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DONOR CHARACTERISTICS AND THE ALLOCATION OF AID TO CLIMATE MITIGATION FINANCE

AIDY HALIMANJAYA[*,†,§] and ELISSAIOS PAPYRAKIS[*,‡,¶]

[*]*School of International Development*
University of East Anglia, Norwich NR4 7TJ, UK

[†]*Tyndall Centre for Climate Change Research*
University of East Anglia, Norwich NR4 7TJ, UK

[‡]*International Institute of Social Studies (ISS)*
Erasmus University Rotterdam, Kortenaerkade 12
2518 AX The Hague, The Netherlands
[§]*aidy.halimanjaya@me.com*
[¶]*papyrakis@iss.nl*
[¶]*e.papyrakis@uea.ac.uk*

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We make use of a panel dataset of 22 donor countries from 1998 to 2009 to examine the links between donor characteristics and the share of overseas development assistance allocated to climate mitigation finance. We find that donors with a larger green domestic budget tend to allocate a smaller portion of overseas aid to mitigation finance (possibly as a result of a competing interest between spending on domestic environmental projects and international climate projects). The opposite holds for donor countries with better institutions (governance) that have ratified the Kyoto Protocol. We also find important discrepancies when comparing the effects of donor characteristics on committed versus disbursed mitigation finance (as a share of aid). For the latter, only commitment to the Kyoto Protocol appears to be of high statistical significance.

Keywords: Climate mitigation finance; development aid; ODA; donors.

1. Introduction

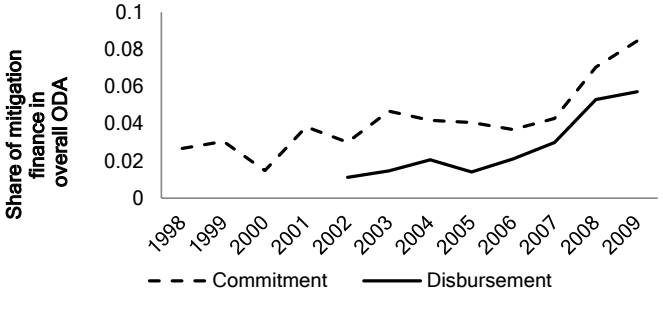
In recent years many scholars have attempted to define the motives behind the supply of overseas development assistance (ODA). It is commonly argued that donors' motives extend beyond the altruistic objective of improving the economy and well-being of people in developing countries (Alesina and Dollar, 2000; Berthelemy, 2006; Hoeffler and Outram, 2011; Maizels and Nissanke, 1984; McKinlay and Little, 1977; Trumbull and Wall, 1994). Lewis (2003) argues that this also applies to the case of environmental aid. The economic and political interests of donors are often stronger determinants of environmental aid than the environmental concerns of recipient countries.

In the past decade, there has also been a significant increase in bilateral ODA aimed at funding activities that tackle climate change (Ballesteros and Moncel, 2010;

Bierbaum and Fay, 2010; Brown, 2010; ICTSD, 2010; Michaelowa and Michaelowa, 2007). With a more specific focus than environmental ODA, official climate mitigation finance (hereafter referred to as 'mitigation finance') largely aims at minimizing GHG emissions. To date there is very little information as to why some donors allocate more of their ODA to mitigation finance than others. This is reflected in a very limited empirical literature investigating the linkages between donors' economic, political and institutional characteristics and the corresponding mitigation finance in development aid. Our study contributes to the literature by empirically examining the role of several characteristics of the 22 Development Assistance Committee (DAC) donors in determining their mitigation finance commitment and disbursement (as a share of overall ODA) from 1998 to 2009. The 22 DAC countries are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Republic of Korea, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.[1]

We define mitigation finance as projects funded by ODA that fall under the Creditor Reporting System (CRS) of the Organization for Economic Co-operation and Development (OECD) (OECD, 2011a). The CRS 1998–2009 data on mitigation finance classify projects funded by ODA into seven categories: (1) only climate change, (2) only biodiversity, (3) desertification, (4) biodiversity and climate change, (5) desertification and climate change, (6) biodiversity, desertification, and climate change and (7) others. In our analysis, we include projects for which climate change mitigation is either the principal or a significant objective (the latter activities have other primary objectives but also significantly contribute to climate mitigation). Appendices A and B provide an overview of mitigation finance reporting and data trends under CRS.

The percentage of ODA allocated to mitigation finance has been on the rise both in terms of original commitment and actual disbursement — however, mitigation finance disbursement has been consistently lower than commitment (see Fig. 1). On the whole,



Note: All figures in this study are constructed by the authors based on data from OECD (2011b).

Figure 1. Trend in mitigation finance commitment and disbursement.

[1]Luxembourg is not included due to the limited number of data available.

mitigation finance disbursement grew faster than mitigation finance commitment which indicates that in the period of our analysis, there has been a modest effort to narrow the gap; in general, it takes several years for donors to reach the amount of mitigation finance they have committed to provide. Between 1998 and 2009, the commitment of mitigation finance rose from US$1.2 to US$9.2 billion (i.e., by 7.6 times). On the other hand, there has been a ninefold increase in the actual mitigation finance disbursed between 2002 and 2009 from US$600 million to US$5.4 billion.

A comparison across the 22 donors shows that Japan is the largest mitigation finance donor followed by Germany. Japan only started to report data on its mitigation finance commitment in 2002, but it has made the largest contribution to mitigation finance both in absolute values and as a proportion of total ODA (see Fig. 2). It allocated 12.5% of its total ODA to mitigation finance from 2002 to 2009 with a cumulative value close to US$20 billion.

