 Types of goods

	Excludable	Non-excludable
Rivalrous	Private goods Forests used for timber	Common-pool resources Forests used for timber
Non-rivalrous	Club-goods Forests as private parks	Public goods Climate, forests as carbon sequestration

3.2 INTERNATIONAL RELATIONS THEORIES

Realism and neo-realism – the balance of power

Realism assumes an anarchistic world in which little is known about other countries' positions and there is little incentive to cooperate. To prevent being overthrown by enemies, a country's main concern is to maintain its power position relative to that of other countries. This is particularly the case for the major hegemons. Hegemon stability theory suggests that international beneficial outcomes can be achieved for all states if one, or a few, hegemons are willing to bear the costs because it benefits themselves in the first place (Snidal ,1985). Actors take rational decisions based on the information available to them and behave in such a way that they perceive to be in their own best interests. This makes realism an utilitarian approach. Neo-realism differs from realism in that they do not in first instance blame human nature for the importance attached to power, but rather the anarchical international system. For this reason realists and neo-realists attach little value to international organisations and institutions (Waltz, 1990, in Rittberger and Zangl, 2006, p15; Hasenclever *et al.*, 1996, p196).

Realism and neo-realism have their origin in security studies, and the main global public good of which realism and neo-realism aim to explain its maintenance is therefore global peace. Military power is however unlikely to influence international climate change negotiations (Chasek *et al.*, 2006). Economic power, on the other hand, can. Another type of power than military and economic power is authority. Countries may be willing to show leadership and take a strong stand to gain international authority in a certain field.

In relation to climate change there can be two main positions that relate to relative power positions in the international arena. Parties may not want to alter their behaviour or allocate funds, because this may weaken their international economic position, or parties may want to take a leadership function and allocate additional funds in order to gain authority and improve their international image as innovative, sustainable and the ones to tackle an important issue.

As an economic and military hegemon, the United States may for example argue that it provides a large share for another global public good (international security) and leaves the lead in climate change mitigation and adaptation to others. On the other hand, the European Union indicated their ambition to become a leader in climate change mitigation (Gupta and Ringius, 2001). This ambition could result in an increased willingness to finance international climate mitigation.

Being a current leader or having the ambition to become a leader and the relationship with climate change mitigation are quite speculative and hard to operationalise. Realism and neo-realism are therefore not further translated into hypotheses to explain climate change mitigation finance in the international context.

Neo-liberalism – collective action

The neo-liberalist premise is that some benefits for a country can only be achieved by cooperating with other countries (Hasenclever *et al.*, 1996). Neo-liberalism is, like realism, a utilitarian approach, but whereas realists aim to maintain or improve their position relative to other countries, neoliberalism aims at absolute increases in benefits. Collective action will lead to increases in absolute gains for the individual countries.

The risk of collective action is that the other countries will not comply with agreements and that a country is exploited by others. This is the traditional 'prisoner's dilemma'. The tragic of the prisoner's dilemma is that whereas both actors prefer mutual cooperation over mutual defection, they will gain most from defecting with the other cooperating, while their worst outcome is that they will cooperate while the other defects. The theoretical result is that both countries defect. In reality, defection can be prevented, since actors are likely to meet again in future, and current defection may have negative future consequences. In the re-iterated prisoner's dilemma chances for defection are therefore reduced. A second means to prevent defection is through contracts and sanctions. For neo-liberalists the main purpose of institutions and regimes is indeed to prevent defection. Institutions and regimes reduce transaction costs of desired actions and increase those of undesired action (Hasenclever *et al.*, 1996, p186).

Following a neo-liberalist theoretical perspective, the main factors to explain finance would be the donor country's own interests. These self-interests will be a trade-off between short term interests, which disfavour unpopular and costly climate change mitigation measures, and long term interests, which take into account the potential costs of climate change. Three types of interests can be derived that influence a country's position on climate change mitigation (Prittwitz, 1990 in Sprinz and Weiß, 2001, p70):

- Polluter interests (welfare gains from continued pollution – for example, CO2 emissions from the combustion of fossil fuels, but also timber imports)
- Victim interests (welfare losses induced by pollution effects – for instance, devastation of agricultural regions); as well as
- Third-party interests (including, inter alia, the capacity to monitor, provide, and use pollution-abatement technology, or substitute the polluting activity or product)

Polluter interests: fossil fuel use dependency

The countries whose economies depend on energy resources are reluctant to accept agreements on severe reductions in emissions. The United Stated, China, India, Brazil and Mexico have, or had, large reserves of fossil fuels. Because of the resulting low prices for fossil fuels, the lifestyles common in these countries consume relatively high amounts of energy (Paterson, 1996). Many countries of the European Union and Japan have always had to import fuels and their economies and lifestyles are therefore presumably much less dependent on fossil fuels. These countries may benefit from lower fossil fuel prices should prices fall when demand is reduced.

Although reluctant to accept binding targets, fossil fuel dependent economies will not oppose climate change mitigation activities in developing countries. If this can be counted as offset, they will prefer these types of measures over domestic emission cuts. If not counted as offset, there is no relation between fossil fuel use dependency and international mitigation finance.

Victim interests: country's vulnerability to climate change

If a country is vulnerable to the impacts of climate change, through increased exposure to floods or hurricanes, loss of land to sea level rise or damage to agriculture and ecosystems as a result of droughts, they have a higher interest in mitigating climate change. In that case, they can also be expected to be willing to finance both domestic and international climate change mitigation measures. Paterson (1996) suggests that European countries are more vulnerable than other developed countries to the direct climate impacts.

Besides these direct climate impacts, there are also indirect impacts in the form of climate refugees. When the sea level rises, various islands in the Indian and Pacific Ocean will lose territory and may ultimately disappear altogether. Also coastal mainland countries, like Bangladesh, are vulnerable to sea level rise. Africa and the Middle-East may suffer from increased droughts. If a country expects to be the destination of many climate change refugees it will be willing to finance international measures to mitigate climate change. Paterson (1996) indicates that the EU may be closer to many of the areas from which climate refugees may come than other developed countries.

Third-party interests: knowledge and technology for climate change mitigation

Countries engaged in knowledge and technology that can be used to mitigate climate change can be expected to be in favour of climate change mitigation measures, since this will offer economic

opportunities. Countries with knowledge and technology for climate change mitigation can therefore be expected to be willing to finance climate change mitigation internationally, because part of this finance will flow back to their own country.

Hypotheses:

2. Higher fossil fuel dependence will lead to more climate change mitigation finance in the international context.
3. Higher perceived impacts of climate change will lead to more climate change mitigation finance in the international context.
4. Higher perceived future influx of climate refugees will lead to more climate change mitigation finance in the international context.
5. Historical connection to potentially climate change-vulnerable regions will lead to more climate change mitigation finance in the international context.
6. Involvement in clean technology development will lead to more climate change mitigation finance in the international context.

Social constructivism

The two utilitarian approaches discussed in the above conceive of states as rational and well-informed actors. In rational choice theory preferences are given and will determine the outcomes of negotiations. This may subsequently lead to the formation of formal institutions, such as treaties. These theories ignore learning, omit the possibility of communicative action to influence preferences, and ignore the influence of implicit norms and principles (Young, 2001). March and Olsen (1998) refer in this regard to the 'logic of appropriateness' - behaviour guided by internalized rules instead of direct self interest, versus the 'logic of consequentiality' – calculated behaviour. Social constructivism regards knowledge and preferences as social constructs: formed through interaction between individuals, hence preferences may change. Social constructivism can be considered part of 'idealism'. It differs from the late 19th century early 20th century normative idealism by its refraining from searching for a particular common ground norm (Rittberger and Zangl, 2006, p21). Instead, social constructivism recognises that different actors hold different norms, and that both the norms and the perception of what is required to meet a specific norm can change over time through learning.

Three concepts can be derived from social constructivism that are relevant to explain perceptions on climate change mitigation and its finance:

- The role of knowledge.
- Norms with regard to climate change, and particular to global injustice in the distribution of the burden of climate change and its mitigation and adaptation
- Logic of appropriateness as voluntary compliance with internalized norms and principles.

The role of knowledge

The role of knowledge and ideas in the formulation of preferences is extremely relevant in relation to climate change. Whether or not anthropogenic activities have accelerated global warming, what the consequences are and what constitutes appropriate measures is constantly being adjusted and refined. Positions of countries regarding climate agreements may have shifted over time mainly because the scientific consensus has shifted.

Knowledge has been argued to be a global public good itself (Stiglitz, 1999). Advances in knowledge are available to all countries. New insights can change individual country's positions when for example the estimated vulnerability to climate change has changed. However, advances in knowledge in general cannot be translated into factors that can explain an individual country's position on climate change mitigation or mitigation finance.

Norms and justice

Another aspect following from social constructivism and norms is the idea of responsibility of developed countries towards developing countries in relation to climate change. The rise in greenhouse gasses is primarily caused by the high consumption needs of energy and other goods (timber, meat, agricultural produce) that have caused deforestation. In addition, the poorest countries bear the largest burden of global warming (Mendelsohn *et al.*, 2006). This international inequity between contributions to and impacts of global warming are by many considered as unjust. Although not officially agreed upon as a 'polluter pays' principle for fear of high claims, many will agree that developed countries carry some degree of responsibility. They should therefore support developing countries in reducing emissions and in taking the necessary measures to adapt to the changing climate.

Hicks *et al.* (2008) suggest that in wealthy modern societies, people value post-material values. This is in line with Maslow's hierarchy of needs, which states that once more basic physical needs are fulfilled, people strive towards mental needs and self-fulfilment (Maslow, 1954).

Logic of appropriateness

Advances in knowledge and dissemination of this knowledge to decision-makers can lead to a commonly accepted perception of what entails the best approach to dealing with climate change. Once this has led to principled beliefs (pertaining to what is to be achieved) and causal beliefs (pertaining to the best approach to take) this can be expected to affect a country's behaviour without the need for binding agreements.

Hypotheses:

Social constructivism is particularly insightful for explaining actors' behaviour by considering not only direct interests but also normative viewpoints and learning. However, at this abstract level, it is difficult to translate this into factors that can explain positions towards climate change mitigation finance. Different norms will lead to different perceptions. I will discuss different normative perceptions in more detail in the subsequent section on Cultural Theory. I include here two hypotheses derived from social constructivism.

7. A higher value attached to global justice and responsibility will lead to more climate change mitigation finance in the international context.
8. Higher wealth will lead to more climate change mitigation finance in the international context.

3.3 CULTURAL THEORY

Whether countries may be willing to provide international finance for climate change mitigation may depend on underlying beliefs of what appropriate climate change mitigation measures are. The international relations theories insufficiently explain these deliberations. How climate change itself and different climate change mitigation measures are perceived by individuals can be explained by their world view. Douglas (1970) introduced the concepts of grid: the extent to which an individual appreciates hierarchical stratification in society, and group: the extent to which an individual appreciates collectivity. Thompson (1990) further elaborated the four world views or perspectives that are formed by group/grid combinations in what is generally referred to as Cultural Theory, see Figure 3.1. The four world views have distinct ideas on the role and controllability of nature and their perspectives can along broad lines be translated into voting behaviour. Starting in the top right corner, the hierarchist has trust in rules and regulations, and nature can be controlled as well. The related government orientation is conservative. Egalitarians value equity high, also with regard to future generations. Nature as the source of all life should be treated with care. Egalitarians would vote liberal or progressive. The individualist is an optimist. Nature is considered resilient. All individuals have the same chances and it is their own responsibility to seize them. General voting behaviour is libertarian. The fatalists do not take responsibility. Anything may happen and there is nothing that can be done about it. Generally, fatalists refrain from voting.

For the purpose of this thesis it is interesting to know how the perspectives translate into opinions with regard to appropriate climate change measures and their finance. These opinions are discussed below and included in Figure 3.1. The fatalist is excluded from this discussion because fatalists do not believe in a makeable world, and their strategy would be: do nothing.

Individualist

The optimistic view of individualists regarding the resilience of nature, leads them to be very sceptical about whether climate change will occur. Moreover, they are convinced that should climate change occur, it may also present benefits (Verweij, 2006). According to Verweij et al. (2006), the individualists would argue that under the current uncertainties, it may be very unwise to spend money on climate change mitigation and that rather other environmental problems should be prioritized.

Should international emissions targets be agreed upon, the discussion is no longer whether climate change is real, but rather what the best measure is to meet the targets imposed. In such an event, individualists would prefer market-based approaches (O'Riordan and Jordan, 1999). When markets determine the prices of CO2 emission rights, reductions can be made in the most cost-efficient ways. Without the possibility to offset, there may be no reason to finance climate mitigation in the international context.

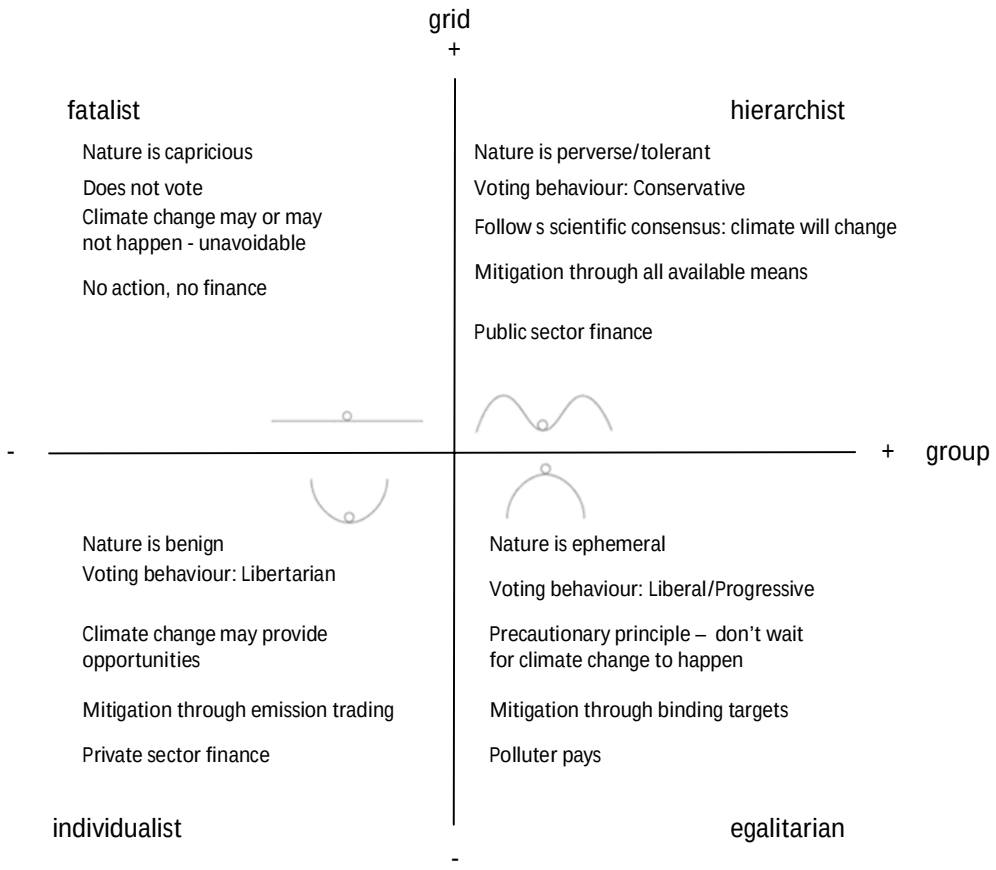

Figure 3.1 Four perspectives on climate change (elaboration based on Thompson, 2003)

Egalitarians

Egalitarians strongly adhere to the precautionary principle. It does not matter whether climate change is uncertain. In their view, the current consumer-oriented capitalist society can not be sustainable, and will only lead to further injustice and inequalities. Egalitarians will oppose management techniques like cost-benefit analysis which is viewed as an attempt to commoditize nature (O'Riordan and Jordan, 1999). The best way to combat climate change is to force polluters to pollute less and consumers to consume less.

Climate change mitigation measures will be supported, but not with the purpose of offsetting emissions elsewhere. Offsetting emissions means that emissions in the developed country are definitively increased, while the prevention of future emissions in developing countries is very uncertain.

Hierarchists

Hierarchist will prefer contracts and regulation that 'incorporate the workings of the natural world into human evaluations and management systems' (O'Riordan and Jordan, 1999, p87). In their perception of climate change they will follow the consensus opinion of scientific authorities (O'Riordan and Jordan, 1999).

Technological fixes (such as artificial carbon absorption, increasing earth surface reflectivity) are considered suitable solutions for the global climate problem. In fact, all means may be acceptable, but taxes

are preferred over carbon-trading. Hierarchist will finance international mitigation measures if this fits the overall scientific opinion.

Although these worldviews explain individual perceptions in very generalized ways, the link of world views to voting behaviour is useful. Government orientation or voting behaviour can be used as an indication of world view and subsequently of probability of approval of climate change mitigation action and their finance. Involvement in international environmental cooperation can be considered part of the government position as well, although this may go back to commitments made by previous governments, which are not easily undone by new governments.

Hypotheses

9. A larger number of non-'libertarian'/right wing seats in government will lead to more climate change mitigation finance in the international context.

3.4 THEORETICAL CONSIDERATIONS OF DOMESTIC POLICY CHANGE

International relations theory focuses largely on positions of 'states'. But where does the 'state position' come from? Depending on the type of political decision-making, decision are to smaller or larger extents influenced by parliaments and non-state domestic actors such as lobby groups. The number of veto-players in decision-making will affect outcomes. More veto-players will result in a lowest common denominator (Hicks *et al.* 2008, p117) and outcomes of negotiations that stay close to the status quo (Hix and Hoyland, 2009). It can therefore be assumed that a high number of veto players is beneficial to vested, presumably industrial, interests, while a lower number of veto players may facilitate change.