The key focus of our analysis is on mitigation finance as a share of total ODA, rather than variation in the absolute size of mitigation finance across donors. That is, our primary interest is in exploring why some donor countries allocate a larger share of their aid, other things equal, to mitigation finance rather than to other purposes (e.g., poverty alleviation, education, health projects, etc). To develop an empirical framework exploring the relationship between donor characteristics and the share of aid devoted to mitigation finance, this paper draws on the wider literature investigating the links between donor characteristics and general development or environmental aid. For example, the study of development aid by Chong and Gradstein (2008) claims that countries with higher levels of income per capita and citizen satisfaction with government performance tend to provide more foreign aid in general. Hicks *et al.* (2008) examine the relationships between environmental aid provision and donor characteristics using data from the project level aid database from Aid Data. They find that wealthier bilateral donor countries are likely to allocate more aid towards green projects that benefit global atmosphere, although their results are not robust to including

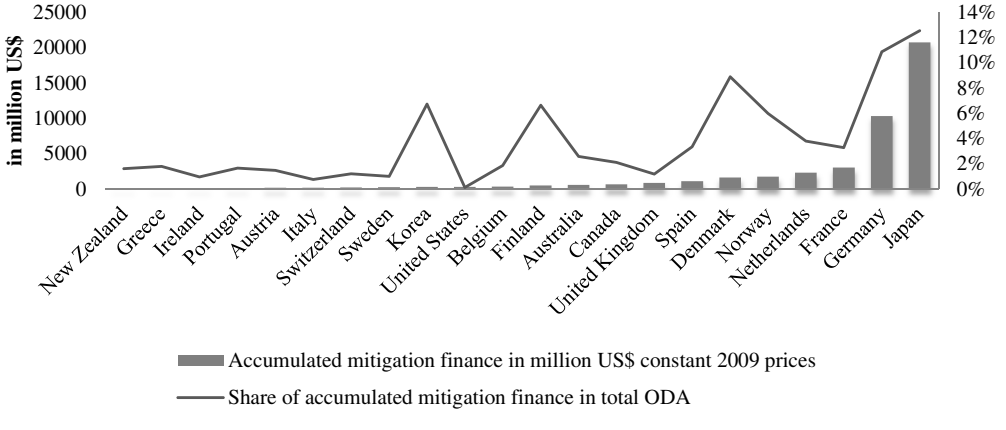


Figure 2. Donors' commitment to mitigation finance (1998–2009).

unobserved time-variant variables or adopting alternative specifications. Their study shows no evidence that institutional/political characteristics, such as the strength of environmental lobby groups, affect the allocation of aid for environmental purposes.

To our knowledge, our paper is the first empirical attempt to identify the determinants behind the allocation of aid to mitigation finance at the donor level. The study by Hicks *et al.* (2008) is the closest to the subject of our research, although with a wider focus on broader environmental aid. Our study advances knowledge in the field by linking mitigation finance more specifically with donor characteristics, with a particular focus on climate change relevant factors, such as the level of carbon dioxide (CO_2) emissions per capita, CO_2 intensity and commitment to the Kyoto Protocol.

Sections 2 and 3 discuss the hypotheses tested in this paper and explain the methodology employed to identify the drivers of donors' allocation of development aid to mitigation finance; Sec. 4 proceeds with the empirical estimation of these hypotheses. Section 5 discusses alternative specifications in the form of robustness checks. Section 6 concludes.

2. Research Hypotheses

Below we discuss the hypotheses that are empirically tested in Secs. 4 and 5 of this study and which aim to link donor characteristics to the allocation of ODA to mitigation finance:

Hypothesis 1: *The higher the CO_2 (GHG) emissions per capita in a DAC donor country, the higher the donor's allocation of ODA to mitigation finance.*

GHG emissions need to be constrained in order to mitigate climate change. The provision of finance to mitigate global GHG emissions and a country's associated responsibilities remain contentious issues in international climate change negotiations. The United Nations Framework Convention on Climate Change (UNFCCC) indicates which factors determine the responsibility of a country for financing GHG emission reduction activities. The preamble to UNFCCC (1992) states

> *…the largest share of historical and current global emissions of greenhouse gases has originated in developed countries, that per capita emissions in developing countries are still relatively low and that the share of global emissions originating in developing countries will grow to meet their social and development needs.*

The preamble guides its parties, both developed and developing countries, to consider per capita GHG emissions as one of the key measurements guiding efforts to protect climate systems (see also den Elzenand Höhne, 2008). To improve understanding of how developed countries' financing has responded to their UNFCCC commitments, this paper tests the effect of donors' per capita CO_2 emissions (as well as other types of GHG emissions) on their mitigation finance provision. Given that

developed economies can naturally also reduce carbon emissions by investing in mitigation domestically (or via Clean Development Mechanism (CDM) projects abroad, which do not, though, count as ODA), it is of interest to explore whether the largest donor carbon emitters tend to allocate (or not) a larger share of their budgeted aid towards mitigation finance (as part of their portfolio of different strategies to combat climate change). The data on per capita CO_2 emissions were provided by Boden *et al.* (2011) and the rest of the GHG data are taken from the UNFCCC (2012).[2]

Hypothesis 2: *The higher the GDP per capita of a DAC country, the higher the donor's allocation of ODA provision to mitigation finance.*

We use GDP per capita to capture donor's economic capacity (after controlling for population size). Economic capacity is one of the key factors in guiding the distribution of global collective effort behind GHG mitigation. The UNFCCC's Article 3 (UNFCCC, 1992) presents a list of principles to which international efforts to protect climate systems should adhere and which should be implemented '*on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities*' (UNFCCC, 1992).

Countries with a higher GDP per capita level are likely to have a better capacity to finance activities supporting global GHG emission reductions (such as energy efficiency and low-carbon development projects). Several empirical studies confirm that carbon abatement efforts intensify as income rises (at least for high-income donor countries that face less stringent budget constraints; see Li and Reuveny, 2006; Neumayer, 2002). Hicks *et al.* (2008) find a positive and statistically significant relationship between income per capita and brown aid, which produces local environmental benefits, and green aid, which provides global environmental benefits. They find that richer donor countries are generally more generous when paying for overseas environmental projects. We test whether this also holds for the case of mitigation finance. Data on income per capita are provided by the World Bank's World Development Indicators (WDI) database (WDI, 2014).

Hypothesis 3: *The better the governance in a DAC country, the higher the donor's allocation of ODA provision to mitigation finance.*

Donors' good governance practices can be crucial in effectively administering public funds in the battle against climate change. It might be the case that donors who have an effective and transparent public administration are more likely to display a stronger commitment towards climate change mitigation. A study claims that commitment to external development promotion is directly affected by the quality of governance in rich countries (Faust, 2008). Donor countries with inclusive domestic

[2]Appendix C presents description and data sources for all variables used in the analysis. Appendix D provides descriptive statistics and Appendix E presents a correlation matrix for all variables.

institutions tend to promote development in poorer countries and exhibit strong commitment to both internal and external redistribution (in terms of income as well as technology transfers; see Milner, 2006). Transparent and inclusive governance structures allow citizens and interest groups to express their views on environmental issues and exert pressure on their governments to take action, both domestically as well as internationally (Neumayer *et al.*, 2002; Payne, 1995). Papyrakis (2013) for example shows how good government institutions correlate with several environmental indices (including lower carbon emissions).