Pluralist systems grant all lobby groups equal access to decision-makers, whereas corporatist systems have fixed relationships with a small number of groups, generally business and labour. Generally, industrial and business interest groups have more resources than environmental interest groups, due to the diffuse, free rider, character of environmental benefits (Hix and Hoyland, 2009). Neopluralist systems, such as the EU recognize this and provide subsidies to specific groups to ensure equal representation of all interests. This means that in neopluralist settings the chances for environmental lobby groups to influence policy making are highest.

The number of veto players and other characteristics of the policy-making system may impede policy change. Institutions, once created, are likely to persist, because they are either accepted as normal (the social-constructivist view) or because it may be too expensive to abolish them (the utilitarian view). In other words there is 'path-dependency', summarized by Howlett *et al.* (2009, p200) as the 'previous conditions that affect future conditions'. Finance for climate mitigation may thus be the consequence of earlier commitments and of previous involvement in international environmental protection. The agreed emission targets under the Kyoto Protocol, included in Hypothesis 1, are in fact an example of such earlier commitments.

Hypotheses

10. Many veto players will lead to less climate change mitigation finance in the international context
11. A neo-pluralist system will lead to more climate change mitigation finance in the international context.
12. Higher involvement in international environmental protection will lead to more climate change mitigation finance in the international context.

3.5 INTERNATIONAL ENVIRONMENTAL AID – EMPIRICAL EVIDENCE

Aid allocation

Official development assistance (ODA), or foreign aid, is perhaps the most common form of financial transfer between governments of developed and developing countries. A vast volume of literature is available on the determinants of the allocation of aid. This literature investigates to what countries and with what volumes donor countries target their assistance, based on characteristics of both donor and recipient countries.

Three main categories of factors can be found in the literature: self-interest, need and merit (Hoeffler and Outram, 2011). Self-interest of donor countries can be traced back to neoliberalist theories. Self-interest in relation to aid may mean the support of relevant trade partners or cooperation to avoid economic refugees coming to the donor country. The second factor, often referred to as 'need' considers whether the poorest countries indeed receive the largest amounts of aid. Need originates from social constructivism and the implicit norm to help 'those in need'. A related factor would be historical responsibility (and trade), which could explain flows of aid to former colonies. The third factor 'merit' refers to the level of democracy and institutional capacity, which are believed to render aid more effective.

Various studies have found aid allocation to be the result of a combination of these factors. Berthélemy (2006) finds all factors to be relevant. Feeny and McGillivray (2008) find OECD-DAC behaviour to be explained by both recipient country needs and donor interests. Dollar and Levin (2006) looked at the extent to which democracy in developing countries influences aid allocation and find that this factor plays a larger role for multi-lateral aid than for bilateral aid. Also former colonies form a significant explanatory factor in their results. Trade was found to be relevant for only a few countries. Proximity to the donor on the other hand was found to be a good explanatory factor for the allocation of aid.

All of these factors concern characteristics of the recipient country or the relationship between recipient and donor country. For understanding the volumes of funds donors make available for aid in general, these factors are less useful. More specific factors are found in the literature on environmental aid.

Environmental aid

Environmental aid can be assumed to have one, or both, of two purposes. The first purpose is to protect the environment in order to maintain environmental services that support development. Particularly the poor depend on ecosystem services for their livelihoods. Environmental aid can thus have an equity enhancing

function. Arvin *et al.* (2009) found that environmental aid has indeed led to development, although they warn further research is required. The second purpose is to protect the environment from the consequences of development, for example in the form of compensation for impeded development due to the non-use of environmental resources. In this case environmental aid has more of an environmental protection function, which is often in the interest of the developed countries.

Hicks *et al.* (2008) looked in more detail at factors explaining the allocation of environmental aid by donors. They investigated 4 sets of in total 11 hypotheses for their capability to predict amounts of aid allocated for 'dirty' and 'environmental' purposes. Dirty aid is all aid that has the potential to lead to environmental degradation, such as resource extraction and heavy industry. Environmental aid may have both conservation (indicated as 'green' environmental aid) and waste water treatment and sanitation (indicated as 'brown' environmental aid) as objectives. A category 'neutral' is also distinguished, but not further analysed and consists of activities in the field of health and education, trade and fiscal policies, telecommunications or emergency aid. The first set of hypotheses consists of donor environmental policies. The idea is that the more environmentally concerned a donor is, the larger percentage of aid will go to environmental purposes. The second set refers to wealth and post-materialists values. With increasing fulfilment of basic needs in the donor country, citizens become more concerned with post-materialists values and the protection of nature. Strength of domestic lobby groups is included as third set. Assumed is that strong environmental groups will lead to higher amounts of environmental aid, and strong industrial groups to lower amounts of environmental aid. The fourth set concerns institutional factors. Here it is expected that a leftist government orientation and corporatist traditions both contribute to proportionally more aid being allocated for environmental purposes. More checks and balances (or veto players) is expected to lead to less aid for environmental purposes. These sets of hypotheses are in line with the theory discussed above.

The hypotheses and their conclusions based on statistical tests with four models are summarized in Table 3.2. Hicks *et al.* (2008) tested both the relationship with 'Dirty Aid' and with 'Environmental Aid'. For the purpose of this thesis only the relationship with Environmental Aid is relevant. Because donor countries comprise only a small set of countries, Hicks *et al.* (2008) used a panel based on 11 years of aid data (1988-99) for 17 donor countries to obtain 160 donor-year cases.

Strongest relations are found between the decrease in allocation of dirty aid with the modernization parameters: wealth and post-materialism. The relationship with the percentage of aid allocation for environmental aid was less clear. What is interesting for this research is that two factors that were expected to have a positive correlation with environmental aid showed a negative correlation: donor domestic environmental policies and left wing governments. Hicks *et al.* (2008) explain the first from a substitution perspective: with a strong domestic environmental policy there is less interest in working on environmental issues internationally. For the second negative relationship between left-wing government and environmental aid it is suggested that left wing governments are pressured for domestic expenditures and that hence they reduce their international expenditures. A final result is that over time dirty aid is

decreasing and environmental aid increasing. This is not further investigated, but can be the result of learning over time on unintended consequences. Hicks *et al*. (2008) emphasize that only the relationships of environmental aid allocation with three variables of donor environmental policy preferences and with the number of veto players were found to be significant, but only in some of the models tested.

Table 3.2 Summary of findings Hicks *et al.* (2008)

Hypothesis	**Relationship of factor with Environmental Aid found**
Donor environmental policies	
1a. The intensity of a donor country's environmental policy preferences will positively correlate with the share of its foreign aid budget dedicated to environmental issues	Negative relationship (direction opposite from what was expected)
1b. The intensity of a donor country's international environmental policy preferences will positively correlate with the share of its foreign aid budget dedicated to 'green' issues	Positive relationship (direction confirmed)
1c. The intensity of a donor country's international environmental policy preferences will positively correlate with the share of its foreign aid budget dedicated to 'green' issues	Positive relationship (direction confirmed)
Wealth and post-materialist values	
2a. The more post-materialist the electorate's preferences, the more 'environmental' the donor country's foreign aid budget	No relationship found
2b. Wealthier country's will be more willing to spend taxpayer money on environmental foreign aid	Positive relationship with the 'green' environmental aid, but negative with the 'brown' environmental aid
Strength of domestic lobby groups	
3a. The stronger a country's environmental lobby the larger the proportion of its aid budget that will target environmental protection	Positive relationship with the 'green' environmental aid, but negative with the 'brown' environmental aid
3b. The stronger a country's 'dirty lobby', the smaller the proportion of its aid budget that will target environmental protection	Negative relationship (direction confirmed)
Institutional factors	
4a. The more left governing party seats in the donor country's legislature, the larger the proportion of its aid budget that will target environmental protection	Models did not agree on relationship. Left-leaning governments seemed to favour brown aid over green aid.
4b.The fewer checks and balances in the donor country's government, the larger the proportion of its aid budget that will target environmental protection	No relationship
4c. The fewer veto players in a donor country's government, the larger the proportion of its aid budget that will target environmental protection	Some models no relationship, some negative relationship
4d. Corporatist states will spend proportionally more of their aid budget on environmental protection than non-corporatist states	No relationship

The factors most relevant for climate change mitigation finance are those that for which a relationship was found with environmental, and particularly 'green', aid: percentage of environmental treaties ratified, compliance with environmental treaties, national wealth, and strength of environmental lobby groups.

3.6 CONCLUSION

This chapter has identified eleven hypotheses for why countries would be willing to finance climate change mitigation in an international context:

1. **Higher required emission reductions to meet Kyoto Protocol targets will lead to more climate change finance in the international context.**

2. **Higher fossil fuel dependence will lead to more climate change mitigation finance in the international context.**
3. **Higher perceived impacts of climate change will lead to more climate change mitigation finance in the international context.**
4. Higher perceived future influx of climate refugees will lead to more climate change mitigation finance in the international context.
5. Historical connection to potentially climate change-vulnerable regions will lead to more climate change mitigation finance in the international context.
6. **Involvement in clean technology development will lead to more climate change mitigation finance in the international context.**
7. A higher value attached to global justice and responsibility will lead to more climate change mitigation finance in the international context.
8. **Higher wealth will lead to more climate change mitigation finance in the international context.**
9. **A larger number of non-'libertarian'/right wing seats in government will lead to more climate change mitigation finance in the international context.**
10. Many veto players will lead to less climate change mitigation finance in the international context
11. A neo-pluralist system will lead to more climate change mitigation finance in the international context.
12. **Higher involvement in international environmental protection will lead to more climate change mitigation finance in the international context.**

Only the hypotheses printed in bold will be tested. I decided to leave out some hypotheses because they would have to be based on unreliable or hard to obtain information, or because earlier research already indicated that the factor was not a suitable predictor. I will discuss for each hypothesis the reason for including it or leaving it out.

Hypothesis 1 is included as a major factor of interest for this study. Hypothesis 2 will be included. If countries with a high fossil fuel dependency finance climate change mitigation internationally, it can be assumed that they do this to offset their emissions. If this is a major reason for providing finance, it may mean that there will be less finance for REDD if REDD cannot be used to create emissions. Hypothesis 3 will be included. The expected impact of climate change on a country is specific to international climate change agreements, and not investigated as part of environmental aid research. Hypothesis 4 and 5 will not be further investigated. Assessing the number of refugees that will result from climate change and that will chose a particular country as destiny requires the combination of various types of information, including expected impacts on developing countries and refugee preferences. This would become very speculative. Hypothesis 6 will be included. The involvement in clean technology is a factor that is specific to international climate change agreements, and not investigated as part of environmental aid research. Moreover, this factor has particular relevance for REDD. If countries invest in climate change mitigation to receive financial flows for their technology, they may favour other mitigation measures over REDD.

Hypothesis 7 is not included. The data for this indicator covered to few countries, which would have meant that half of the cases would have to be omitted from the regression involving this indicator. Hypothesis 8 and 9 will be included. They are testable and add a different dimension to the self-interest factors. Hypotheses 10 and 11 are left out. Hicks *et al* (2008) tested similar hypotheses and did not find a relationship for these factors. Hypothesis 12 is included. Many of today's financial allocations may have been the result of agreements in the past based on the circumstances prevailing at that time. This potential path-dependency should not be ignored in the analysis.

The identified factors link to international climate change finance at different levels. This is graphically illustrated in Figure 3.2. Most factors affect climate change mitigation finance through public sector finance generally. Part of the public sector finance for climate change mitigation will be invested domestically and part internationally. Fossil fuel dependence is assumed not to influence climate change finance directly, but rather to influence whether money is spent internationally or nationally. Involvement in clean technology is not related to climate change mitigation finance generally, but only to international climate change finance. Countries hoping to sell their technology and gain back some of their international aid, may target aid for this purpose.

Two control variables are included to control for the country's economic context: availability of public sector finance and economic growth. The total amount of public sector finance available is likely to influence the total contributions to climate change mitigation finance. Economic growth can affect whether available public sector finance is invested nationally or internationally. The assumption is that low growth will reduce spending in the international context and instead raise national investments.

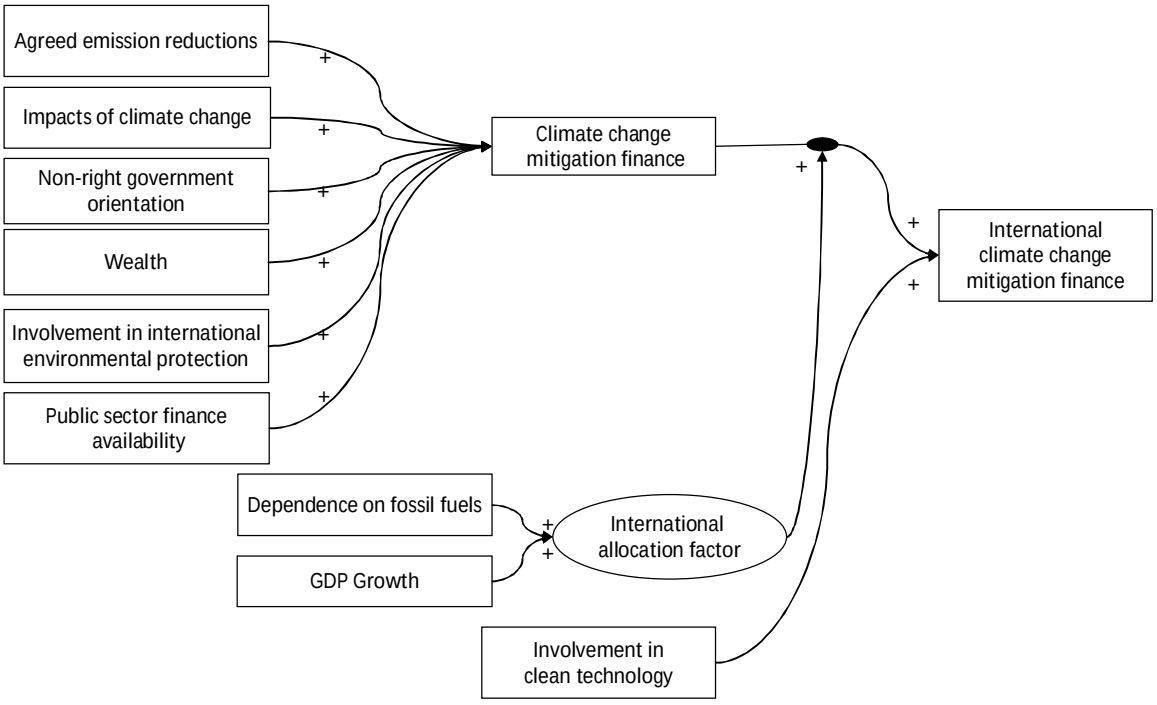

Figure 3.2 Graphical presentation of relationship between factors and international climate change finance

4 RESEARCH DESIGN

Based on the theoretical discussion of factors influencing public sector finance for climate mitigation in the international context, this chapter operationalises the hypotheses for further testing using empirical data. Although the main research focuses on REDD, the empirical component investigates financial contributions for climate change mitigation more generally. The research question for this component is formulated as:

What factors explain the financial contributions developed country governments have made for the purpose of climate change mitigation?

This question is a Y-oriented question in which various possible factors are tested for their explanatory capacity of the dependent variable.

4.1 DEPENDENT VARIABLE

The dependent variable of which I would like to explain the variation between countries is the financial disbursements developed countries make through both bilateral and multilateral donations with the specific aim to mitigate climate change.

As indicator I use the percentage of aid for climate change mitigation purposes as percentage of the countries' GDP. I choose GDP instead of ODA because the purpose is not to explain the allocation of aid, but rather differences in contributions between countries. The percentage of GDP is the most logical indicator to make cross country comparisons on this issue.

The OECD-DAC publicly provides the financial flows for official development assistance for OECD-DAC countries through both bilateral and multilateral funds. The countries themselves provide information through the CRS (creditor reporting system) on whether the funds they provide served the climate change mitigation purpose. This is done through indicating its significance for the 'Rio Markers'. The Rio Markers were developed to track financial flows in relation to three conventions that originated from the UNCED 1992 conference, or Earth Summit: the Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (UNCBD) and the Convention to Combat Desertification (UNCCD). Countries indicate whether the specific disbursement had the goals of the conventions as primary objective or made a significant contribution to them. For the analysis the total aid (gross disbursements) with climate change mitigation as primary or as significant objective is used.

In addition donors make contributions to multilateral funds which use part of their funds for climate change mitigation. The amounts to multilateral funds cannot easily be traced back to individual donors. A publication by the OECD (OECD-DAC, 2011) provides estimation for contribution of individual donors to climate change mitigation via multilateral funds, by multiplying contributions to the fund with percentage that the fund reports as being spent on climate change mitigation purposes. This publication provides only average disbursements for the period 2008-2009. These years therefore formed the basis for the collection of all other data. As far as possible these have been determined as 2008-2009 averages as well. Otherwise 2008 data or data from the most recent preceding year have been included in the analysis.

GDP data were taken from the World Bank's World Development Indicators Database. Current USD are used for 2008 and 2009 are taken from the database. 2008 values are adjusted to obtain constant 2009 USD, using inflation rates derived from the ODA data. Subsequently the 2008-2009 average was determined.

The indicator is a combination of direct measurements of contributed funds for climate change mitigation and GDP which are officially published, and therefore have a high reliability. The indication of markers is done by donors themselves and especially the indication of 'significant objective' is not unambiguous. Moreover, since 2010 a specific marker for climate change adaptation is added, which could possibly mean that adaptation funds allocated before 2010 were marked under climate change mitigation This limits the validity of the indicator.

4.2 INDEPENDENT VARIABLES

Level of emission reductions to meet Kyoto Protocol targets

As indicator the level of emission reductions that are required in 2008 to meet the Kyoto Protocol's targets is used. Emission reduction targets are formulated as change in annual emissions that are to be achieved in 2012 compared to 1990. These targets are included in the Kyoto Protocol. For the EU a combined target was agreed that was later redistributed over the countries that were then part of the European Union. Grubb (2003) lists the agreed targets. Based on information on CO2 emissions in kilo tonnes per year in the World Bank's World Development Indicators database (World Bank, 2012) the gap between 2008 emissions and target emissions was calculated. Because the United States never ratified the Kyoto Protocol, and therefore do not recognise their target of a reduction of annual emissions with 7% compared to 1990 levels, their emission target is set at zero. Although targets exist for Germany, the World Development Indicators database does not include 1990 data for Germany. For South Korea no targets have been agreed under the Kyoto Protocol.