To identify whether developed countries with better governance commit themselves to more mitigation finance, our study includes the average value of the six institutional indices by Kaufmann *et al.* (2010) in our specifications. We also test separately each of these six indices: i.e., the level of regulatory quality, rule of law, voice and accountability, corruption control, political stability, and government effectiveness. Each index ranges from −2.5 to 2.5, with higher values corresponding to higher institutional quality. All of these institutional variables strongly correlate with one another (see Appendix E). Hence, we avoid including multiple governance indices in the same specification in order to avoid multicollinearity.

Hypothesis 4: *The number of left-wing party seats in the parliament of a DAC country can influence the allocation of ODA provision to mitigation finance either positively or negatively.*

Donor governments' main political views might influence their decisions about the relative importance of environmental issues (such as climate mitigation) in their national and international agenda. Studies reach conflicting findings on the relationship between political views and environmental related actions. Neumayer (2004a) finds that left-wing parties and individuals are more pro-environment than their counterparts: donor governments with more left-wing representatives tend to have stronger environmental policies leading to lower levels of pollution (Jensen and Spoon, 2011, also show that green left-wing party representation in government, across European Union member states, facilitates progress towards the Kyoto Protocol targets). On the other hand, the study by Hicks *et al.* (2008) finds that leftist party representation in donor governments has little relevance in decisions about the allocation of green aid. They argue that this unexpected outcome is possibly due to legislatures being pressurised by local green NGOs and environmentalists to allocate more funds at home than overseas — as a result, left-wing governments may spend more generously on the environment at home rather than abroad (note that this hypothesis does not necessarily contradict the one put forward by Neumayer, 2004a). Some earlier empirical evidence by King and Borchardt (1994) suggests that left-wing parties (across OECD countries) are associated with less interest in environmental issues (and air quality in particular) having historically a policy agenda that instead places much more emphasis on maximum employment and income for the working class — right-wing governments,

would hence be more eager to mitigate carbon emissions by investing abroad, if this is indeed economically more efficient (as a result of high local abatement costs), despite the smaller benefits accruing to local employment. Right-wing governments also tend to be more in favor of globalization and freer flow of capital, which might also be reflected on a more flexible stance with respect to the geographic location of emission abatement (see Milner and Judkins, 2004).

Given this contradictory evidence, we test the correlation between the political views of donor governments and mitigation finance using the data from the Database of Political Institutions (DPI) (Beck *et al.*, 2001), which classify party orientation with respect to economic policy: '1' denotes governments defined as conservative or right-wing; '2' denotes centrist and '3', those that are social democratic or left-wing.

Hypothesis 5: *The proportion of domestic environmental spending in the total government budget of a DAC country can influence the donor's allocation of ODA to mitigation finance either positively or negatively.*

Donor governments that allocate a large share of their budget towards domestic environmental spending might be characterised by broader environmental commitment (that can extend also to the case of international mitigation finance). This might also be in line with an explicit attempt by donor countries to 'internationalize' their domestic environmental policy objectives (e.g., see Chasek, 2007 and DeSombre, 2000), for evidence on the US and Canada). On the other hand, it might be the case that domestic spending on environmental projects limit the availability of funding for overseas environmental activities (see Hicks *et al.*, 2008). Budget constraints and the implicit division of 'green' spending between domestic versus international investment may negatively affect the allocation of ODA to mitigation finance. Domestic environmental spending (that might be favored, even if less cost-efficient, by local politicians, as it directly links to domestic employment) may render foreign spending less favored as a means to meet certain targets (as in the case of carbon emission reductions; see Platjouw, 2009). We include the proportion of domestic environmental spending in the total government budget in our regression analysis in order to test for the sign of any such correlation. Data are provided by the International Monetary Fund's (IMF, 2010) Government Finance Statistics (GFS).

Other control variables

Other control variables, such as the size of population and time dummies, are included in all specifications. It might be the case that larger donor countries find it easier to raise and/or reserve funds for international environmental projects (other things equal). Additionally, larger developed economies tend to bear a larger historical responsibility towards the climate change problem, and as a result they might exhibit a stronger commitment to providing mitigation finance. This is also in line with earlier work by Mosley (1985) who argues that the governments of larger donor countries often take the lead in supplying more ODA (with small donor countries often free-riding on the

aid efforts of the former); Lundsgaarde *et al.* (2007) provide empirical evidence of such a positive link between donor population size (via social spending) and overall aid generosity (i.e., the share of total aid in GDP). Data on population levels are taken from WDI (2014).[3]

Other additional variables are included for robustness, namely the CO_2 intensity of energy supply (i.e., emissions per kg of oil equivalent energy use taken from WDI (2014); hereafter '*CO_2 intensity*') and the ratification status of the Kyoto Protocol. Donors who have heavily invested in lowering their own levels of CO_2 energy intensity in their domestic economies (e.g., as a result of a larger reliance on renewable energy technologies might for example allocate a smaller share of their aid in green finance (Hicks *et al.*, 2008; Platjouw, 2009) — this might be either the result of budget constraints (domestic environmental investment in renewable energy may crowd-out foreign environmental investment) or a conscious decision to prioritise aid allocation in other areas (given that ethical obligations towards climate mitigation would have already been partly met by domestic investment in greener energy). Furthermore, once donor countries develop technologies (often with large initial setup costs) that reduce the carbon intensity of their domestic energy supply (e.g., carbon-capture and storage facilities or renewable energy technologies), the transfer of these technologies to developing countries (in the form of aid) remains relatively expensive as a result of strong pattern protection schemes (Dechezlepretre *et al.*, 2013; Liu and Liang, 2011).

We also expect donor countries that have ratified the Kyoto Protocol to provide more mitigation finance. Michaelowa and Michaelowa (2011) suggest that donor government 'green beliefs' (and related support for environmental policy action) is linked to their Kyoto commitments. In general, the ratification of the Kyoto Protocol has been linked to pro-environmental behavior (e.g., development of green patents and the adoption of renewable energy technologies; see Nesta *et al.*, 2014, or passage of climate change legislation, see Fankhauser *et al.*, 2015), which is likely to extend to the international environmental arena. To test whether donor commitment to the Kyoto Protocol is associated with a higher proportion of mitigation finance in total ODA, a 0-1 dummy (*kyotoprot*) is included as an additional control (with '1' corresponding to ratification of the Protocol). Data are taken from the Environmental Treaties and Resource Indicators (CIESIN-SEDAC, 2011).