The indicator is valid because it clearly shows the tasks that countries are faced with. Large gaps between actual and agreed upon emissions can induce countries to invest in carbon offsets. The indicator is reliable since it is based on objective data in publicly available database.

Dependence on fossil fuels

As indicator for dependence on fossil fuel use the CO2 emissions per USD of GDP are used. The World Development Indicators database (World Bank, 2012) provides information on total CO2 emissions per country. Combined with data on GDP, the indicator has been calculated. Data for 2008 have been used.

This indicator has a high validity, since if large amounts of greenhouse gasses are emitted in a country, the country's economy can be understood to strongly depend on the use of fossil fuels. Because of the use of data available in a publicly available database, the reliability is high as well.

Perceived vulnerability to climate change

Various studies estimate impacts of climate change. The Working Group II's report on Impacts, Adaptation and Vulnerability of the IPCC's fourth assessment report (IPCC, 2007) provides details on already experienced climate impacts per region. A more recent 'Special Report of Working Groups I and II of the IPCC (Handmer *et al.*, 2012) looks into potential future impacts of climate extremes. Although these studies provide a wealth of information on various possible impacts, it is difficult to translate these results into an aggregated figure of impacts per country. I therefore choose to use the results of a study by Mendelsohn *et al.* (2000) who estimate economic damage per country as percentage of the country's GDP. They use two models that combine global circulation models and response functions. The paper presents aggregate results in damage as percentage of GDP for the situation with average global warming of 2 degrees Celsius in 2100 for the two models based on various simulations. Although the paper admits various shortcomings and absolute results may not be very accurate, I think the study by Mendelsohn *et al* (2000) is unique in its per country approach at the global level and can be used to understand the differences in impacts among countries, and therefore suitable for the analysis that I intend to carry out. To be able to allow regression analysis, I have estimated the impacts based on maps in the article and averaged the results. Negative values refer to negative impacts on GDP and therefore a higher vulnerability to climate change, positive values refer to positive impacts of climate change in terms of the country's GDP.

The validity of this indicator is high, but its reliability is moderate since various other studies may have been carried out all using presumably different assumptions and time horizons.

Involvement in clean technology development

As indicator I use the results from a ranking provided by the World Wildlife Fund on the sales of clean technology as percentage of a country's GDP for different countries (WWF and Roland Berger, 2009). They made this ranking for the first time in 2009 and repeated this in 2011 and 2012, and currently refer to this as the 'Global Cleantech Innovation Index' (WWF and Cleantech Group, 2012). The ranking can be an indication of the importance of clean technology for a country's economy, and can therefore be considered a valid indicator for this factor. The reliability of the indicator is moderate to high. It combines information from various studies, and therefore makes it difficult to check. On the other hand, this compilation of information has been carried out by hired consultants and checked by an expert group, increasing its

reliability. The data represent the situation in 2008, although the combination of various sources of information may include some earlier information as well.

Number of green seats in government (non-right wing)

For the government orientation the percentage of government seats with a particular orientation will be used. I make use of the data set 'Comparative Political Data Set III' available from the University of Bern's website (Armingeon et al., 2011) which includes data on government and government composition for all OECD countries. Unfortunately, no data set exists of 'environmental' government seats. Because left-wing parties can have either a progressive or a more conservative national social focus (as was also suggested by Hicks et al. (2008)) it makes more sense to look at the absence of right-wing parties, than at the presence of left-wing parties. As indicator I will therefore use the data for 2008 for cabinet positions held by both central and left-wing parties as percentage of total positions per country (indicators gov_cent1 and gov_left1 of the database).

The validity of the indicator is somewhat limited, because also left-wing government can have a nationalistic focus and oppose to international expenditure. The reliability is rather high, government composition is objectively accessible, although attaching labels of left, right, center across countries may not be unambiguous.

International environmental involvement

The 2005 Environmental Sustainability Index (Socio Economic Data and Applications Center, 2005) includes an aggregate index for international collaboration on environmental issues (GLO_COL). This index combines scores for number of memberships in environmental intergovernmental organizations, contribution to international and bilateral funding of environmental projects and development aid and participation in international environmental agreements. In order not to use financial contributions to explain contributions, I used the involvement in international environmental organisations as indicator of international environmental involvement. The data is publicly available and combines objectively quantifiable parameters and can therefore be considered reliable.

Wealth

As indicator for wealth, GDP per capita is included as 2008/09 average. This data is available from the World Development Indicators database from the World Bank. The data is publicly available and forms a valid and reliable indicator for wealth.

4.3 CONTROL VARIABLES

Government expenditure

For government expenditure the 2008-2009 average is taken of general government final consumption expenditure (% of GDP), an indicator included in the World Bank's World Development Indicators database. The data is publicly available and forms a valid and reliable indicator for government expenditure.

Growth

As variable GDP growth is taken from the World Bank's World Development Indicators database. Because reactions to changes in growth are likely to only take effect after some time, the 2007-2008 average was selected. The data is publicly available and forms a valid and reliable indicator for economic growth.

All variables are summarised in Table 4.1.

Table 4.1 Summary of dependent and independent variables

Factor		**Indicator**	**Source/type of assessment**	**Year**
Dependent variable	Climate change mitigation finance	Climate change mitigation aid as % of ODA	OECD-DAC, Rio markers in combination with World Development Indicators, World Bank	2008-09 average
Main factor of interest	Emission target	Emission target still open for 2009-2012	World Development Indicators, World Bank. Grubb (2003) for targets	2008
Neo-liberalism	Dependence on fossil fuels	CO2 emissions per USD of GDP	World Development Indicators, World Bank	2008
	Vulnerability to climate change	Damage as % of GDP	Mendelsohn *et al.* (2000)	2000 estimation for 2100 impacts
	Involvement in clean technology	Ranking in Cleantech Innovation index	Report by WWF and Roland Berger (2009)	2008
Social constructivism	Wealth	GDP/capita	World development indicators, World Bank	2008-09 average
Cultural theory	Green government orientation (non-right wing)	% of total central and left-wing government seats	Data set Comparative Political Data Set III (35 OECD Countries and/or EU-member countries)	2008
National policy-making and policy change	International environmental involvement, organisations	GLO_COL score of ESI, component member of international environmental organisations	Environmental sustainability index global collaboration index	2005
Control	Government expenditure	general government final consumption expenditure (% of GDP)	World Development Indicators, World Bank	2008-09 average
	Growth	GDP growth	World Development Indicators, World Bank	2007-08 average

4.4 UNIT OF ANALYSIS AND SELECTION OF CASES

The unit of analysis is countries. The research will look into the behaviour of individual countries' governments. It is the responsibility of Kyoto's protocol Annex II countries to provide finance for climate change mitigation and adaptation activities in developing countries. Annex II countries consist of all developed countries. Compared to the OECD-DAC countries, only two differences are found between the two sets of countries: Iceland (not OECD-DAC) and (South) Korea (not Annex II). The OECD-DAC

countries have made financial contributions for global environmental protection following the Rio Conventions. To analyse contributions following the Rio Conventions, it makes sense to investigate financial contributions from OECD-DAC countries. The total set would make 23 cases. However, since dependent variable data are missing for Luxembourg, the total number of cases is 22. A list of Kyoto Protocol Annex II and OECD-DAC countries is included in Annex B.

4.5 DATA ANALYSIS METHOD

To understand what motivates countries to make contributions to global environmental protection both a cross-sectional analysis and a time series analysis could provide relevant insights. Unfortunately no long time series are available and the cross section of Annex II countries is not very large. The identified explanatory factors (independent variables) may change over time, but only slowly. The focus of the research will therefore be on a cross-sectional analysis.

Internal validity

The main drawbacks in a cross-sectional analysis are the omitting of relevant variables and the fact that the impact of a factor may only show in subsequent years. By introducing a time lag through the use of data for the independent variables for preceding years, this can be prevented. Because, as was indicated, the selected factors change only slowly over time, this risk is considered small. For the analysis in this thesis no particular time-lag has been introduced; the most recent data preceding the year 2009 that were available have been used. An exception is GDP growth for which 2007-2008 data have been used.

External validity

The external validity is high, because the set of countries is not a sample but contains all Annex II countries, except Iceland. The number of countries is however on the low side for a large N statistical analysis, especially regarding the number of factors that are being investigated. A solution to the small N problem would be to use a panel, in which different year-country values for the variables are considered as individual measurements. For this study the creation of a panel data set was impeded by the difficulty of obtaining information on disbursements for climate change mitigation through multilateral funds by donor. Moreover, as was mentioned above, most independent variables hardly change over time.

Analysis

To test the relevance of the individual factors on climate mitigation finance I use multiple regression analysis. A number of steps precede this analysis.

1. Test whether there is indeed variation in the dependent variable that can subsequently be explained.
This is done through simple graphs of variation among the selected cases.

2. Test whether variables are normally distributed. A normal distribution is a prerequisite for many analyses.

A normal distribution means that the mean value of the data set is the most frequent value, and that the more deviant a value is from the mean, the less frequent it is observed. To assess whether the variables are normally distributed the Shapiro-Wilks test is carried out. A higher significance in this test indicates that the variable is closer to a normal distribution. In addition, for all variables frequency histograms and normal Q-Q plots, in which variable values are plotted against the values of the set if they were normally distributed, are inspected visually. If data showed a strong skewedness, it was tested whether a natural log transformation, or a transformation by applying another power (for skewedness to the left power <1, for skewedness to the right power>1), would yield a normal distribution. If this was the case, these data were used for further analysis.

3. *Determine correlation between indicators.*

Determining the correlation between indicators has two purposes:

- The correlation between an independent and the dependent variable are a direct result.
- If independent variables show high correlations among themselves, then one of them can be excluded from further analysis to prevent collinearity.

The Pearson correlation coefficient is calculated by dividing the covariance of Xi (the independent variables) and Y (the dependent variable) by the square root of the product of variance of X and Y. It is a standardized measure with values ranging between -1 and +1 that not only indicates whether X and Y covary but also whether this covariation is strong (the closer to -1 and +1 the stronger the relationship).

A high absolute correlation coefficient does not yet mean that a relationship is significant. It may be the case that a variable would behave in a certain way independent of the other variable. To test the significance the relationship between X and Y is compared to what would have been expected in the case that X and Y were not related (Kellstedt and Whitten, 2009, p136). The lower the value of p the stronger the indication that the relationship is different from what would have been found without a relation between the variables. Often values for p lower than 0.01 or 0.05 are taken as sign of a significant relationship.

To determine p, one needs to know what is expected. Therefore, it is important to know whether variables show a normal distribution. This was determined in step 2.

4. Multiple regression with the variables displaying high correlations.

With the small number of cases, regression can only be carried out with a limited number of variables. Although theoretically the number of independent variables can be the number of cases minus one, it is preferred not to include more than one variable per 4-5 cases. With 22 cases the maximum number of independent variables is therefore 4-5. The multiple regression analysis is therefore carried out in several iterations. A core model is formed based on four variables: the required emission reduction, the two control variables and the dependence on fossil fuel, which can be considered a control variable as well, influencing the part of finance allocated for international mitigation. This model is tested in combination with the five other variables. Government orientation and wealth are taken together as social constructivist/normative

explanation. Although the number of cases does not allow the inclusion of many variables, one model includes all variables to gain an idea of the mutual relevance of the variables. The performance of the models is assessed by considering the F value, significance and adjusted R square. The F value indicates is a measure of goodness of fit. The value is calculated as the quotient of the variance in the model and the variance in the residuals. Significance is denoted by a p-value, with lower values indicating higher significance of the model as a whole. The adjusted R square indicates which percentage of the variation in the dependent variable is explained by the model.

5. Analysis of residuals

Homoskedasticity is the situation in which the error terms, that is the differences between predicted and actual values of Y, are normally distributed. A normal distribution is an indication that the errors are random, and are not representing a pattern that is unexplained by the model. The normal distribution of errors is hence another measure of the validity of the derived model. The normal distribution of the error terms is tested by the presentation of a frequency histogram or a P-P plot.

The statistical software program SPSS is used for all analysis. For variables with missing data the missing data were left out of the analysis pair-wise.

5 EXPLAINING VARIATIONS IN CLIMATE CHANGE MITIGATION FINANCE

This chapter discusses the results of the statistical analysis of empirical data on climate change mitigation disbursements and a number of possible factors explaining these disbursements. The chapter starts with a discussion in variations among countries in the dependent variable.

5.1 VARIATION IN CLIMATE CHANGE MITIGATION FINANCE AMONG COUNTRIES

Disbursements for the purpose of climate change mitigation in the international context vary greatly among countries (Figure 5.1). In terms of absolute amounts averaged over 2008 and 2009 and comprising both bilateral and multilateral aid, Japan is top contributor with almost 2000 million USD per year. Germany, France and Spain follow at a distance with contributions ranging from 500 to 640 million USD. As percentage of their country's GDP, the differences between the country's contributions are less pronounced (Figure 5.2), and also the ranking according to contribution changes. When it comes to climate change mitigation disbursements as percentage of GDP, Norway makes the highest contribution (0.038%) directly followed by Japan (0.037%), and then Spain (0.034%). France, Denmark (both 0.021%) and Germany (0.019%) follow at some distance. Also Finland (0.013%) and Belgium (0.012%) make contributions higher than the average contribution of 0.011%. The main question for the empirical analysis is: how can this variation among countries be explained?

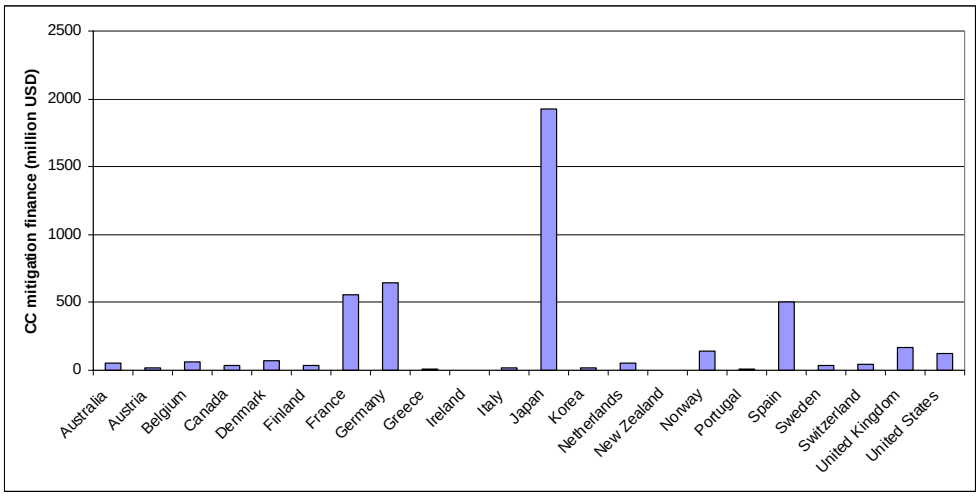

Figure 5.1 Aid for climate change mitigation 2008-2009 average in million USD (Source: OECD, 2012)

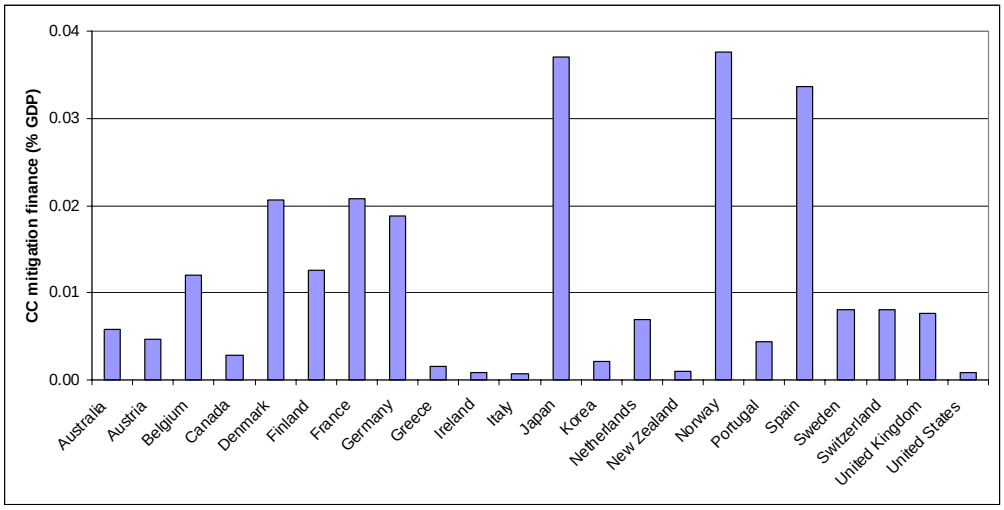

Figure 5.2 Aid for climate change mitigation 2008-2009 as percentage of GDP (Source: OECD, 2012 and World Bank, 2012)

5.2 EXPLAINING THE VARIATION AND TRENDS IN MITIGATION FINANCE – CORRELATION

The correlation of all independent variables with the dependent variable is determined by calculating the Pearson correlation coefficient. Since this can only be done for normally distributed variables, the data for some variables has been transformed by applying power estimates, and for one variable by also adding a constant. The results of these transformations are included in Annex D. For all variables the transformation with the most normal distribution was used to determine correlation coefficients.

Table 5.1 summarises the correlation coefficients of the independent variables with the dependent variable and with the other independent variables. The second row for each variable includes the significance of the correlation. The results show weak relationships for all the factors, with highest absolute correlations between 0.4 and 0.5. The significance of the correlations with the independent variable is rather low, with 0.044 as the lowest p-value. However, considering the small sample size, a p-value below 0.10 (10%) is a reasonable result. Correlations with wealth and involvement in international environmental organisations can therefore be considered significant as well.