3. Methodology

We make use of random-effects models to identify the influence of donor characteristics on the proportion of mitigation finance in their total provision of ODA (A^j_{it}). We

[3]An earlier version of the paper included a measure of democracy from the Polity IV dataset (Marshall *et al.*, 2011), given some earlier empirical evidence suggesting that democratic governments exhibit stronger commitment to environmental protection, possibly as a result of being held accountable to their electorates for their spending decisions (Neumayer, 2004a). Given the very small variation across donor countries and time, we decided not to include the proxy in the empirical analysis.

make use of unbalanced panel data in order to make use of the maximum possible number of observations. We adopt a random effects estimation, given that random effects estimators tend to be much more efficient for variables with little variation over time (which is the case for several of our explanatory variables, such as measures of governance, GDP per capita, population levels, which fluctuate little from one year to the next; see Halaby, 2004; Hsiao, 2007; Neumayer, 2004b, for an elaborate discussion). Fixed-effect estimations tend to overinflate the standard errors of the coefficients corresponding to variables with little time variation — see Neumayer (2004b) for an adoption of random effect estimations in the aid empirical literature.

Donor characteristics are captured by their level of CO_2 emissions per capita, E_{it}, their level of wealth, measured by income per capita, I_{it}, governance, G_{it}, their composition of left or right representatives in the national parliament, L_{it}, the proportion of environmental expenditure in their government budget, X_{it}, and a vector of other explanatory variables, Z_{it} as seen in Eq. (1) below.[4]

$$A_{it}^{j} = \propto_0 + \propto_1 E_{it} + \propto_2 I_{it} + \propto_3 G_{it} + \propto_4 L_{it} + \propto_5 X_{it} + \propto_6 Z_{it} + a_i + \varepsilon_{it}. \quad (1)$$

The superscript j of the dependent variable A_{it}^{j} denotes different measures of mitigation finance; namely the proportion of mitigation finance in a donor's total ODA commitment or disbursement. The period of analysis for the regressions focusing on mitigation finance commitment and disbursement is 1998–2009 and 2002–2009 respectively.

4. The Allocation of Development Aid to Mitigation Finance — Empirical Evidence

Table 1 presents empirical results based on several specifications that link donor characteristics with the share of mitigation finance in development aid provision. The table is divided into two parts: the first two columns display results with mitigation finance commitment as the dependent variable; the last two columns replicate the same specifications for the case of mitigation finance disbursement. We first analyze the empirical results that refer to mitigation finance commitment (columns 1 and 2).

In all our specifications in Table 1, we include *lnco2pc* as an explanatory variable, which measures the logarithm of CO_2 emissions per capita (see Hypothesis 1 of Sec. 2). We do not find a statistically significant relationship between CO_2 emissions (in per capita terms) and mitigation finance commitment. While this might look surprising at first sight, one should remember that our dependent variable is the share of aid allocated to mitigation finance (commitment) rather than a measure of overall investment in mitigation; developed economies can naturally also reduce carbon emissions by investing in mitigation domestically (or via CDM projects abroad, which do not, though, count as ODA).

The level of a donor's income per capita (*lngdppc*) is also not statistically significant (see Hypothesis 2 of Sec. 2). This indicates that richer donors do not necessarily

[4]Appendix E provides a correlation matrix for all variables included in the analysis.

Table 1. Determinants of mitigation finance in total ODA.

Dependent variable: Share of mitigation finance in total ODA, 1998 to 2009	Commitment		Disbursement	
	(1)	(2)	(3)	(4)
lnco2pc	0.016	−0.010	−0.004	−0.007
	(1.018)	(−0.440)	(−0.356)	(−0.495)
lngdppc	−0.009	0.019	0.024	0.026
	(−0.428)	(0.761)	(1.381)	(1.280)
govern	0.025**	0.046***	−0.005	−0.004
	(2.112)	(3.378)	(−0.486)	(−0.359)
leftgov	−0.003	−0.003	0.002	0.002
	(−1.150)	(−1.171)	(0.662)	(0.698)
environexpen	−0.026*	−0.035**	−0.003	−0.001
	(−1.898)	(−2.154)	(−0.313)	(−0.117)
lnpop	0.008*	0.010**	0.001	0.001
	(1.773)	(2.204)	(0.154)	(0.006)
kyotoprot	0.058***	0.059***	0.041**	0.039**
	(3.601)	(3.551)	(2.252)	(2.147)
co2inten		0.040*		0.002
		(1.823)		(0.330)
R-Squared (overall)	0.434	0.380	0.361	0.349
R-Squared (between)	0.527	0.582	0.371	0.350
R-Squared (within)	0.389	0.489	0.345	0.360
N	113	113	94	94

Note: Robust *t*-statistics in parentheses. *, ** and *** denote significance at the 10%, 5% and 1%, level respectively. Time dummies included in all regressions.

commit a larger share of their ODA towards mitigation finance, other things equal (this finding contradicts Hicks *et al.*, 2008), who, though, base their estimates on pooled OLS using the total amount of environmental green finance as their dependent variable). While richer donors might, on the whole, commit to larger amounts of overall ODA, there is no evidence of any intrinsic preference favoring mitigation finance (e.g., against other types of development aid that might have stronger local development impacts but less effect on climate change mitigation).

We also include in all regressions a measure of governance (*govern*) that aims to capture a donor government's institutional capacity for effective administration and policy formulation (see Hypothesis 3 of Sec. 2) — for this purpose, we make use of the average value of the six institutional indices by Kaufmann *et al.* (2010). Our measure of governance appears to be positively and statistically significantly correlated with climate mitigation commitment (see Table 1, columns 1 and 2). This supports our earlier hypothesis suggesting that donors who have an effective and transparent public administration are more likely to display a stronger commitment towards climate change mitigation (Neumayer *et al.*, 2002; Payne, 1995).

Furthermore, we include an index capturing the political orientation of each donor government, with higher values corresponding to more left-wing government orientation (*leftgov*) (see Hypothesis 4 of Sec. 2) — we find the index to be negative for the case of climate mitigation commitment, but statistically insignificant. This weak correlation is not particularly surprising given the earlier contradictory empirical evidence found in the literature that suggest both negative and positive linkages (some suggest that left-wing political parties tend to adopt stronger environmental policies, see Neumayer, 2004a, but others that they place more priority on domestic environmental issues, see Hicks *et al.*, 2008 as well as domestic employment, see Milner and Judkins, 2004).