Required emission reduction shows a very weak positive correlation with climate change finance, with low significance. This indicates that high emission targets hardly correlate with climate change finance. As expected, the relationship with vulnerability to climate change is negative, indicating that a lower value for impacts, which indicates higher damages, leads to more international climate change mitigation finance. Significance is just above the 10% level. Government orientation shows a weak correlation with international climate change mitigation finance, and low significance. The absence of a right wing orientation has little effect on the amount of climate change finance in the international context. Higher wealth is positively correlated with climate change finance, with significance at the 10% level, meaning that richer countries provide more funds. Involvement in international environmental organisations shows a high correlation with the dependent variable with significance at the 10% level. The results indicate that involvement in clean technology indeed leads to higher investments in international climate change mitigation activities, but the correlation is not significant. The two control variables government

expenditure and GDP growth are both positively correlated with international climate change finance, which would mean that a higher availability of public sector funds and higher growth both lead to more international climate change finance. The correlations are however not significant. The strongest correlation, and highest significance, is found between climate change finance and the dependence on fossil fuels. This correlation is negative, indicating that a higher dependence on fossil fuels leads to less climate change mitigation finance. This is the only variable for which the sign of the correlation differs from what was hypothesized.

Table 5.1 Correlation between independent variables and the dependent variable and their significance

	Climate change finance	Required emission reduction	Vulnerability to climate change (+1.25, ln)	Green government orientation 2008	Wealth	Involvement in int. env. org.	Involvement in clean technology (ln)	Expenditure	Growth	Dependence on fossil fuels (ln)
Climate change finance	1	0.023 (0.923)	-0.351 (0.110)	0.263 (0.250)	0.381* (0.080)	0.407* (0.060)	0.330 (0.196)	0.294 (0.185)	0.136 (0.547)	-0.433** (0.044)
Required emission reduction	0.023 (0.923)	1	0.210 (0.374)	0.415* (0.069)*	0.258 (0.272)	-0.598*** (0.005)	0.125 (0.658)	-0.196 (0.407)	0.097 (0.685)	0.206 (0.385)
Vulnerability to climate change (+1.25, ln)	-0.351 (0.110)	0.210 (0.374)	1	-0.176 (0.444)	-0.183 (0.416)	-0.213 (0.342)	-0.011 (0.967)	0.249 (0.264)	-0.110 (0.627)	0.386* (0.076)
Green government orientation 2008	0.263 (0.250)	0.415* (0.069)	-0.176 (0.444)	1	0.025 (0.915)	-0.116 (0.616)	-0.121 (0.655)	-0.060 (0.795)	0.532** (0.013)	-0.039 (0.866)
Wealth	0.381* (0.080)	0.258 (0.272)	-0.183 (0.416)	0.025 (0.915)	1	0.020 (0.931)	-0.053 (0.839)	0.073 (0.746)	-0.030 (0.895)	-0.660*** (0.001)
Involvement in int. env. org.	0.407* (0.060)	-0.598*** (0.005)	-0.213 (0.342)	-0.116 (0.616)	0.020 (0.931)	1	0.239 (0.356)	0.329 (0.135)	-0.066 (0.770)	-0.159 (0.481)
Involvement in clean technology (ln)	0.330 (0.196)	0.125 (0.658)	-0.011 (0.967)	-0.121 (0.655)	-0.053 (0.839)	0.239 (0.356)	1	0.205 (0.429)	-0.041 (0.876)	0.002 (0.995)
Expenditure	0.294 (0.185)	-0.196 (0.407)	0.249 (0.264)	-0.060 (0.795)	0.073 (0.746)	0.329 (0.135)	0.205 (0.429)	1	-0.321 (0.145)	-0.252 (0.258)
Growth	0.136 (0.547)	0.097 (0.685)	-0.110 (0.627)	0.532** (0.013)	-0.030 (0.895)	-0.066 (0.770)	-0.041 (0.876)	-0.321 (0.145)	1	0.206 (0.359)
Dependence on fossil fuels (ln)	-0.433** (0.044)	0.206 (0.385)	0.386* (0.076)	-0.039 (0.866)	-0.660*** (0.001)	-0.159 (0.481)	0.002 (0.995)	-0.252 (0.258)	0.206 (0.359)	1

***** correlation is significant at the 0.10 level
** correlation is significant at the 0.05 level
*** correlation is significant at the 0.01 level

The independent variables are also correlated with other independent variables. Required emission reduction shows a strong and highly significant negative correlation with involvement in international environmental organisations. This indicates that countries that have a high gap between their 2008 emission levels and the targets to which they committed, have little involvement in international environmental organisations. Required emission reductions are also correlated to the absence of a right-wing government. Countries with a more central and left-wing government orientation have higher emission reduction requirements. It is hard to think of a logical explanation for this correlation. It may also be the result of earlier commitments and lack of mitigation measures when the government may have had a different orientation. Vulnerability to climate change is positively related to dependence on fossil fuels. This would indicate that countries with more fossil fuel use expect less climate change impact (positive GDP effect of

climate change). Little expected impact could explain a lack of interest in reducing fossil fuel dependence. Green government orientation shows a correlation with GDP growth. Also here, the correlation may or may not be a result of previous' government actions, or alternatively high growth reduces interest in right-wing ideologies, while low growth may enhance such interests. Wealth is strongly negatively correlated with fossil fuel dependence. Wealthier nations appear to be less dependent on fossil fuels. None of the independent variables have such high correlation coefficients that they are better not combined in regression analysis.

Correlations between two variables may be influenced by effects actually caused by other variables, and thus be biased. This bias can result in both a too high and a too low correlation coefficient. The following section combines the various variables in multiple regression models to better understand the interaction among the variables in the explanation of the variation in the independent variable.

5.3 EXPLAINING THE VARIATION AND TRENDS IN MITIGATION FINANCE – MULTIPLE REGRESSION ANALYSIS

The purpose of a multiple regression analysis is to test the explanatory power of independent variables in interaction with each other. Linear multiple regression assumes linear relationships between all independent variables and the dependent variable. For the variables identified for this research, there is no reason to assume a non-linear relationship (See scatterplots included in Annex E). A multiple regression yields a relationship between X_i and Y of the following form:

$$Y = a + \Sigma b_i X_i + e$$

In which:		
	a	is a constant, also referred to as Y-intercept
	b_i	is a coefficient with which to multiply variable X_i. b_i
	e	is an error term displaying the difference between the predicted value of Y (Y_p) and Y

A core set of variables consisting of required emission reduction, government expenditure, GDP growth and fossil fuel dependence was analysed separately and in combination with other factors. To better understand the contribution of all variables, one model (6) included all variables. Because inclusion of involvement in clean technology reduces the number of cases due to missing values, also a model was tested from which this variable was excluded. Table 5.2 contains for all models the unstandardized regression coefficients that together with the constant make up the equation to compute values for Y based on the values for the various factors X. The unstandardized regression coefficients are not comparable to each other and therefore do not provide insight in which variables are the strongest predictors. Standardization makes the coefficients comparable to each other by dividing the unstandardized coefficients b_i by their standard deviation. For a bivariate regression, the standardized coefficients would equal the correlation coefficient. For multiple regression the coefficients are adjusted through the interaction with the other independent variables. Table 5.2 therefore also presents the standardized regression coefficients with the p-values to indicate significance.

Table 5.2 Results from multiple regression

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Unstandardized regression coefficients (standard error in parentheses)							
Constant	-1.481	-3.965	-4.092	-3.850	-0.291	-1.873	-1.806
Required emission reduction	0.016	0.024	0.002	0.051	0.011	0.080	0.081
	(0.024)	(0.023)	(0.039)	(0.025)	(0.029)	(0.106)	(0.046)
Vulnerability to climate change (+1.25,ln)		-2.385			0.077	-1.783	-1.791
		(1.588)			(0.093)	(2.429)	(1.602)
Green government orientation 2008			0.004			-0.007	-0.007
			(0.011)			(0.022)	(0.011)
Wealth *1000			0.015			-0.022	-0.023
			(0.038)			(0.072)	(0.036)
Involvement in int. env. org.				0.162		0.169	0.171
				(0.067)		(0.165)	(0.082)
Involvement in clean technology (ln)					0.436	0.011	
					(0.413)	(0.716)	
Expenditure	0.100	0.144	0.093	0.055	0.077	0.096	0.097
	(0.074)	(0.077)	(0.081)	(0.067)	(0.093)	(0.125)	(0.080)
Growth	0.393	0.344	0.272	0.346	0.387	0.502	0.508
	(0.283)	(0.273)	(0.416)	(0.246)	(0.344)	(0.667)	(0.368)
Dependence on fossil fuels (ln)	-1.233	-0.766	-0.811	-1.239	-1.254	-1.527	-1.546
	(0.613)	(0.666)	(1.173)	(0.533)	(0.746)	(2.108)	(1.143)
Standardized regression coefficients (p-value in parentheses)							
Required emission reduction	0.146	0.219	0.019	0.468*	0.099	0.732	0.774
	(0.514)	(0.326)	(0.959)	(0.063)	(0.722)	(0.485)	(0.109)
Vulnerability to climate change (+1.25,ln)		-0.370				-0.277	-0.278
		(0.155)				(0.496)	(0.287)
Green government orientation 2008			0.141			-0.230	-0.237
			(0.701)			(0.758)	(0.501)
Wealth*1000			0.163			-0.214	-0.249
			(0.697)			(0.771)	(0.540)
Involvement in int. env. org.				0.577*		0.602	0.608*
				(0.030)		(0.352)	(0.061)
Involvement in clean technology (ln)					0.282	0.007	
					(0.319)	(0.988)	
Expenditure	0.310	0.447	0.289	0.170	0.239	0.298	0.300
	(0.198)	(0.083)	(0.270)	(0.427)	(0.428)	(0.485)	(0.254)
Growth	0.313	0.274	0.217	0.276	0.308	0.400	0.404
	(0.184)	(0.228)	(0.524)	(0.181)	(0.290)	(0.486)	(0.196)
Dependence on fossil fuels (ln)	-0.449*	-0.279	-0.295	-0.451**	-0.457	-0.556	-0.563
	(0.062)	(0.269)	(0.502)	(0.036)	(0.127)	(0.501)	(0.203)
F	1.857	2.061	1.125	3.138	1.224	0.805	1.993
Significance	(0.171)	(0.132)	(0.400)	(0.042)*	(0.372)	(0.634)	(0.143)
Adjusted R^2	0.153	0.218	0.038	0.360	0.074	-0.143	0.295
N	20	20	20	20	15	15	20

***** correlation is significant at the 0.10 level
** correlation is significant at the 0.05 level
*** correlation is significant at the 0.01 level

The results show that only one model (4) is significant (see Table 5.2). In addition to the core set of variables this model includes involvement in international environmental organisations. Although initially a low correlation was found between required emission reductions and climate change finance, multiple regression identifies required emission reductions as a rather strong (0.468) and significant (0.063) predictor of international climate change finance. Involvement in international environmental organisations is found to be the strongest and most significant predictor of international climate change finance with a standardized regression coefficient of 0.577 and significance at the 5% level. Dependence on fossil fuels remains negatively related to climate change finance with a relatively strong regression (-0.451) and significance at the 5% level. The two control variables expenditure and growth show a positively relation to international climate change finance, but this relation is not significant.

Other factors do not yield a significant relationship with climate change finance. Vulnerability to climate change consistently shows a negative relationship, while the relationship with green government orientation and wealth is sometimes positively and sometimes negatively related to international climate change mitigation finance. Involvement in clean technology does not contribute to explaining the variation in climate change mitigation finance when combined with other variables. But since this variable has relatively many missing cases, the results of models including this variable are less reliable.

The combination of required emission reduction, involvement in international environmental organisations, dependence on fossil fuel, expenditure and growth, results in a significant model for the explanation of international climate change finance. Another indication of the validity of the models is the extent to which residuals are normally distributed. For the significant model (4) the residuals (included in Annex F) show a reasonable normal distribution. The adjusted R-square indicates that this model explains around 36% of the variation in the dependent variable. Although the model is significant, improvements could be made. Such improvements can come from larger datasets, improved operationalisation or the identification of additional variables that may provide additional explanation of the variation in international climate change finance among different countries.

5.4 CONCLUSIONS

The contributions made by individual donors for the purpose of climate change mitigation as percentage of a country's GDP varies among donors. It was tested to what extent this variation could be explained by a number of factors, derived from theory.

Highest regressions are found for required emission reductions, involvement in international environmental organizations and dependence on fossil fuels. For all other factors no significant relationship was found. All results are summarised in Table 5.3.

Table 5.3 Summary of hypothesis testing

	Direction confirmed?	Strength	Significance
1. Higher required emission reductions to meet Kyoto Protocol targets will lead to more climate change finance in the international context.	Yes	Strong	High
2. Higher dependence on fossil fuels will lead to more climate change mitigation finance in the international context.	No	Strong	High
3. Higher perceived impacts of climate change will lead to more climate change mitigation finance in the international context.	Yes	Weak	Low
4. Involvement in clean technology development will lead to more climate change mitigation finance in the international context.	Yes	Weak	Low
5. Higher wealth will lead to more climate change mitigation finance in the international context.	No	Weak	Low
6. A larger number of non-'libertarian'/right wing seats in government will lead to more climate change mitigation finance in the international context.	No	Weak	Low
7. Higher involvement in international environmental organisations and agreements will lead to more climate change mitigation finance in the international context.	Yes	Strong	High

An important finding is that required emission reductions have a positive impact on international climate change finance. This may indicate that countries invest internationally in order to obtain emission offsets. This should be further investigated, by using data on actual offset purchases. If this is true it may mean that, without binding targets, the amount of international climate change mitigation finance may decrease.

On the other hand, involvement in international environmental organizations turned out to be the best predictor of international climate change mitigation. This is an indication that countries contribute because they feel a responsibility to address the climate change problem, without direct benefits to the countries themselves. Contributions following from this motivation are likely to remain without binding targets.

A negative relationship between fossil fuel dependence and climate change mitigation finance in the international context is surprising. When faced with emission targets and without willing to alter their behaviour, international investments to obtain offsets would be a logical strategy to pursue. Further analysis is required to better understand the underlying mechanism.

In the following chapter it is discussed what these findings mean for future REDD finance.

6 DISCUSSION: IMPLICATIONS FOR REDD FINANCE?

The previous chapters focused on public sector finance for climate change mitigation in the international context. This chapter discusses what the findings imply for REDD: does climate change mitigation finance also mean REDD finance? Additionally, some considerations are included regarding the question whether finance will be enough. The chapter ends with recommendations for future research.

6.1 DOES CLIMATE CHANGE MITIGATION FINANCE MEAN REDD FINANCE?

REDD is one of several policy instruments that can be employed to mitigate climate change. As was indicated in Chapter 1, REDD has advantages in that it is presumably cost-efficient, and can provide additional benefits by preserving various other forest ecosystem services. At the same time, REDD has disadvantages pertaining to the difficulty to measures forest carbon storage, and negative consequences for biodiversity and livelihoods if not implemented in the right way. The question is therefore, will REDD be chosen as climate change mitigation measure if funds are available?

The advantages and disadvantages can be summarised in distinct positions:

1. Negative, other climate change mitigation measures preferred:
    a. because of interest in clean technology, or
    b. because of perceived negative impacts of REDD
    c. because of perceived ineffectiveness and difficulty to assess impact
2. Positive, REDD preferred,
    a. because it is cost-efficient, or
    b. because of other perceived benefits in terms of regulation of hydrological cycle, biodiversity, livelihoods

I discuss the relationship with REDD for each of the factors used as independent variable in previous chapters, and the implications of the results of the empirical analysis.

Required emission reductions

The assumption behind including required emission reduction as variable is that countries that need to realise high emission reductions to meet the Kyoto Protocol targets would be interested in buying offsets on the international compliance market. Without binding emission targets, the driving force behind this financial flow would disappear. The positive regression coefficient found therefore means a negative result for REDD in the situation without the possibility of using REDD to generate offsets.

Fossil fuel dependence

If countries are willing to finance international climate change mitigation because of fossil fuel dependence, it can be assumed that their main interest is to obtain emission credits. In this thesis I consider a situation in which REDD cannot be used for this purpose. If the obtainment of emission credits is the main reason for a country to provide climate change mitigation finance, this means that REDD will not be financed.

The relationship between fossil fuel dependence and climate change mitigation was found to be negative. The absence of a positive relationship between fossil fuel dependence and climate mitigation finance may mean good news for REDD. It could indicate that countries are willing to finance climate change mitigation without the prospects of acquiring offsets, and may therefore also be willing to finance REDD.

Vulnerability to climate change

Countries that are investing in international climate change mitigation in order to prevent negative impacts of climate change in their own country will be interested in engaging in all possible measures, and particularly the more cost-efficient ones. As Stern's abatement curve indicates (Stern, 2006), REDD is relatively cost-efficient.

The relationship between expected vulnerability to climate change finance was found to be negative (higher vulnerability means more climate change mitigation finance). Higher expected impacts would therefore mean more climate change spending and also more finance for REDD. However, many developed countries have rather low expected climate change impacts, which could mean that finance may not materialize. The impact on REDD may therefore be negative. However, the relationship was not found to be significant, and no firm conclusions can be drawn.

Involvement in clean technology development

Countries involved in clean technology might favour technical solutions for renewable energy generation or carbon capture and storage over forest protection. A positive relationship was found which would be a negative result for REDD. The relationship was however not found to be significant, and no firm conclusions can be drawn.

Wealth

More climate change mitigation finance as a result of higher wealth does not lead to a specific type of climate mitigation measure. Postmaterialist values refer more to the appreciation of nature as such, than to the protection of forests for their carbon sequestration function. The two may however coincide and protect other forest services while also mitigating climate change. As stated above, if REDD can be cost-efficient, and if safeguards are in place to prevent negative consequences, REDD may be chosen. The multiple regression was indeterminate on the relationship between wealth and international climate mitigation finance, and therefore no conclusion can be made regarding impacts for REDD.

Green government orientation

This factor was derived from cultural theory. With respect to REDD, the individualist will prefer the full inclusion of REDD credits as tradable permission rights, to meet targets at low costs. Individualists will therefore not be interested in REDD without the possibility of offsets. Hierarchists will see REDD as cost-efficient option, while egalitarians will value the protection of forests, but may object to its commodification. Public sector finance for REDD will be accepted by egalitarians. If country finance international climate change mitigation because of these deliberations, they will also be likely to finance REDD.

Similar to the results for wealth, the multiple regression was indeterminate on the relationship between wealth and international climate mitigation finance, and therefore no conclusion can be made regarding impacts for REDD.

Involvement in international environmental organisations

More climate change mitigation finance as a result of stronger involvement international environmental organisations does not lead to a specific type of climate mitigation measure. REDD can be cost-efficient, and if safeguards are in place to prevent negative consequences, REDD may be chosen. The fact that involvement in international environmental organisations is the best predictor for climate change finance is a positive finding for REDD.

Conclusion

The main predictors of climate change finance are required emission reduction, involvement in international environmental organisations and fossil fuel dependence. Table 6.1 summarizes all findings. Of the three main predictors two have positive consequences for REDD and one negative consequences. Without binding targets less international climate change finance may be available, but part can still be assumed to be available for REDD.

Table 6.1 Summary of implication of findings for REDD

	Relationship with climate change mitigation finance	**Meaning for REDD finance (based on direction)**
Required emission reductions	Positive, strong, high significance	Negative
Dependence on fossil fuels	Negative, strong, high significance	Unclear, could be positive
Vulnerability to climate change	Negative, weak, low significance	Negative
Involvement in clean technology	Positive, weak, low significance	Negative
Wealth	Direction unclear, weak, low significance	Cannot be determined
Green government orientation	Direction unclear, weak, low significance	Cannot be determined
Involvement in int. env. organisations	Positive, strong, high significance	Positive

6.2 WILL FINANCE SUFFICE?

Will there be sufficient finance for REDD? Chapter 2 presented estimates of financial requirements for REDD. These range from 12 billion USD/year to 148 billion USD/year to fully stop forest degradation by 2030 (UNFCCC, 2007). The Eliasch review estimates REDD implementation costs at 17-33 billion USD/year to halve emissions from deforestation by 2030 (Eliasch, 2008), assuming full integration in the carbon compliance market.

Public sector funds for climate change mitigation amounted to 4.5 billion USD in 2009 (Figure 6.1, multilateral values are 2008-2009 average). These funds are meant for various types of mitigation. REDD is only one of several measures and only aimed at the 12% of greenhouse gas emissions emanating from deforestation and forest degradation.

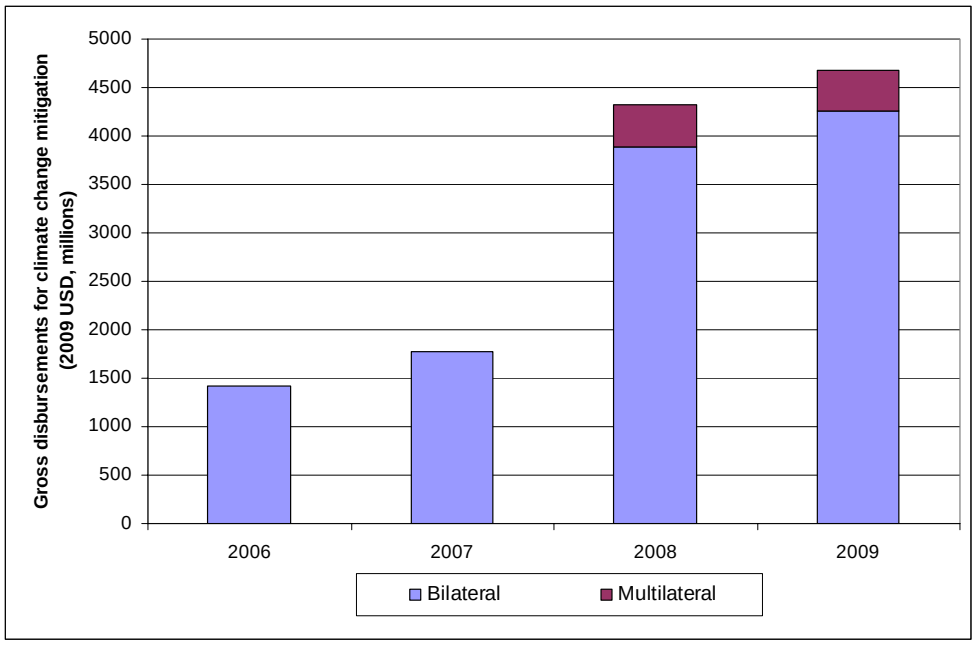

Figure 6.1 Gross disbursements for climate change mitigation (Source: OECD, 2012)

The website www.climatefundsupdate.org keeps track of both contributions to and allocations from various climate funds. The site includes information on six funds with a specific REDD focus: Amazon Fund (Fundo Amazônia), Congo Basin Forest Fund, Forest Carbon Partnership Facility, Forest Investment Program, International Forest Carbon Initiative, Norway's International Climate and Forest Initiative, and the UN-REDD Programme. Some of these funds may feed into others. Total deposits into these funds from bilateral donors amount to 1.19 billion USD. Additionally some contributions are made by NGOs and large corporations.

Figure 6.2 displays the deposits into specific REDD funds by donor. The values are also presented as percentage of donor country's GDP (2010). Interpretation of this graph should be done with care. The funds are likely to be the result of several years of deposits. The website does not specify in what year deposits have been made. This means that the value as percentage of GDP does not actually present this value but is only meant to put contributions of different countries in perspective. Norway is by far the largest

contributor. The UK and Australia follow as contributors two and three, both in terms of total amounts and compared to the 2010 GDP.

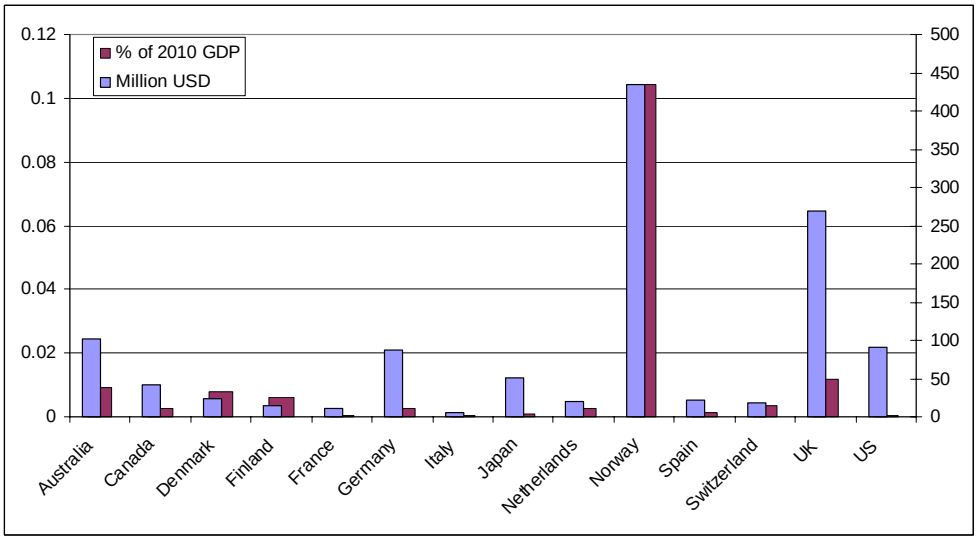

Figure 6.2 Deposits into REDD funds as percentage of GDP (Source: Climate Funds Update, 2012)

Current REDD finance is insufficient to meet the requirements, but one should take into account that it was also not meant to finance REDD fully. Current, so called 'fast start', finance is mainly meant to build capacity and gain experience with measurement, reporting and verification in REDD pilot projects, while waiting for clarity on the targets and mechanisms agreed upon. However, even if all climate change mitigation disbursements of the years 2008/2009 (4.5 billion USD) would be used for REDD, this would still be insufficient.

Most of the authors on climate change mitigation finance agree that the required resources should come from a combined private sector and public sector effort. The main purpose of public sector finance is to leverage private sector funding. With regard to REDD, private sector involvement would be through compliance markets. Without the possibility to trade emission credits, there is little reason for large scale private sector involvement, since REDD does not require technological innovations and REDD provides little possibilities to receive returns on investments.

REDD finance should therefore come from public sector funding or voluntary markets. Doornbosch and Knight (2008) state that public sector finance should only be used for those activities that are economically sound, but financially not feasible for private parties. Although there is still fierce debate among economists regarding whether the costs of mitigation outweigh the benefits, major reviews have indicated that they do (Stern, 2006; Eliasch, 2008). Measures in developed countries can only account for part of all required emission reductions, and mitigation in developing countries is therefore required in everyone's interest. Avoiding future emissions by avoiding deforestation will thus be a logical step to take. And without private sector involvement, REDD finance should come from the public sector.

Public sector finance is not an unlimited source of finance. Only few developed countries meet the Monterrey agreement to spend 0.7% of GDP on development aid (Figure 6.3). This means it is unlikely that funding for climate change mitigation will be 'new and additional'. Rather, increased mitigation finance in the international context can be expected to encroach upon other types of development aid (Michaelowa and Michaelowa, 2007).

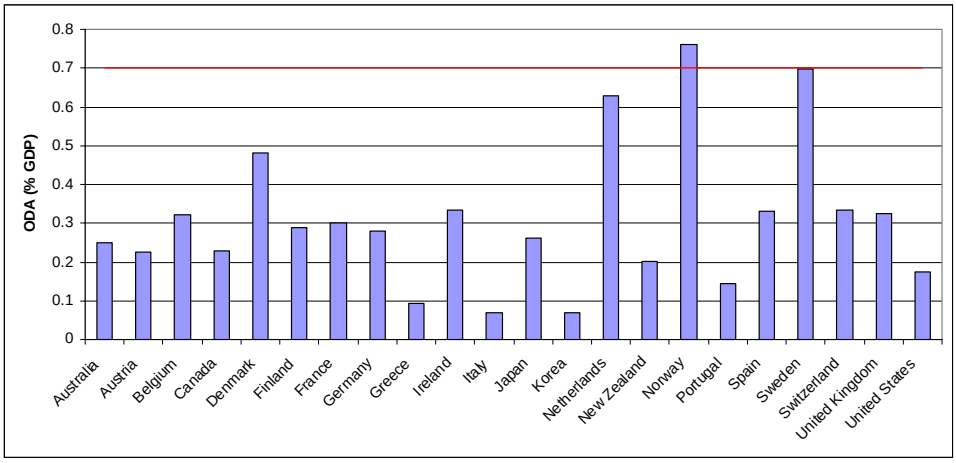

Figure 6.3 Official development assistance as percentage of GDP (2008/2009)

Alternatively, new sources of finance are to be found. For this purpose, various revenue mechanisms have been proposed, as introduced in Chapter 2, and summarized in Annex A. Revenue can be generated by new taxes on carbon-related sectors or on other sectors such as financial transactions. Although presented as new finance, it essentially means a different distribution of taxes over specific sectors or civilians. If these proposals are indeed implemented, additional climate change finance can be generated of which part can be used for REDD.

Table 6.2 presents the estimated REDD finance as percentage of the GDP of OECD countries and of OECD and upcoming economies (Brasil, Russia, India, China and South Africa). The finance for REDD ranges from 0.02% to 0.3 % of GDP.

Table 6.2 REDD financial requirements as percentage of GDP

REDD finance estimated at: (billion USD)	Percentage of GDP OECD (based on 2010 GDP)	Percentage of GDP OECD+BRIC+SA (based on 2010 GDP)	Percentage of agreed 0.7% GDP (based on 2010 GDP for OECD)	Percentage of GDP for climate change finance of OECD countries (2008-2009) as used in the analysis
12	0.028	0.022	4	0.011
17	0.040	0.031	6	
33	0.077	0.060	11	
148	0.344	0.271	49	

On the one hand, these values show that public sector finance is not likely ever to suffice: 1) current ODA funding which was agreed at 0.7% was never met, but by a few countries. 2) if public sector funding will be used for mitigation it is likely to lead to reduction of ODA for real development purpose, 3) the 2008-2009 data used in the analysis in this thesis found an average contribution for all international climate change mitigation of only 0.011%, and 4) REDD represents only part of emissions to be reduced. On the other

hand, the required amounts are 4 to 50% of the 0.7% GDP aid commitments, with the 50% as an upper extreme. If countries would provide the funds they previously promised already a large part of the REDD financial requirements could be met.

6.3 A FUTURE FOR REDD?

REDD finance remains uncertain in the absence of binding agreements and tradable credits. Of the three factors that were found to best explain variation in climate change finance among developed countries, two are positively related to REDD, while one is likely to negatively affect REDD finance. The results indicate that binding emission targets and the possibility to use REDD to generate offsets can play an important, but not the only, role in generating finance for REDD.

Whether public finance could provide sufficient finance is still an open question. Most authors agree that the total finance required for mitigation should to a large extent come from the private sector, leveraged by public sector funding. This is unlikely to apply to REDD. Without binding targets, REDD should be financed through public sector funds. This would amount to 0.02 - 0.3% of developed countries' GDP. A lot, but perhaps not entirely unfeasible. Additional finance could be generated by new taxes and levies, but this will only be a distribution of the burden.

7 CONCLUSIONS AND RECOMMENDATIONS

This thesis' main aim was to shed light on the probability of finance for REDD, should it not be allowed to use REDD emission credits to offset emissions and meet a country's emission targets, with as main research question:

> Can public sector finance be expected for REDD when there are either no binding emission targets or when REDD measures cannot be used to meet such targets?

The following subquestions were formulated to answer this question:

1. What are the characteristics of the REDD mechanism?
2. What factors influence a government's willingness to finance climate change mitigation?
3. To what extent can the factors explain financial contributions for climate change mitigation?
4. What does the relevance of the findings mean for finance of the REDD mechanism?

Because REDD is relatively recent and because consequently hypotheses on REDD will be hard to test empirically, the empirical component of the research focused on climate change mitigation finance more generally. Based on literature, various hypotheses were derived and tested for their explanatory power for the variation in climate change mitigation finance in the international context among developed countries. It was subsequently discussed what the implications were for REDD. Conclusions therefore pertain both to public sector international climate change finance and to REDD.

7.1 WHAT ARE THE CHARACTERISTICS OF THE REDD MECHANISM?

REDD is meant to make forest worth more standing than cut down (Eliasch, 2008) by providing international payments for reduced emissions from deforestation and forest degradation. Besides the difficulties to measure whether deforestation and forest degradation are indeed prevented, REDD implementation may also have a number of drawbacks. Additional measures are required to safeguard biodiversity and local community rights and livelihoods.

The required finance for REDD amounts to tens of billion USD/year. Without binding targets the funds should come mainly from public sector finance. Various proposals have been made to generate revenue for international climate change mitigation more generally. Auctioning of emission credits, taxing specific sectors or putting a levy on carbon or other transactions are part of the proposals. Besides variation in amounts of funds raised and certainty of future revenue, the proposals mainly vary in the distribution of the burden of the costs over different countries, sectors and groups in society.

7.2 WHAT FACTORS INFLUENCE A GOVERNMENT'S WILLINGNESS TO FINANCE CLIMATE CHANGE MITIGATION?

Following the main research question, one factor of interest is the role of agreed emission targets. Based on literature from international relations, cultural theory, domestic policy making and aid allocation, six additional factors were derived that were assumed to affect the level of a country's climate change mitigation financial contribution. Seven hypotheses were formulated regarding the amount of international climate change mitigation finance that countries contribute and subsequently tested empirically:

1. Higher required emission reductions to meet Kyoto Protocol targets will lead to more climate change finance in the international context.
2. Higher fossil fuel dependence will lead to more climate change mitigation finance in the international context.
3. Higher perceived impacts of climate change will lead to more climate change mitigation finance in the international context.
4. Involvement in clean technology development will lead to more climate change mitigation finance in the international context.
5. Higher wealth will lead to more climate change mitigation finance in the international context.
6. A larger number of non-'libertarian'/right wing seats in government will lead to more climate change mitigation finance in the international context.
7. Higher involvement in international environmental protection will lead to more climate change mitigation finance in the international context.

In addition two control variables, government expenditure and GDP growth were included in the analysis. Government expenditure was assumed to limit the allocation of financial resources for climate change mitigation, while growth was assumed to positively influence the part of financial resources spent in the international context.

7.3 TO WHAT EXTENT CAN THE FACTORS EXPLAIN FINANCIAL CONTRIBUTIONS FOR CLIMATE CHANGE MITIGATION?

The basis of the empirical analysis was formed by the four variables 'required emission reduction', 'fossil fuel dependence', 'government expenditure' and 'growth'. This model was analysed separately and in combination with other independent variables. Only the model that included as fifth variable the involvement in international environmental organisation was found to be significant (p-value 0.042).

Required emission reduction, defined as the reductions in emissions to be realised after 2008 in order to meet the agreed Kyoto Protocol targets in 2012, were found to be an important and significant (standard regression coefficient 0.468, p-value 0.063) predictor of international climate change mitigation finance. The most important predictor is however the involvement in international environmental organisations (standard regression coefficient 0.577, p-value 0.030). Dependence on fossil fuel is an important predictor as well (standard regression coefficient -0.451, p-value 0.036). Government expenditure and growth play

less of a role and no significant relationships were found. Also for all other variables the analysis based on the available data set did not result in significant relationships.