Our next variable of interest is the proportion of domestic environmental spending in total government expenditure (*environexpen*) (see Hypothesis 5 of Sec. 2). We find a negative and statistically significant relationship between domestic environmental expenditure and the proportion of mitigation finance allocated in total ODA. Budget constraints and the division of green spending between domestic versus international investment are hence likely to affect decisions on the allocation of aid to mitigation finance. In column 1, one can see that a 1% drop in the proportion of donor environmental expenditure in the government budget, corresponds approximately to a 2.6% rise in the share of mitigation finance in overall ODA (the effect is slightly larger for column 2). Competition between domestic and overseas green projects for financial resources may deter governments from generously financing activities abroad (that will have little and indirect impacts on their electorates – this is in line with the arguments put forward by Hicks *et al.*, 2008 and Platjouw, 2009).

We find positive and statistically significant coefficients for the population size of donor countries (*lnpop*) and their ratification status of the Kyoto protocol (*kyotoprot*). Larger donors seem to take the lead in mitigation finance provision (this might reflect an acknowledgment of their relative larger historical responsibility towards the climate change problem or perhaps an easier capacity to raise funds for international environmental projects, see also Mosley, 1985 and Lundsgaarde *et al.*, 2007, for similar arguments put forward for general aid provision). Donor countries that ratified the Kyoto protocol also seem to allocate a larger share of aid to mitigation finance. This is in line with earlier evidence linking the ratification of the Kyoto Protocol with pro-environmental behavior (Nesta *et al.*, 2014; Fankhauser *et al.*, 2015). Kyoto ratification is likely to signal a stronger commitment towards climate change mitigation, which is likely to extend to the case of mitigation finance.

In column 2 of Table 1, we enrich our specification by including the CO_2 intensity of energy supply (*co2inten*) as an additional regressor. We find a positive and statistically significant coefficient (at the 10% level). Donors who have heavily invested in lowering their own levels of CO_2 energy intensity in their domestic economies (e.g., as a result of a larger reliance on renewable energy technologies) might allocate a smaller share of their ODA in mitigation finance, either as a result of implicit budget constraints or a conscious decision to prioritize aid allocation in other areas, now that

ethical obligations towards climate change would have been partly met via domestic green investment (Hicks *et al.*, 2008; Platjouw, 2009).

In columns 3 and 4 of Table 1, the focus switches from mitigation finance commitment to actual disbursement. Data on mitigation finance disbursement are available only from 2002 onwards (hence, the smaller sample size in comparison to the commitment regressions; i.e., columns 1 and 2). We include the same set of explanatory variables, as in the commitment specifications. The disbursement regressions reveal important discrepancies when comparing donor behavior in terms of original commitment and actual disbursement. For the latter, it is only commitment to the Kyoto Protocol that matters (with a coefficient significant at 1%). While this discrepancy might look surprising at first sight, differences across donor countries with respect to their commitment and disbursement behavior are well documented in the empirical literature on aid (and referred to as the 'commitment-disbursement gap', e.g., see Roodman, 2009; White and McGillivray, 1995). Given that the second commitment period of the Kyoto Protocol currently extends until December 2020, this raises concerns about climate finance spending in the absence of a follow-up commitment mechanism/treaty and the overall efforts to 'green' the global development aid agenda.

Table 2. Determinants of mitigation finance in total ODA the case of Clean Development Mechanism (CDM).

	Commitment (5)	Disbursement (6)
lnco2pc	0.013	−0.020
	(0.656)	(−1.102)
lngdppc	0.033**	0.056**
	(1.902)	(2.292)
govern	0.044***	−0.004
	(2.883)	(−0.024)
leftgov	−0.02	0.001
	(−0.057)	(0.186)
environexpen	−0.041**	−0.001
	(−2.373)	(−0.044)
lnpop	0.019***	0.002
	(2.733)	(0.780)
cdm	−0.031***	−0.022*
	(−2.976)	(−1.635)
R-Squared (overall)	0.494	0.330
R-Squared (between)	0.665	0.437
R-Squared (within)	0.599	0.364
N	59	59

Note: Robust *t*-statistics in parentheses. *, ** and *** denote significance at the 10%, 5% and 1%, level respectively. Time dummies included in all regressions.

In Table 2, we re-estimate specifications (1) and (3) when including a dummy variable (*cdm*) that captures whether a donor country invests in carbon reductions through the CDM for any particular year.[5,6] The CDM allows donor countries to meet their Kyoto targets by investing in carbon reductions in the developing world. CDM investments need to be complementary to any development aid reserved for mitigation finance purposes — ODA projects using mitigation finance are not eligible to be registered as CDM investment and vice versa in order to prevent a possible diversion of ODA (to climate projects that can count towards Kyoto targets; see Dutschke and Michaelowa, 2006; Paulsson, 2009). Table 2 now excludes the pre-2005 period (hence the drop in the sample size), as there were no CDM projects recorded for any donor prior to 2005. We have also avoided entering the CDM dummy jointly with the Kyoto Protocol dummy, due to the high correlation between the two (0.76 correlation coefficient). We find that CDM investment is negatively and statistically significantly correlated with the share of mitigation finance in ODA (at 1% and 10% for commitment and disbursement, respectively). This is not very surprising given that both CDM projects and aid allocated to mitigation finance share the objective of reducing carbon emissions in the developing world (although only the former counts towards the fulfillment of Kyoto targets) — donor countries can, in principle, contribute to climate change mitigation via the CDM mechanism instead of allocating aid funds to mitigation finance, and hence reserve a larger share of development assistance for other purposes. For the rest, results are in accordance with the earlier findings of Table 1 (apart from the donor level of GDP per capita, which is now positive and significant at the 5% level for the sub-period we examine). Data on CDM participation are provided by the UNFCCC's CDM database (UNFCCC, 2014).

5. Robustness Checks — Alternative Specifications

Non-CO_2 greenhouse gases

In this section, we discuss alternative specifications in the form of robustness checks. As a first robustness check, we replicated column 1 of Table 1, including in alternate order a set of five additional non-CO_2 greenhouse gases as additional regressors (namely the natural logarithms of per capita methane emissions, perfluorocarbons, hydrofluorocarbons, sulphur hexafluoride and nitrous oxide). Results are in line with our earlier findings pointing to an insignificant relationship between donor carbon emissions and the share of aid allocated to mitigation finance — the coefficients of non-CO_2 greenhouse gases are also statistically insignificant, with only exception the coefficient of perfluorocarbons (which although significant at the 5%, is of very low magnitude, with a two standard deviation increase in perfluorocarbons corresponding

[5]Many of the registered CDM projects are co-financed by multiple donor countries — this does not allow for a disaggregation of project values across funding partners. It is for this reason that we have made use of a country dummy variable to capture CDM investment (see also Grunewald and Martínez-Zarzoso, 2009, for a similar approach).

[6]A similar replication of specifications (2) and (4) of Table 1 yields very similar results.

to only a 2% difference in the share of aid allocated to mitigation finance). Furthermore, we also replicated column 1 of Table 1 by substituting the level of CO_2 emissions per capita with an aggregate measure of all greenhouse gases (expressed in their CO_2-equivalent value in per capita terms) — the corresponding coefficient was again insignificant. Results are available from the authors upon request.

Disaggregated governance indicators

As a further robustness check, we replicated column 1 of Table 1 by separately testing the influence of the six disaggregated World Governance indicators (Kaufmann *et al.*, 2010) in alternate order (instead of their average value, captured by the variable *govern*). In Appendix F, we present the corresponding coefficients of each of the six governance indices. Four of these indices exhibit a positive significant correlation with mitigation finance commitment: i.e., regulatory quality (*regulquality*), rule of law (*ruleoflaw*), voice and accountability (*voiceaccount*), and control for corruption (*contcorrupt*). The other two indices, i.e., political stability (*polstability*) and government effectiveness (*goveffective*), are statistically insignificant. In general, donors characterized by good institutions appear to show greater commitment towards mitigation finance. The voice and accountability variable exhibits the strongest correlation with mitigation finance commitment — this is in line with the empirical work by Bättig and Bernauer (2009), who also find a very strong positive effect of political accountability on levels of government commitment to climate change mitigation. In general, democratic countries commit themselves more to environmental protection, for example by allowing concerned and informed citizens, as well as social movements and free media, to raise awareness about environmental problems and influence political outcomes (Holden, 2002).

Absolute value of mitigation finance

As we mentioned in Sec. 1, the key focus of the analysis is not on the level of overall mitigation finance, but instead on mitigation finance as a share of total ODA. That is, our primary interest is in exploring why some donor countries allocate a larger share of their aid, other things equal, to mitigation finance rather than to other purposes (e.g., poverty alleviation, education, health projects, etc.) — in other words, we attempt to explain why some donors place more emphasis on climate projects compared to other types of ODA (and hence have a 'greener' ODA portfolio). Another research question, that might merit attention on its own, is why some donor countries provide more mitigation finance (in absolute values) than as a share of ODA. When we include the logarithm of total mitigation finance as the dependent variable and control for the size of overall ODA volumes, we find that it is only overall ODA (and ratification of the Kyoto Protocol) that explains total mitigation finance. Donors that are more generous in their overall 'ODA', also tend to be more generous in terms of mitigation finance, as one would expect — the other socio-economic characteristics that we examined in the earlier regressions do not seem to matter.

Disbursement-commitment ratio

As a last robustness check we replicated specification 1 of Table 1 using the disbursement–commitment ratio as the dependent variable (a low ratio indicates poor donor performance in terms of meeting commitments). For example, one might hypothesize that richer donors might have a larger disbursement to commitment ratio, as a result of facing fewer financial constraints (see Odedokun, 2003, for similar evidence on overall ODA patterns). The same might also hold for donor countries with better governance structures (Faust, 2008). None of our explanatory variables, though, correlates significantly with the disbursement–commitment gap — the gap may hence reflect a general tendency that is independent of donor characteristics. Results are available from the authors upon request.

6. Conclusions

To date, the drivers of donors' allocation to mitigation finance remain unclear. Identifying these drivers is important to support the global climate agenda, particularly in view of the relative slow growth in global ODA and the pressurizing development priorities as listed in the post-2015 United Nations Development Agenda (UN, 2013). An improved understanding of these drivers is key to a more effective fundraising strategy of the UNFCCC's Standing Committee of Finance (with a target of 100 billion US$ per year by 2020). To our knowledge, our study has been the first empirical attempt to explain variation in mitigation finance at the donor level.

While donors' commitment to fund climate mitigation has increased considerably from 2002 to 2009, there are large differences across donor countries with respect to the share of ODA allocated to mitigation finance. We have empirically explored how variation in this share may relate to several donor characteristics. We have found out that the donors' allocation of ODA to mitigation finance is negatively correlated with the share of environmental expenditure in the government budget — domestic environmental spending (in combination with implicit budget constraints) may limit the availability of funding for overseas environmental activities. Donor countries with better institutions that have ratified the Kyoto protocol also tend to commit to a larger share of their ODA being given for climate mitigation purposes. We also find important discrepancies when comparing donor behavior in terms of original commitment and actual disbursement. For the latter, it is only ratification of the Kyoto Protocol that matters. The donor level of per capita CO_2 emissions does not appear to influence the commitment/disbursement of mitigation finance (as a share of ODA).

Various extensions of our analysis could be further developed in the future. A possible extension of the analysis as a new line of study could entail a comparative study between the supply of adaptation finance provided by bilateral and multilateral donors (e.g., international organizations). Detailed country-specific case studies might also shed additional light on the determinants of climate finance supply by probing into

more detail at how domestic policies on the provision of different types of aid are shaped at the country level.

Appendix A. Climate Change Mitigation Data

Figure A.1 shows an increase in the reporting of mitigation finance data over time, although some countries have consistently under-reported it. For example, Japan has only nine years of available data on projects purely addressing emission mitigation and projects whose objective is mitigation combined with combating desertification and protecting biodiversity (Fig. A.2). Norway is the only donor that consistently reports its ODA projects, according to the Rio Marker CRS, and hence has a full 12 years of data of reporting on all the Rio Markers.

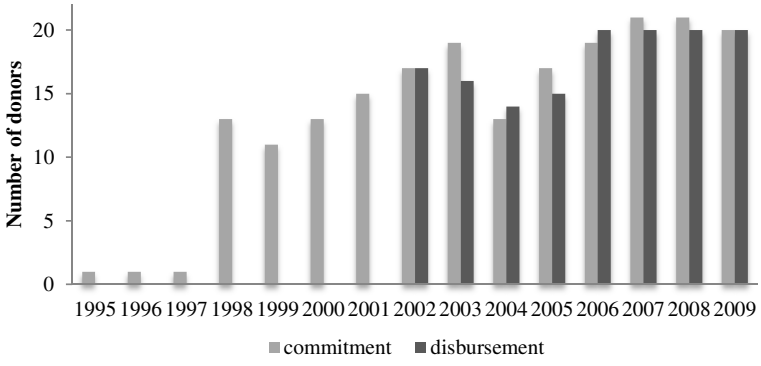


Fig. A. 1. Number of donors reporting on mitigation finance commitment and disbursement.