The importance of required emission reductions for the level of international climate change mitigation finance could indicate that countries invest internationally in order to obtain emission offsets. If this is true, it may mean that without binding targets, the amount of international climate change mitigation finance may decrease. On the other hand, the relevance of involvement in international organisations indicates a willingness to contribute to climate change mitigation without direct benefits for the donating country. A negative relationship between fossil fuel dependence and climate change reveals that the assumption that a higher fossil fuel dependence would lead to more international climate change mitigation finance was incorrect. Although it can be understood that fossil fuel-dependent countries would oppose severe targets, once the targets are set it would make sense for these countries to fulfil a relatively large portion of their targets by purchasing offsets. Other mechanisms play a role here that, considering the role of this factor in explaining climate change mitigation finance, merit further analysis.

7.4 WHAT DOES THE RELEVANCE OF THE FINDINGS MEAN FOR FINANCE OF THE REDD MECHANISM?

Most relationships between the factors identified and international public sector climate change mitigation finance can be expected to apply to REDD as well. If an increase in a factor means an increase in climate change mitigation finance, this will also mean an increase in REDD finance, particularly because REDD is a relatively cheap climate change mitigation measure.

The major exception to this rule are required emission reduction and involvement in clean technology. Without the possibility to use REDD for offsets, required emission reductions will not lead to REDD finance. And if countries finance mitigation because they hope to reap the benefits of increased demands for clean technology, they are likely to prefer technical climate mitigation measures over REDD.

The factors that best explain international climate change mitigation finance have opposite impacts on REDD. Since this thesis assumed that REDD cannot be used to generate emission offsets, the importance of required emission reductions in international climate change mitigation finance is negative for REDD finance. On the other hand, contributions made because of commitments to international environmental protection are likely to remain also without binding targets. The importance of involvement in international environmental organisations in explaining international climate change mitigation finance can therefore be positive for REDD finance. A positive relationship between fossil fuel dependence and international climate change mitigation finance would have pointed towards buying of offsets that would not benefit REDD finance. The fact that a negative relationship was found is hence good news, although the underlying mechanism is not yet well understood. With these opposing forces, it can be assumed that without binding targets less public sector finance becomes available for international climate change mitigation, but that part of the funds that become available are likely to also be used for REDD. Whether finance will be sufficient is another question. Current disbursements for general climate change mitigation

do not meet the estimated requirements for REDD, and REDD targets only part of global emissions. Additional finance is required, and will very much depend on choices made on type of revenue mechanisms that are currently begin proposed. If these mechanisms are implemented, the results of this study indicate that part of this finance may be used for REDD.

7.5 RECOMMENDATIONS FOR FUTURE RESEARCH

Recommendations pertain to improving the research presented in this thesis to better answer the main question of whether available finance will go to REDD.

Better data

Actual financial contributions for climate change (disbursements) are made by countries both through bilateral and multilateral channels. Precise amounts targeted at mitigation are difficult to discern for two reasons. Bilateral contributions are indicated by donor countries but can entail both 'primary' and 'significant' objectives of the financed project, and therefore also include finance for projects in which climate change mitigation is only part of the result. Multilateral funds fund various activities and report on climate change activities as part of their total disbursements. Finding country's contributions to climate change mitigation through multilateral funds thus involves combining information on contributions to the fund with output from the fund. This information turned out hard to obtain. Ideally, the research would be repeated with annual disbursements for REDD, for more countries and through multilateral funds, once available.

Other factors and operationalisations

The high regression coefficient found for the variable required emission reduction was interpreted as indicating a requirement for emission offsets. It would be useful to further investigate this relationship by including data on actual offset purchases. In addition, insight in national activities would help to better understand whether international climate change mitigation activities are undertaken by countries that are also active at the national level, or that international action is the result of a reluctance to reduce emissions domestically.

The adjusted R-square of the significant model of 0.360 indicates that the model explains only around 36% of the variations in international climate change mitigation finance. Besides a larger dataset and improved operationalisations, it can be expected that other, yet unidentified, factors contribute to international climate mitigation finance. Further explorations of what these factors could be merits attention.

Factors concerning recipient countries

Many of the factors in aid allocation concern recipient country characteristics (need, merit), and donor-recipient relationships (trade, colonial history). These factors will not affect the availability of climate mitigation finance in general. However, they may influence whether finance will actually go to REDD. REDD target countries concern only a few highly forested or fast deforesting developing countries. Donor countries may first choose which countries to support financially, and subsequently for what types of

activities. If the donor countries favour other recipients, they may choose to finance other climate mitigation measures than REDD. Aid allocation literature indicates factors such as institutional capacity or democracy as determinants of aid effectiveness. As Ebeling and Yasué (2008) indicate, countries with largest deforestation rates are also the ones with low governance capacity. What will this mean for the effectiveness of REDD? Can safeguards ensure an effective REDD implementation?

Protecting forest through other conventions

This thesis only considered disbursements with the specific purpose of climate change mitigation. However, forest protection was earlier done for the protection of other forest services and biodiversity, through other means. It would be interesting to better study these funds and the factors explaining disbursements for these purposes. Combing the Rio Marker data for the Convention on Biodiversity and to Combat Desertification may however lead to a double-counting of the same funds.

7.6 FINAL REMARKS

This thesis provided and initial analysis of factors influencing international climate change mitigation finance and the implications for REDD. The results indicate that binding emission targets play an important role but that other factors, involvement in international environmental organisations and fossil fuel dependence, are important as well.

Only part of the variation in climate change mitigation finance among developed countries could be explained by the data analysed. Additional research should focus on larger data sets, better operationalisation, and additional factors. Better understanding the mechanisms that affect international climate change mitigation finance is pertinent for deciding on effective climate change mitigation mechanisms.

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A. OVERVIEW OF REVENUE MECHANISMS FOR CLIMATE MITIGATION

Proposal	Revenue (billion USD)	Type of source	Remark
Mexico	10-95	(carbon) market-linked	based on GHG emissions, population and GDP
Private compliance market	15-45	carbon market	
Government compliance market	not a source of revenue	carbon market	purchase of offsets by developed countries
International aviation emission trading scheme	1.4-14	carbon market (-linked)	International aviation would effectively be treated as a separate country, with its own allocation of AAUs and targets for 2020. Part of AAU will be auctioned.
International maritime emissions reduction scheme	20-30	carbon market/ market-linked	
Levy on maritime bunker fuels	1.5-9	carbon market/ market-linked	
Levy on surplus assigned amount units	7-50	carbon market-linked	
International auctioning of allowances	9-35	carbon market-linked	A percentage of assigned amount units (AAU) will be auctioned internationally
International maritime emission trading scheme	3-34	carbon market-linked	
National auctioning of allowances	8-30	carbon market-linked	compliance buyers (national and private) to pay for allowances instead of being allocated them for free, assumed 10-15% of total allowances auctioned for international climate finance
European aviation emission trading scheme	0.9-9	carbon market-linked	
Extending the share of proceeds	3.5-7	carbon market-linked	
Levy on certified emission reductions	0.3-2.3	carbon market-linked	
Currency transaction tax (Tobin tax)	17-35	market-linked	
International air passenger adaptation levy	8-20	market-linked	
Carbon tax	16	market-linked	2 USD per tCO2
Levy on international aviation and maritime transport	4	market-linked	
Levy on insurance premiums	3.3	market-linked	
G77 + China	220-440	non market-linked	0.5-1% of GDP
Foreign direct investments	170	non market-linked	
Sovereign wealth funds	38	non market-linked	
Foreign exchange reserves	9-34	non market-linked	
Bonds	4-20	non market-linked	
Special Drawing Rights	5-7	non market-linked	
Official Development Assistance	3	non market-linked	Of current ODA of 150 billion USD per year (which is half of the 0.7% of GNI), 2% is currently channelled to finance mitigation and adaptation in developing countries through multilateral and bilateral funds.
Debt swap programmes	1	non market-linked	
Philantropy	1	non market-linked	

Source: Global Canopy Programme (2009)

B. KYOTO PROTOCOL ANNEX II AND OECD-DAC COUNTRIES.

Flag	Country	CO2 emission targets (change compared to 1990 levels)
	Australia	8
	Austria	-13
	Belgium	-7.5
	Canada	-6
	Denmark	-21
	Finland	0
	France	0
	Germany	-21
	Greece	25
	Iceland*	Missing
	Ireland	13
	Italy	-6.5
	Japan	-6
	Korea (South)**	Not Annex II, so no binding targets
	Netherlands	-6
	New Zealand	0
	Norway	1
	Portugal	27
	Spain	15
	Sweden	4
	Switzerland	-8
	United Kingdom of Great Britain and Northern Ireland	-12.5
	United States of America	-7
	South Korea**	-

* Iceland is not an OECD-DAC country

** South Korea is not an Annex II country

C. OVERVIEW OF DATA USED

Collected data

	Dependent variable	**Independent variables**								
Country	**CC_GDP**	**EmGap**	**CC_ImpGDP**	**Gov_08**	**GDP_cap**	**IntEnv_O**	**CleanTech**	**Exp0809**	**Growth0708**	**CO2_GDP**
	Climate change mitigation finance	*Required emission reduction*	*Vulnerability to climate change*	*Green government orientation in 2008*	*Wealth*	*International environmental involvement, organizations*	*Involvement in clean technology*	*Government expenditure*	*GDP growth*	*Dependence on fossil fuels*
Australia	0.0057	-22.27	0.3125	100.00	44502	13	missing	17.00	3.70	376.06
Austria	0.0047	-21.69	0.125	100.00	47047	17	0.325	19.00	2.55	163.52
Belgium	0.0120	-4.33	0.125	58.67	45006	19	0.3	24.00	1.94	206.86
Canada	0.0029	-22.24	1.5	0.00	40624	17	0.375	21.00	1.44	362.08
Denmark	0.0206	-13.45	0.25	0.00	58542	20	3.3	28.00	.40	133.84
Finland	0.0125	-9.86	0.375	50.00	47394	20	0.4	24.00	2.81	207.78
France	0.0208	5.85	0.125	6.25	41737	29	0.275	24.00	1.10	133.13
Germany	0.0188	missing	0.125	100.00	41740	28	0.7	19.00	2.18	217.09
Greece	0.0015	-7.06	0.5625	0.00	29107	16	0.175	19.00	1.42	286.69
Ireland	0.0008	-21.17	0.25	13.33	52610	14	0.2	19.00	1.11	165.38
Italy	0.0007	-10.90	0.125	33.89	36630	20	missing	21.00	.26	192.92
Japan	0.0371	-14.83	-0.25	5.56	40707	19	0.3	19.00	.58	247.58
Korea	0.0021	missing	0.125	missing	17185	17	0.3	16.00	3.70	546.67
Netherlands	0.0069	-11.21	0.125	87.50	49516	22	0.175	27.00	2.86	199.53
New Zealand	0.0010	-27.41	0.4375	88.22	27364	8	missing	20.00	.72	280.90
Norway	0.0377	-36.70	0.25	100.00	80309	15	0.1	21.00	1.34	110.14
Portugal	0.0044	-1.38	0.25	58.36	22484	17	missing	21.00	1.18	223.52
Spain	0.0337	-20.52	0.25	100.00	32933	19	0.6	20.00	2.18	206.59
Sweden	0.0081	9.64	0.375	31.82	45238	18	0.125	27.00	1.35	100.89
Switzerland	0.0081	-2.14	-0.25	42.86	65153	16	missing	11.00	2.87	80.27
United Kingdom	0.0076	-4.57	0.125	100.00	36352	22	0.14	23.00	1.18	198.36
United States	0.0009	0	0.375	0.00	46616	21	0.15	17.00	.77	381.97

Used in analysis after transformations

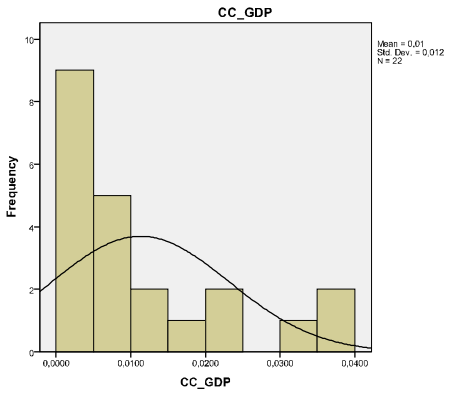
	Dependent variable	Independent variables								
Country	**Ln(CC_GDP)**	**EmGap_P**	**Ln(CC_ImpGDP+1.25)**	**Gov_08**	**GDP1000_cap**	**IntEnv_O**	**Ln(CleanTech)**	**Exp0809**	**Growth0708**	**Ln(CO2_GDP)**
	Climate change mitigation finance	*Required emission reduction*	*Vulnerability to climate change*	*Green government orientation in 2008*	*Wealth*	*International environmental involvement, organizations*	*Involvement in clean technology*	*Government expenditure*	*GDP growth*	*Dependence on fossil fuels*
Australia	-5.16	22.27	.45	100.00	44.50	13	missing	17.00	3.70	5.93
Austria	-5.35	21.69	.32	100.00	47.05	17	-1.12	19.00	2.55	5.1
Belgium	-4.43	4.33	.32	58.67	45.01	19	-1.20	24.00	1.94	5.33
Canada	-5.86	22.24	1.01	0.00	40.62	17	-.98	21.00	1.44	5.89
Denmark	-3.88	13.45	.41	0.00	58.54	20	1.19	28.00	.40	4.9
Finland	-4.38	9.86	.49	50.00	47.39	20	-.92	24.00	2.81	5.34
France	-3.87	-5.85	.32	6.25	41.74	29	-1.29	24.00	1.10	4.89
Germany	-3.97	missing	.32	100.00	41.74	28	-.36	19.00	2.18	5.38
Greece	-6.47	7.06	.59	0.00	29.11	16	-1.74	19.00	1.42	5.66
Ireland	-7.11	21.17	.41	13.33	52.61	14	-1.61	19.00	1.11	5.11
Italy	-7.2	10.90	.32	33.89	36.63	20	missing	21.00	.26	5.26
Japan	-3.29	14.83	.0	5.56	40.71	19	-1.20	19.00	.58	5.51
Korea	-6.15	missing	.32	missing	17.19	17	-1.20	16.00	3.70	6.3
Netherlands	-4.97	11.21	.32	87.50	49.52	22	-1.74	27.00	2.86	5.3
New Zealand	-6.87	27.41	.52	88.22	27.36	8	missing	20.00	.72	5.64
Norway	-3.28	36.70	.41	100.00	80.31	15	-2.30	21.00	1.34	4.7
Portugal	-5.43	1.38	.41	58.36	22.48	17	missing	21.00	1.18	5.41
Spain	-3.39	20.52	.41	100.00	32.93	19	-.51	20.00	2.18	5.33
Sweden	-4.82	-9.64	.49	31.82	45.24	18	-2.08	27.00	1.35	4.61
Switzerland	-4.82	2.14	.0	42.86	65.15	16	missing	11.00	2.87	4.39
United Kingdom	-4.88	4.57	.32	100.00	36.35	22	-1.97	23.00	1.18	5.29
United States	-7.07	0	.49	0.00	46.62	21	-1.90	17.00	.77	5.95

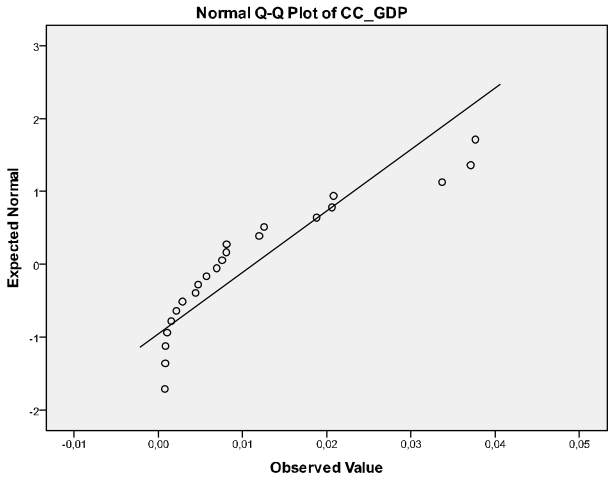
D. INDIVIDUAL VARIABLES – DISTRIBUTION

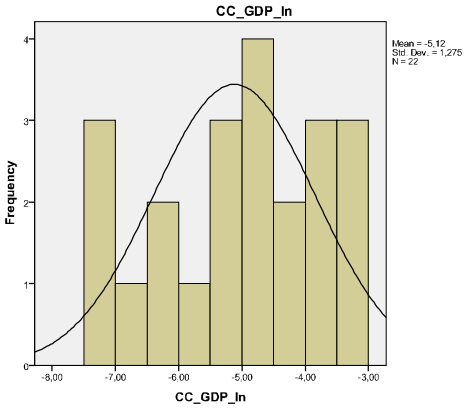
This annex provides the histograms and normal Q-Q plots to test whether variables have a normal distribution. In addition, the results of the Shapiro-Wilks tests are included. Shapiro-Wilks is considered suitable for smaller sample sizes. Higher significance values resulting from this test indicate a distribution closer to normal. The table also includes the findings from visual inspection of the plots. For variables that were not normally distributed, it was tested whether natural log transformations or power estimates would yield better results. The type of transformation is included in the variable name (ln stands for natural logarithm, sqrt for square root, and 2 for a power 2). For the variable CC_ImpGDP, a constant of 1.25 was added before transformation.

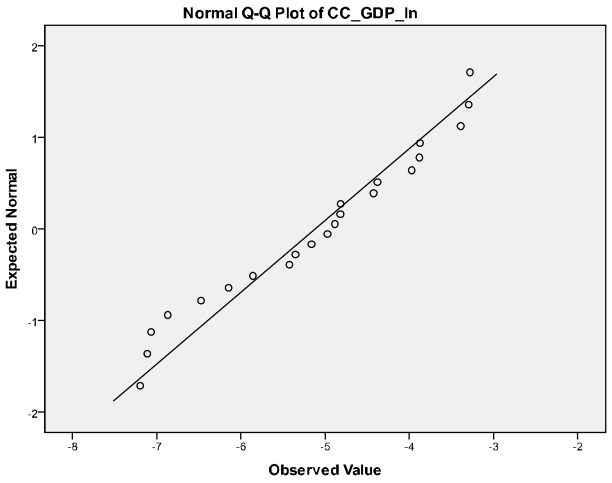
The last column indicates which variables are included in further correlation and regression analysis.