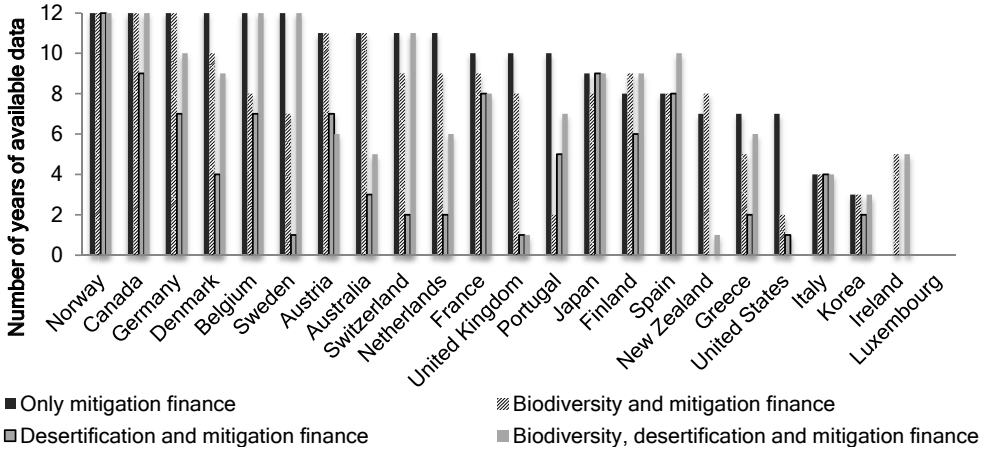


Fig. A. 2. Number of reporting years by each donor for each Rio Marker objective.

Appendix B. Donors' Commitment and Disbursement to Mitigation Finance (1998–2009)

Year	Mixed mitigation finance (1)+(2)+(3)+(4)		Only mitigation finance (1)		Biodiversity and mitigation finance (2)		Desertification and mitigation finance (3)		Biodiversity, desertification, and mitigation finance (4)	
	C	*D*	*C*	*D*	*C*	*D*	*C*	*D*	*C*	*D*
1998	1249.7		499.8		213.1		286.3		250.5	
1999	1682.4		1055.7		214.6		88.4		323.7	
2000	867.9		346.9		225.0		28.0		268.0	
2001	2200.9		1490.4		208.2		52.5		449.7	
2002	2020.3	668.5	1121.8	287.2	474.1	105.5	24.8	44.7	399.6	231.1
2003	3955.9	1033.0	2941.5	646.1	210.4	150.8	38.0	48.6	766.1	187.4
2004	3480.6	1474.1	2731.8	968.8	155.1	124.0	47.6	67.6	546.0	313.7
2005	4438.6	1440.9	3324.7	1096.4	186.0	105.6	58.6	19.0	869.3	219.9
2006	4119.6	2022.7	2794.5	1423.4	264.4	116.2	112.3	24.7	948.4	458.4
2007	4061.9	2619.8	2703.7	1780.2	313.0	200.9	48.6	35.0	996.6	603.6
2008	7919.8	5138.3	6308.3	3890.8	258.8	266.6	215.4	71.7	1137.2	909.2
2009	9205.6	5429.1	7369.0	4255.1	1191.3	530.0	128.6	74.3	516.6	569.8

Note: C = commitment; D = disbursement. In million US$ constant 2009 prices.

Appendix C. List of Variables and Data Sources

Type of variable	Variable label	Definition	Data source
Mitigation finance in various forms	commitment disbursement	Proportion of mitigation finance in total ODA (commitment/disbursement)	OECD (2011a, b)
Carbon emissions	lnco2pc	Log of CO_2 in thousand metric tons of carbon divided by total population	Author's calculation using the data from Boden *et al.* (2011)
	co2inten	CO_2intensity (kg per kg of oil equivalent energy use)	WDI (2014)
Level of wealth	lngdppc	Log of Gross Domestic Product (GDP) per capita in constant US$ 2009	WDI (2014)
Governance	govern	The average of six Kaufmann's World Governance Indicators (listed below). Each indicator ranges from −2.5 to 2.5 (max)	Author's calculation based on Kaufmann *et al.* (2010)
	regulquality	*Regulatory quality* captures the ability of government to formulate and implement sound policies and regulations	Kaufmann *et al.* (2010)

Appendix C. (*Continued*)

Type of variable	Variable label	Definition	Data source
	ruleoflaw	*Rule of law* index captures the extent to which agents have confidence in and abide by the rules of society, as well as the quality of contract enforcement and property rights	Kaufmann *et al.* (2010)
	voiceaccount	*Voice and accountability* captures the extent to which citizens can participate in government selection procedures and have freedom of expression and association	Kaufmann *et al.* (2010)
	contcorrupt	*Control of corruption* captures the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests	Kaufmann *et al.* (2010)
	polstability	*Political stability* captures perceptions on the likelihood that governments become destabilized or overthrown by unconstitutional or violent means	Kaufmann *et al.* (2010)
	goveffective	*Government effectiveness* that captures the quality of public services and policy formulation, as well as the degree of government commitment to policies.	Kaufmann *et al.* (2010)
Environmental expenditure	environexpen	Environmental protection as per cent of total outlays (central government budget)	IMF (2010)
Kyoto protocol ratification	kyotoprot	Kyoto protocol ratification; coded 1 if ratified; coded 0 otherwise	CIESIN-SEDAC (2011)
Composition of donor government	leftrightgov	Coded: (3) conservative, Christian democratic, or right-wing; (2) centrist and (1) communist, socialist, social democratic, or left-wing. Annual data covers the period 1975–2010	Beck *et al.* (2001)
Population	lnpop	Log of population size	WDI (2014)
Clean Development Mechanism	cdm	Participation in the CDM; code 1 if participation for a particular; coded 0 otherwise	UNFCCC (2014)

Appendix D. Descriptive Statistics

Variable label	No of observations	Mean	Standard deviation	Min	Max
Commitment	199	0.022	0.035	0.000	0.267
Disbursement	142	0.016	0.025	0.000	0.143
lnco2pc	264	2.229	0.336	1.548	3.008
co2inten	264	2.238	0.548	0.960	3.427
lngdppc	264	10.393	0.205	9.743	10.933
enviroexpen	172	0.512	0.330	−0.458	1.617
kyotoprot	264	0.417	0.494	0.000	1.000
leftgov	251	1.956	0.935	1.000	3.000
lnpop	264	16.776	1.212	15.127	19.542
cdm	96	16.588	2.570	11.113	18.419
Govern	210	1.398	0.360	0.502	1.913
regulquality	210	1.402	0.317	0.537	2.012
ruleoflaw	220	1.503	0.379	0.313	1.964
voiceaccount	220	1.345	0.254	0.609	1.827
contcorrupt	220	1.634	0.587	0.156	2.466
polstability	220	0.927	0.371	−0.180	1.577
goveffective	220	1.592	0.426	0.316	2.237

Appendix E. Correlation Matrix

	Commitment	Disbursement	lnco2pc	co2inten	lngdppc	enviroexpen	kyotoprot	leftgov	lnpop
Commitment	1.0000								
Disbursement	0.7477*	1.0000							
	0.0000								
lnco2pc	−0.0186	−0.1387	1.0000						
	0.7939	0.0997							
co2inten	0.0661	−0.0308	0.4261*	1.0000					
	0.3535	0.7162	0.0000						
lngdppc	0.0341	0.0437	0.2395*	−0.2598*	1.0000				
	0.6328	0.6057	0.0001	0.0000					
enviroexpen	−0.1377	−0.0136	0.2271*	0.2854*	0.1609	1.0000			
	0.1153	0.8956	0.0027	0.0001	0.0350				
kyotoprot	0.1521	0.2444*	−0.0469	−0.0500	0.2872*	0.0825	1.0000		
	0.0320	0.0034	0.4482	0.4187	0.0000	0.2822			
leftgov	−0.1502	−0.0335	−0.1091	−0.0563	−0.198*	0.0441	−0.1512	1.0000	
	0.0401	0.6993	0.0844	0.3745	0.0016	0.5664	0.0165		
lnpop	0.2861*	0.1710	0.2812*	0.1840*	−0.0584	−0.2904*	0.0168	−0.1029	1.0000
	0.0000	0.0419	0.0000	0.0027	0.3448	0.0001	0.7861	0.1039	
cdmdummy	0.1961	0.2068	−0.2596*	−0.3705*	0.2896*	0.0055	0.5636*	0.0724	−0.0331
	0.0391	0.0310	0.0026	0.0000	0.0008	0.9603	0.0000	0.4224	0.7062
Govern	−0.0820	−0.1578	0.1213	−0.4226*	0.4990*	0.2688*	−0.1022	0.1183	−0.4915*
	0.2837	0.0607	0.0794	0.0000	0.0000	0.0017	0.1400	0.0960	0.0000
regulquality	−0.1416	−0.2270*	0.2280*	−0.2205*	0.4284*	0.4252*	0.0114	0.1475	−0.3225*
	0.0631	0.0066	0.0009	0.0013	0.0000	0.0000	0.8690	0.0377	0.0000
ruleoflaw	−0.0093	−0.0755	0.1576	−0.3935*	0.5465*	0.2349*	−0.0111	0.0822	−0.4031*
	0.9036	0.3718	0.0193	0.0000	0.0000	0.0047	0.8701	0.2367	0.0000
voiceaccount	−0.1640	−0.1998	0.0315	−0.3542*	0.4718*	0.1548	−0.0595	0.1270	−0.5439*

Appendix E. (*Continued*)

	Commitment	Disbursement	lnco2pc	co2inten	lngdppc	enviroexpen	kyotoprot	leftgov	lnpop
	0.0311	0.0171	0.6417	0.0000	0.0000	0.0649	0.3800	0.0670	0.0000
contcorrupt	−0.0521	−0.1188	0.1108	−0.3968*	0.4773*	0.1971	−0.0708	0.1551	−0.4151*
	0.4961	0.1592	0.1013	0.0000	0.0000	0.0183	0.2958	0.0249	0.0000
polstability	−0.0159	−0.1049	−0.0379	−0.3079*	0.2587*	0.2028	−0.2191*	0.1092	−0.6127*
	0.8354	0.2142	0.5761	0.0000	0.0001	0.0151	0.0011	0.1155	0.0000
goveffective	−0.1120	−0.1762	0.1689	−0.4180*	0.4932*	0.1651	−0.1647	0.0245	−0.3764*
	0.1424	0.0359	0.0121	0.0000	0.0000	0.0488	0.0144	0.7249	0.0000

	cdm-dummy	govern	regul-quality	ruleoflaw	voice-account	cont-corrupt	pol-stability	gov-effective
cdmdummy	1.0000							
govern	0.2031	1.0000						
	0.0226							
regulquality	0.1230	0.8839*	1.0000					
	0.1701	0.0000						
ruleoflaw	0.1877	0.9540*	0.8404*	1.0000				
	0.0312	0.0000	0.0000					
voiceaccount	0.1617	0.8908*	0.7771*	0.7863*	1.0000			
	0.0640	0.0000	0.0000	0.0000				
contcorrupt	0.2271*	0.9780*	0.8747*	0.9355*	0.8577*	1.0000		
	0.0088	0.0000	0.0000	0.0000	0.0000			
polstability	0.1766	0.7626*	0.4943*	0.6564*	0.6537*	0.6665*	1.0000	
	0.0429	0.0000	0.0000	0.0000	0.0000	0.0000		
goveffective	0.1258	0.9404*	0.8207*	0.8960*	0.7952*	0.8972*	0.6335*	1.0000
	0.1506	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	

Note: *denotes significance at 1% level.

Appendix F. Determinants of Mitigation Finance: Institutional Variables

Dependent variable: Share of mitigation finance in total ODA (*commitment*), 1998 to 2009, N=113	Coefficient	*t*-statistic	R-squared		
			Overall	Between	Within
regulquality	0.023***	2.607	0.392	0.376	0.404
ruleoflaw	0.031***	2.292	0.464	0.542	0.414
voiceaccount	0.067***	3.675	0.449	0.464	0.422
contcorrupt	0.017***	2.634	0.454	0.558	0.391
polstability	−0.001	−0.077	0.336	0.211	0.395
goveffective	0.005	0.500	0.388	0.391	0.371

Note: lnco2pc, lngdppc, leftgov, environexpen and lnpop are controlled for in all regressions. The *t*-statistics are heteroscedasticity-corrected. *** denotes significance at the 1% level. Time dummies included in all regressions.

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