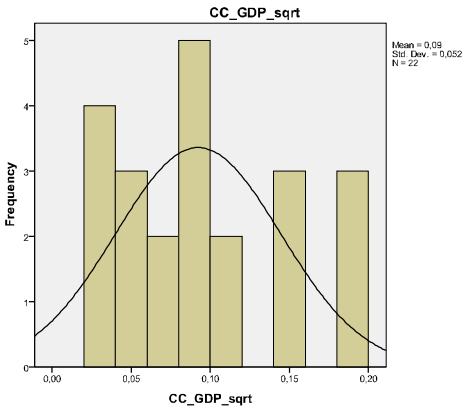
	Shapiro-Wilks			Visual inspection	Included in analysis:
	Statistic	df	Sig.		
CC_GDP	.808	22	.001	no	
CC_GDP_ln	**.939**	**22**	**.185**	**yes**	*
CC_GDP_sqrt	.911	22	.049	yes	
Emgap_P	.981	20	.952	Yes	*
CO2_GDP	.898	22	.027	no	
CO2_GDP_sqrt	.957	22	.438	yes	
CO2_GDP_ln	**.980**	**22**	**.912**	**yes**	*
CC_ImpGDP	.735	22	.000	no	
CC_ImpGD_sqrt	.791	22	.000	no	
CC_ImpGDP_ln	**.829**	**22**	**.001**	**yes**	*
CleanTech	.447	17	.000	no	
CleanTech_ln	**.875**	**17**	**.026**	**yes**	*
GDP1000_cap	**.956**	**22**	**.410**	**yes**	*
Gov_08	**.842**	**21**	**.003**	**yes**	*
IntEnv_O	**.943**	**22**	**.223**	**yes**	*
Exp0809	**.955**	**22**	**.398**	**yes**	*
Growth0708	**.933**	**22**	**.139**	**yes**	*

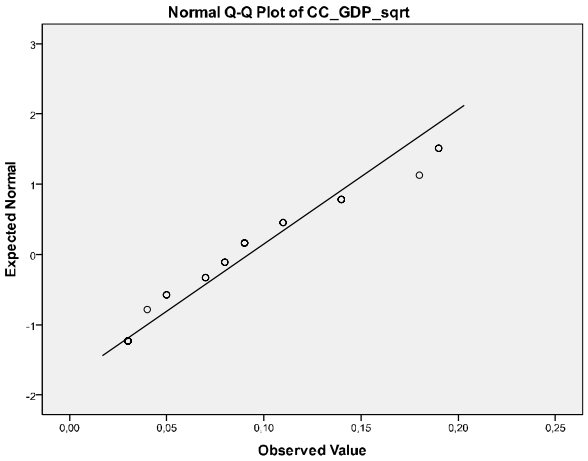


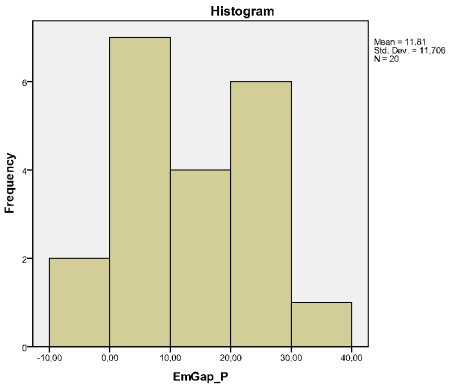


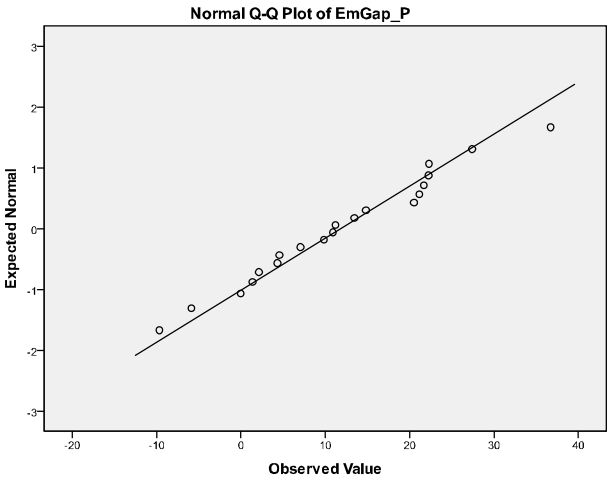

CC_GDP_ln
Mean = -5,12
Std. Dev. = 1,275
N = 22
Frequency
CC_GDP_ln

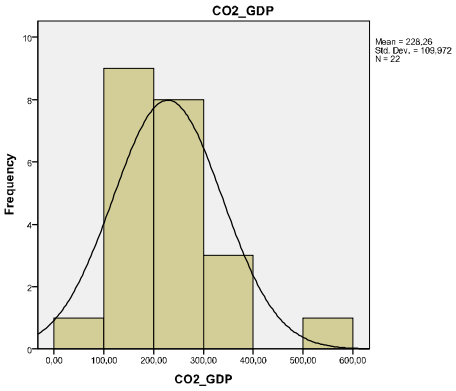

Normal Q-Q Plot of CC_GDP_ln
Expected Normal
Observed Value

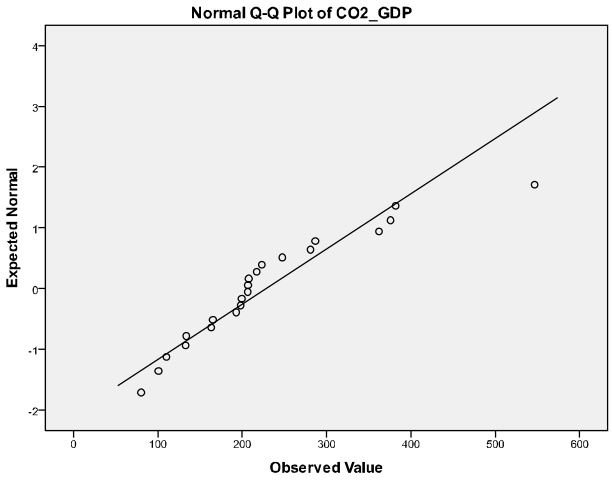

CC_GDP_sqrt
Mean = 0,09
Std. Dev. = 0,052
N = 22
Frequency
CC_GDP_sqrt

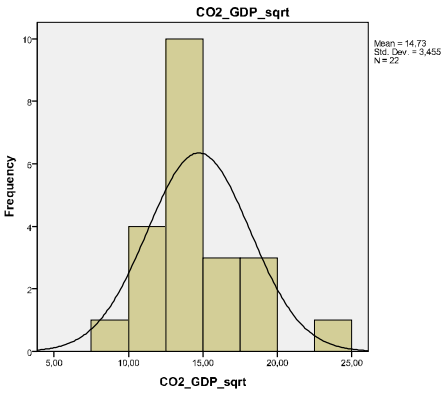

Normal Q-Q Plot of CC_GDP_sqrt
Expected Normal
Observed Value

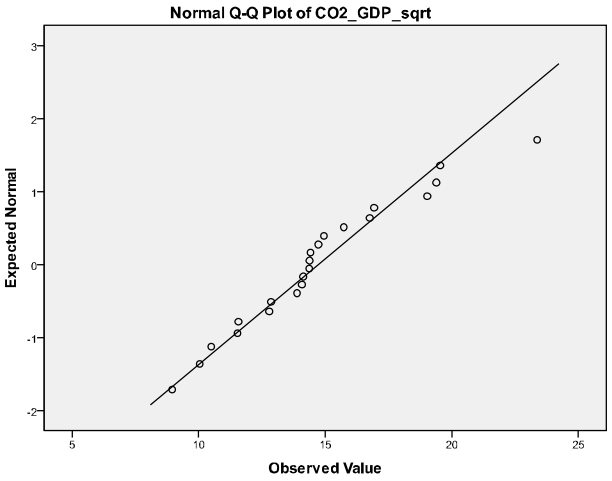

Histogram
Mean = 11,81
Std. Dev. = 11,706
N = 20
Frequency
EmGap_P

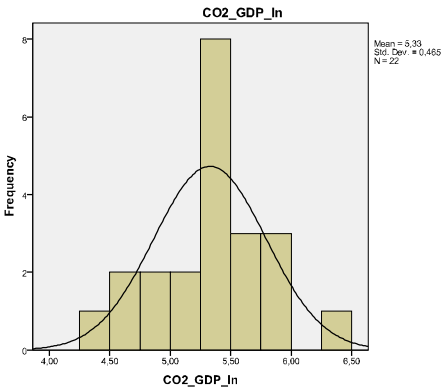

Normal Q-Q Plot of EmGap_P
Expected Normal
Observed Value

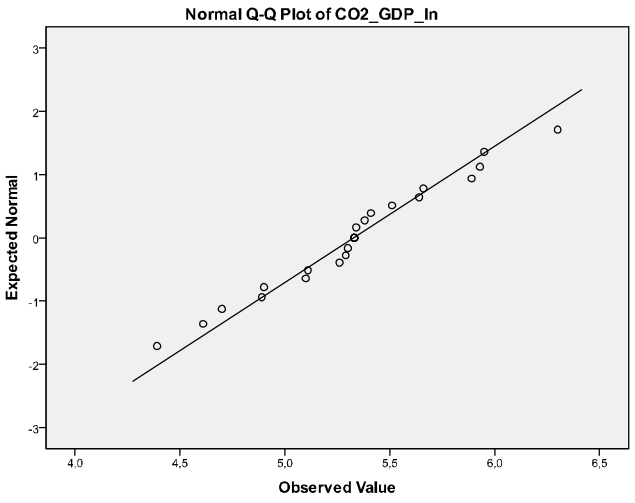

CO2_GDP
Mean = 228,26
Std. Dev. = 109,972
N = 22
Frequency
CO2_GDP

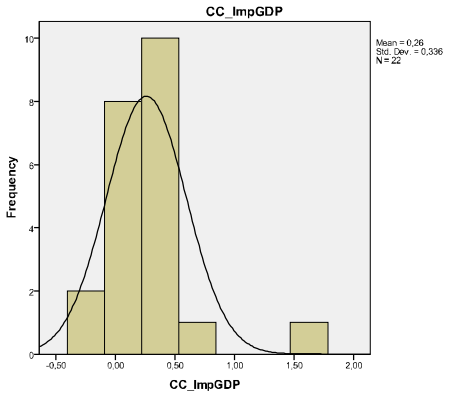

Normal Q-Q Plot of CO2_GDP
Expected Normal
Observed Value

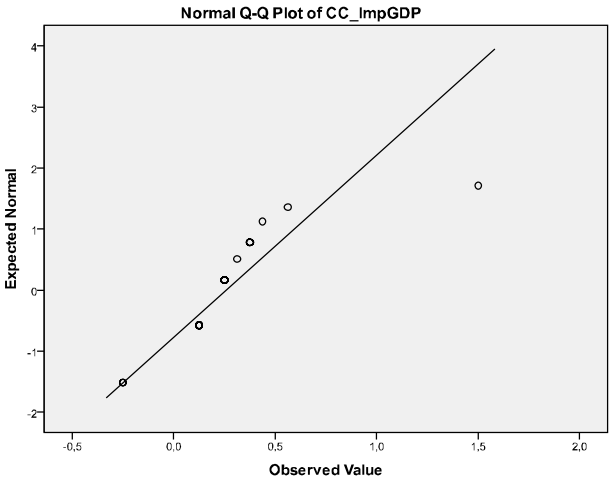

CO2_GDP_sqrt
Mean = 14,73
Std. Dev. = 5,455
N = 22
Frequency
CO2_GDP_sqrt

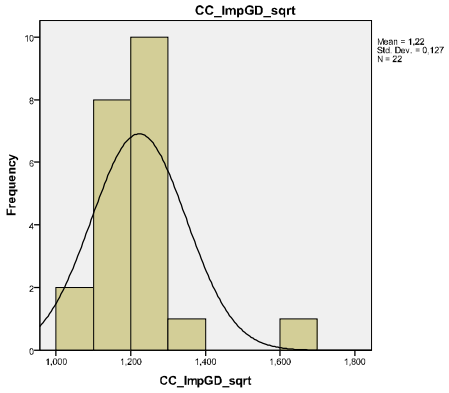

Normal Q-Q Plot of CO2_GDP_sqrt
Expected Normal
Observed Value

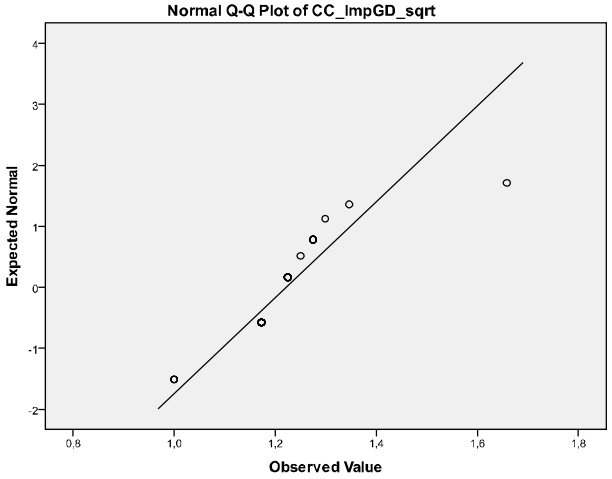

CO2_GDP_ln
Mean = 5,33
Std. Dev. = 0,465
N = 22
Frequency
CO2_GDP_ln

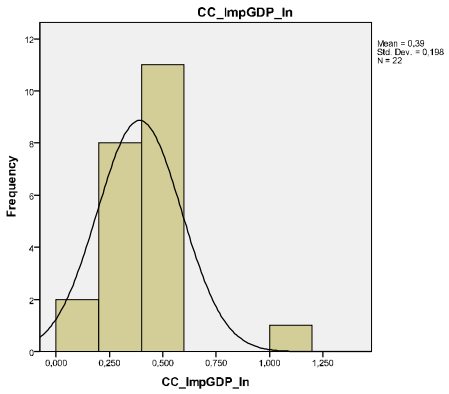

Normal Q-Q Plot of CO2_GDP_ln
Expected Normal
Observed Value

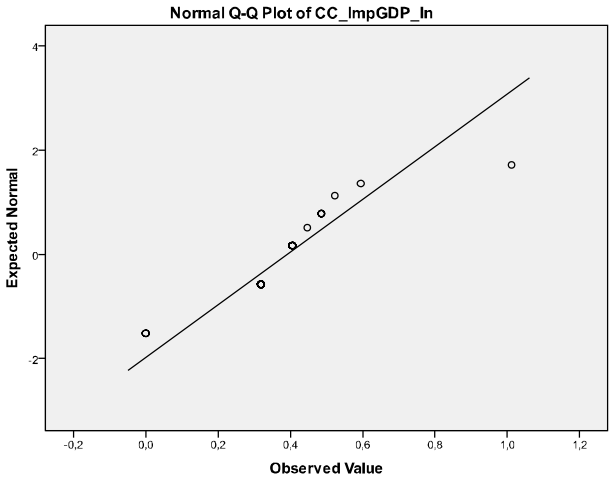

CC_lmpGDP
Mean = 0,26
Std. Dev. = 0,336
N = 22
Frequency
CC_lmpGDP

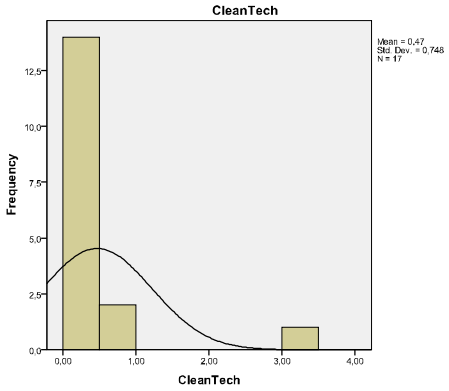

Normal Q-Q Plot of CC_lmpGDP
Expected Normal
Observed Value

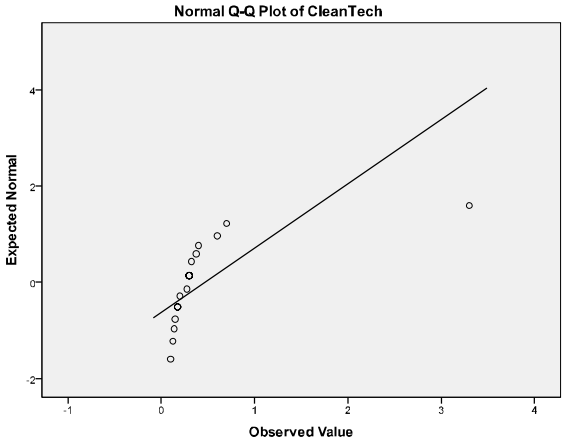

CC_lmpGD_sqrt
Mean = 1,22
Std. Dev. = 0,127
N = 22
Frequency
CC_lmpGD_sqrt

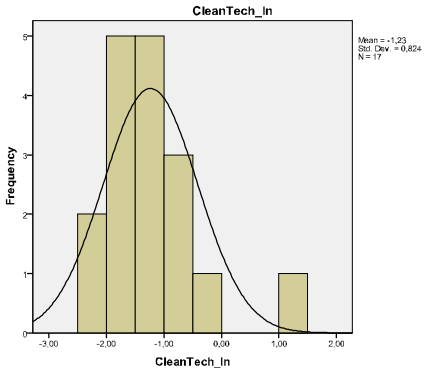

Normal Q-Q Plot of CC_lmpGD_sqrt
Expected Normal
Observed Value

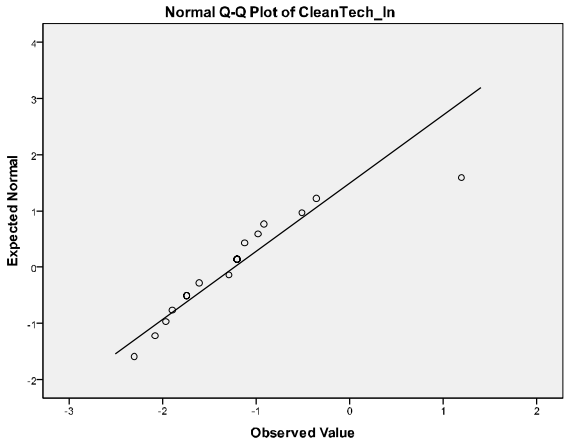

CC_lmpGDP_ln
Mean = 0,39
Std. Dev. = 0,198
N = 22
Frequency
CC_lmpGDP_ln

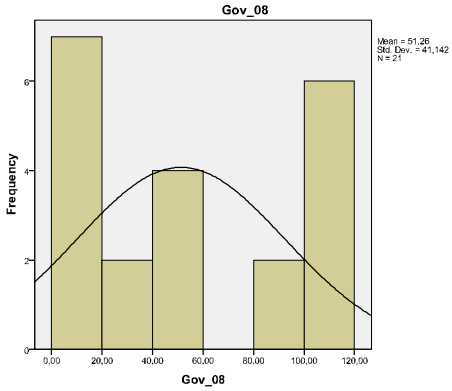

Normal Q-Q Plot of CC_lmpGDP_ln
Expected Normal
Observed Value

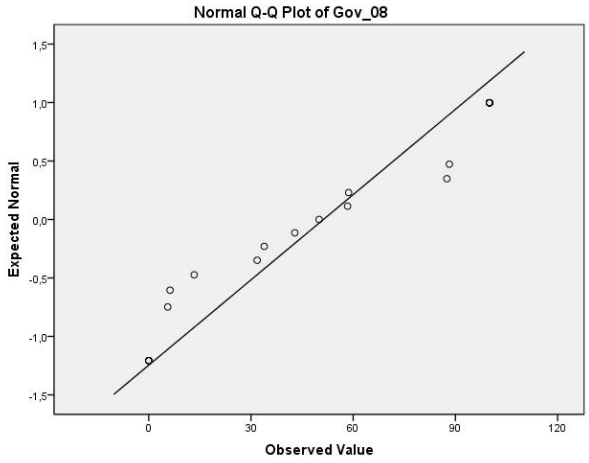

CleanTech
Mean = 0,47
Std. Dev. = 0,748
N = 17
Frequency
CleanTech

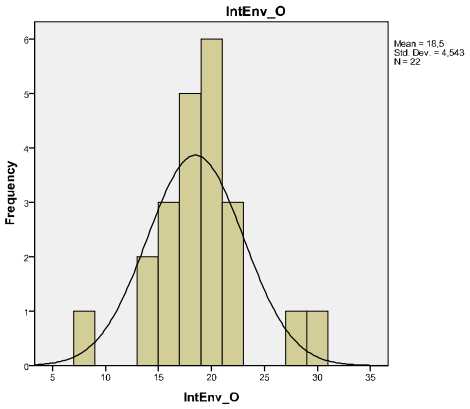

Normal Q-Q Plot of CleanTech
Expected Normal
Observed Value

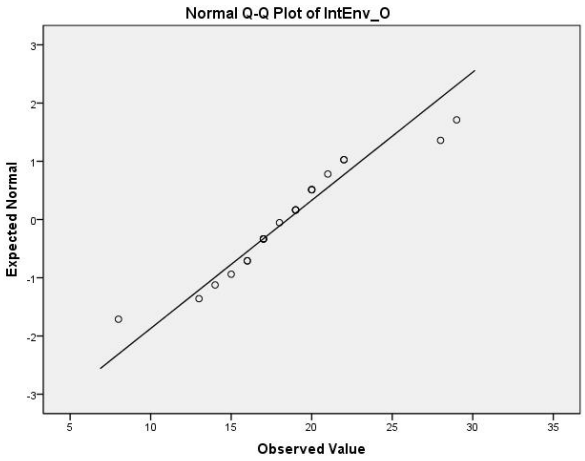

CleanTech_ln
Mean = -1,23
Std. Dev. = 0,824
N = 17
Frequency
CleanTech_ln

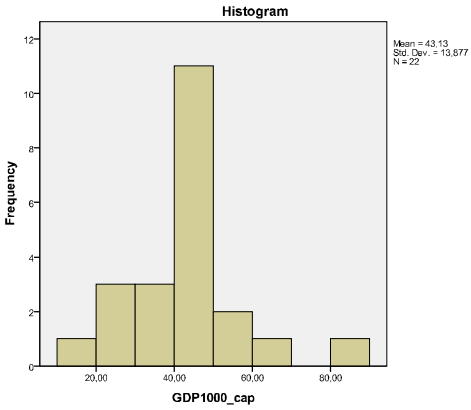

Normal Q-Q Plot of CleanTech_ln
Expected Normal
Observed Value

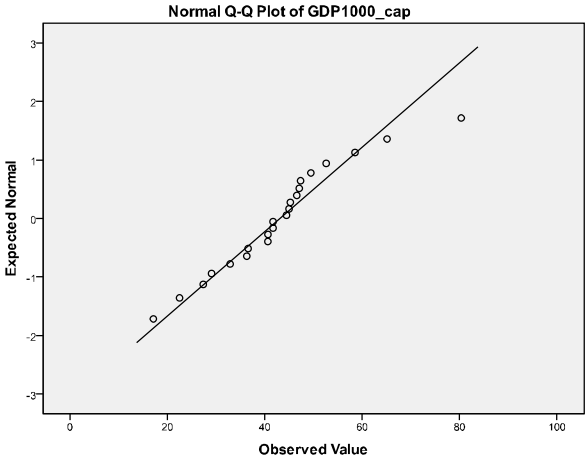

Gov_08
Mean = 51,26
Std. Dev. = 41,142
N = 21
Frequency
Gov_08

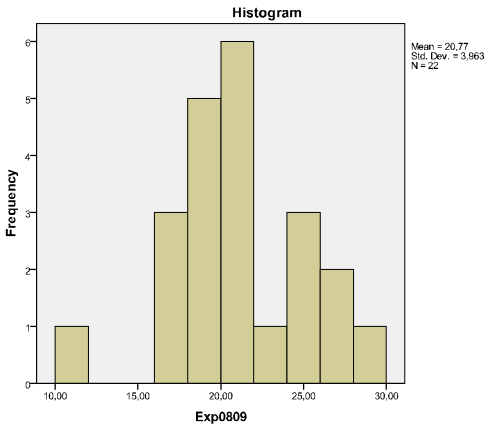

Normal Q-Q Plot of Gov_08
Expected Normal
Observed Value

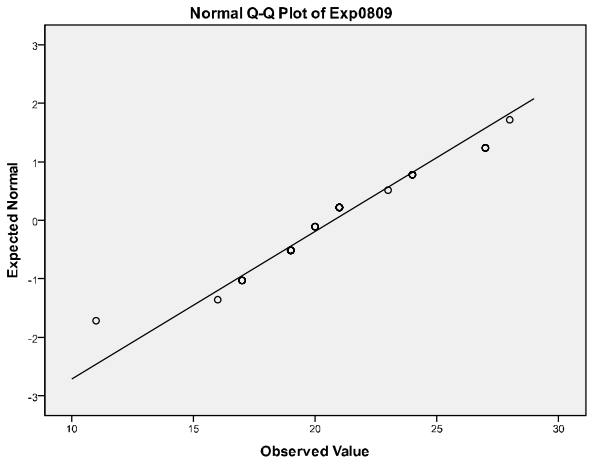

IntEnv_O
Mean = 18,5
Std. Dev. = 4,543
N = 22
Frequency
IntEnv_O

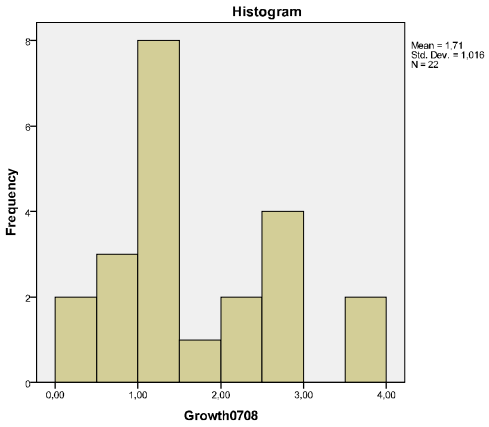

Normal Q-Q Plot of IntEnv_O
Expected Normal
Observed Value

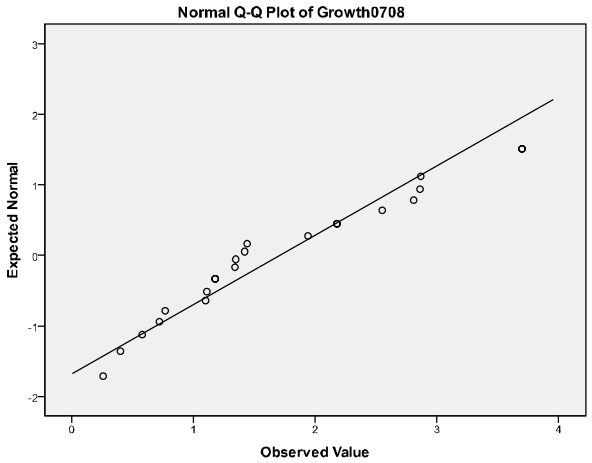

Histogram
Mean = 43,13
Std. Dev. = 13,877
N = 22
Frequency
GDP1000_cap


Normal Q-Q Plot of GDP1000_cap
Expected Normal
Observed Value

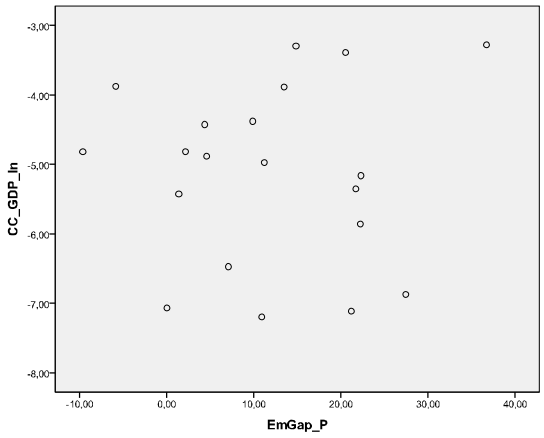

Histogram
Mean = 20,77
Std. Dev. = 3,963
N = 22
Frequency
Exp0809

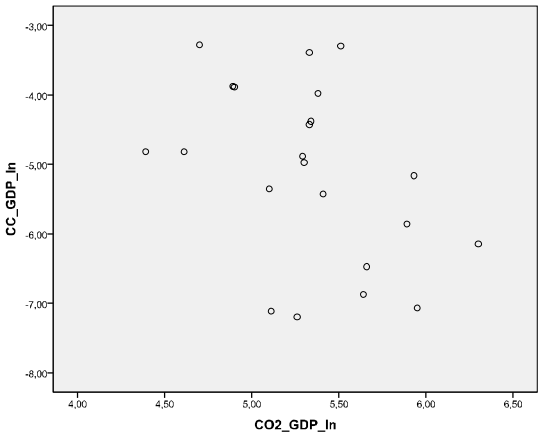

Normal Q-Q Plot of Exp0809
Expected Normal
Observed Value

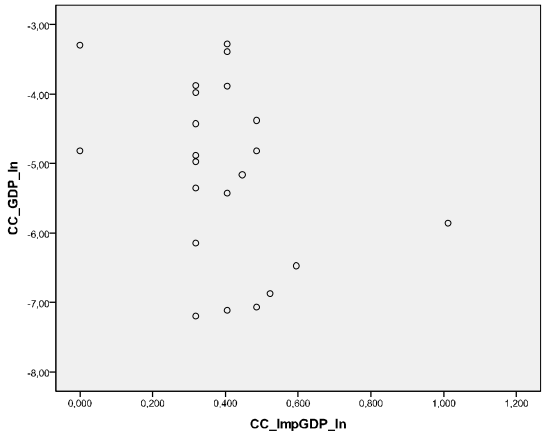

Histogram
Mean = 1,71
Std. Dev. = 1,016
N = 22
Frequency
Growth0708

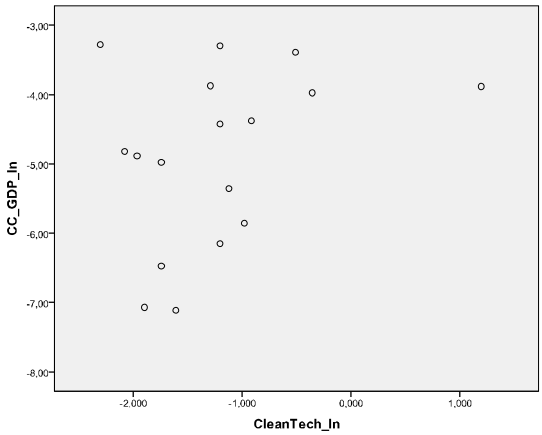

Normal Q-Q Plot of Growth0708
Expected Normal
Observed Value

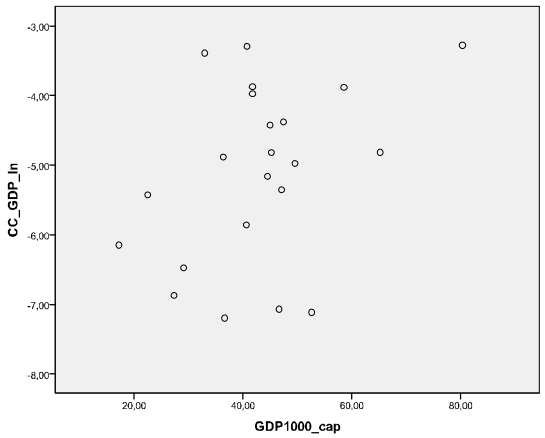
E. SCATTER PLOTS FOR SELECTED VARIABLES

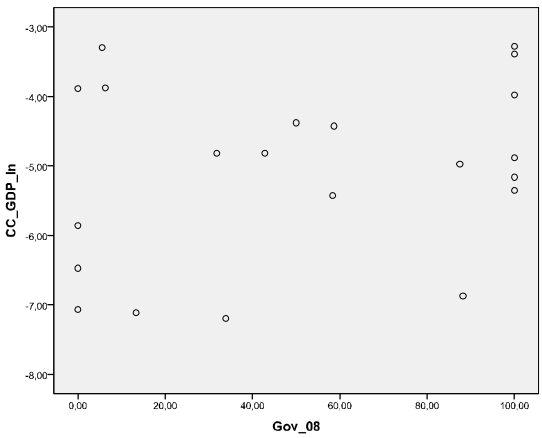


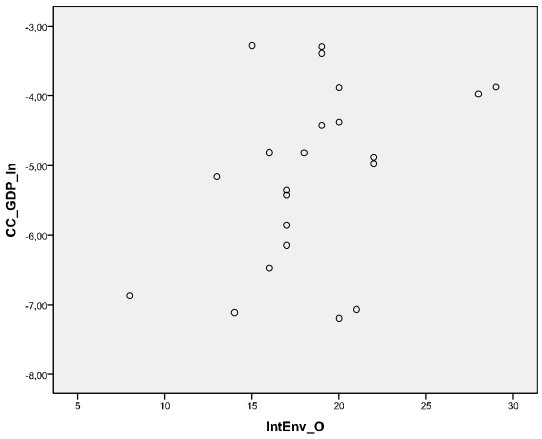


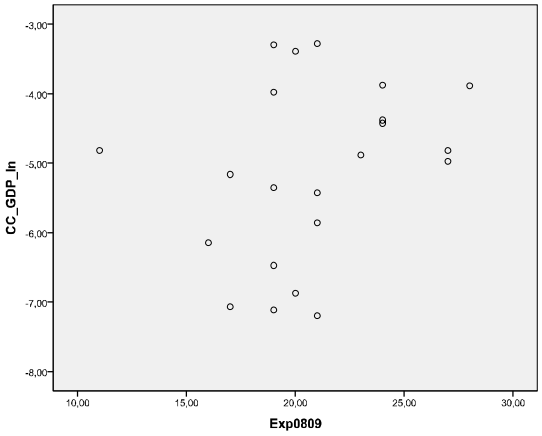


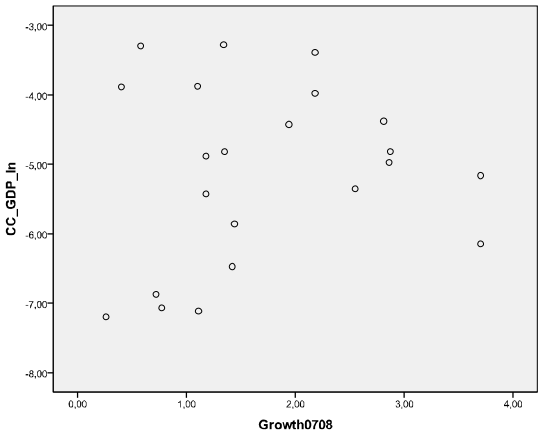







CC_GDP_ln
-3,00
-4,00
-5,00
-6,00
-7,00
-8,00
5
10
15
20
25
30
IntEnv_O


CC_GDP_ln
-3,00
-4,00
-5,00
-6,00
-7,00
-8,00
10,00
15,00
20,00
25,00
30,00
Exp0809


CC_GDP_ln
-3,00
-4,00
-5,00
-6,00
-7,00
-8,00
0,00
1,00
2,00
3,00
4,00
Growth0708

F. CHECK OF NORMAL DISTRIBUTION OF RESIDUALS

Dependent Variable: CC_GDP_ln

Independent Variables:

EmGap_P

IntEnv_O

Exp0809

Growth0708

CO2_GDP_ln