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The Shift of Development Aid towards Renewable Energy and Energy Efficiency

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Abstract

Since the UN Conference on Environment and Development in Rio 1992, bi- and multilateral donors stress that development assistance has increasingly been oriented towards climate friendly interventions. With respect to energy aid, this should lead to a substantial increase of projects related to renewable energy and energy efficiency. We use the new project-level aid (PLAID) database of over 750,000 aid activities for 21 OECD DAC donor countries to assess whether such a reorientation has indeed taken place. Based on extensive keyword search and hand-coding on the basis of individual project descriptions, we generate a specific coding system for the relevant categories of aid activities.

On this basis, we first present an overview of the change over time using descriptive statistics. The share of renewable energy and energy efficiency projects in total development aid projects fell significantly from the peak reached in 1981 and reached a low in 2005, only returning to 1990s averages in 2008. Thus a reorientation of aid due to climate change reasons clearly has not taken place. However, differences between individual donors are huge. The climate policy pioneers Germany, the Netherlands, Norway and Sweden show aid peaks both linked to oil crises and developments in international climate policy. Austria, Denmark, Finland and Spain started engaging in renewable energy- and energy efficiency-related aid only in the 1990s.

In a second step, we econometrically analyze the politico-economic determinants of observable changes over time. Generally, in times of a high oil price, renewable energy and energy efficiency aid increased. Surprisingly, only the Rio conference mobilized climate related energy aid, while the Kyoto conference was followed by a reduction. Overall, the "old wine in new bottles" hypothesis is partially vindicated.

Key words: Renewable energy, energy efficiency, climate change mitigation, development assistance

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1. Introduction

Since its inception in the late 1940s, development assistance has engaged in building hydropower plants. From the 1970s, it has also tried to improve the livelihoods of marginal populations by off-grid electrification using biomass and photovoltaics, or by improving the efficiency of charcoal stoves. From the late 1980s, it has become clear that such activities contribute to mitigation of climate change as they lower greenhouse gas emissions compared to energy supply based on fossil fuels.

Ever since the Rio conference in 1992, combining development and climate related efforts has been an international objective, embodied in the principle of "common but differentiated responsibilities" (CISDL 2002). In addition, due to the scarcity of real successes, traditional development assistance faced a confidence crisis in the 1980s. Development agencies may thus have been eager to contribute to the new and more fashionable objective of mitigating climate change. The expected trend raised some concerns about the priorities of development assistance (see Michaelowa and Michaelowa 2007).

At the same time, proponents of the climate-change agenda suggest that donor support for climate change mitigation in developing countries is much lower than required and that actual disbursement of climate change related aid pledges is dismal (see Vidal 2009).

Thus, on the one hand, there is the reproach that *too much* climate aid has shifted the priorities of development cooperation away from the central objective of poverty reduction. On the other hand, there is the accusation that despite all promises *too little* aid has been channeled into activities in support of the UN Framework Convention on Climate Change.

Due to the scarcity of reliable data, neither of the two arguments has been seriously tested so far. However, a new "project"-level[1] aid database (PLAID), available to the public since March 2010, now provides a much better source of information on the development of aid activities in this field (AidData 2010). Based on individual project descriptions, we code over 750,000 aid activities of 21 OECD DAC donors with respect to their relevance for specific types of energy efficiency and renewable energy. On this basis we then assess the following questions:

- Has there been a real change in development activities towards a greater emphasis on renewable energy and energy efficiency?
- And if so, what are the major drivers of this effect? Has the change come about as a consequence of the international treaties on climate policy or, more generally, of a stronger environmental consciousness in donor countries? Or is it primarily related to traditional factors driving decisions in development policy, and therefore unrelated to public opinion or green political ideology?

In Section 2, we develop the conceptual framework of this analysis based on the idea that the relevance of renewable energy and energy efficiency projects could be driven either by the same traditional factors as ever ("old wine" / business as usual) or by the effect of international climate policy agreements since Rio, and by environmental preferences of donor country citizens and governments. In Section 3 we describe the new PLAID dataset, our coding procedure for aid related to renewable energy and energy efficiency, and the political-economic variables we additionally considered. Section 4 provides an initial empirical assessment based on descriptive statistics. Section 5 finally brings all arguments together in an econometric analysis and Section 6 concludes.

[1] Note that "project-level" refers to any kind of individually reported aid activity, not only actual projects but also budget support, program support, feasibility studies etc. In the context of this paper, this distinction is irrelevant and for ease of exposition, we will use the terms "project" and "aid activity" interchangeably.

2. Old wine or political impact of greener preferences in the post-Rio era? – A conceptual framework

In order to distinguish between "business as usual", and change in sectoral aid allocation related to the Rio summit and post-Rio environmental preferences of donor country citizens and governments, we develop a general framework encompassing both parts of the argument.
The "old wine" or "business as usual" argument suggests that either nothing changed at all after 1992, or, if something changed, this should only be in relation to factors that drove such change already before 1992. In the context of aid, a typical determinant of any given donor's sectoral allocation is typically a certain comparative advantage in the sector. In our context, we would thus expect donors with relatively strong renewable energy sectors or strong know how in energy efficiency to be particularly active in these fields, independently of the implications of the Rio summit or related environmental preferences. In addition, aid policy traditionally reacts on global economic trends that influence economic development. Since energy supply is considered vital for development, oil prices are one important factor considered in this context. As a consequence, we expect that throughout our measurement period, high oil prices should have increased donors' support for renewable energy and energy efficiency.
The alternative policy change argument suggests a direct or an indirect impact of the Rio summit with its agreement on the UN Framework Convention on Climate Change (UNFCCC) and the following (and still ongoing) international negotiations on the mitigation of climate change, which led to the signing of the Kyoto Protocol in 1997 and its entry into force in 2005. Any direct impact should be reflected in a clear difference between sectoral aid allocations before and after 1992, 1997 and 2005. An indirect effect could work via these negotiations and subsequent debates shaping public and government's preferences in donor countries. In this case, we should expect changes in aid allocation to follow changes in donor government composition, or, alternatively, in voters' preferences as expressed, e.g., in their vote share for environmental parties.
In this context, it is assumed that environmental policy has become such a prominent part of international and national policy debates that it may be relevant for electoral decisions. This is indeed confirmed by other studies (see Michaelowa and Michaelowa 2010, List and Sturm 2006, Blanke 2002). Hicks et al. (2008, p. 160) speak of a "political market for environmental aid in wealthy countries" and argue that "this market is shaped by the preferences of voters within each country".

We can resume the above discussion by two sets of hypotheses:

(a) "Old wine" model
H1: An increase in a donor's comparative advantage in renewable energy and energy efficiency leads to more aid into the respective sectors.
H2: An increase in oil prices leads to more aid for renewable energy and energy efficiency.

(b) Policy change model
H3: With every new international climate policy agreement donors increase their aid for renewable energy and energy efficiency.
H4: Greener donor government preferences lead to higher aid for renewable energy and energy efficiency.
H5: Greener public preferences in donor countries lead to higher aid for renewable energy and energy efficiency.

3. The data

Our dependent variable is the share of renewable energy or energy efficiency projects in total aid. We calculate this share both in terms of project numbers and in terms of financial commitments. All aid data is retrieved from the new PLAID database (AidData 2010) whose detailed project descriptions enables us to specify projects according to all relevant project categories. The donors' own coding as reported to the DAC is far too general and rather imprecise (cf. Timmons et al. 2008, Michaelowa and Michaelowa 2010), so that it cannot be used in this study.

Our coding procedure was based on the following three steps:

First, we decided about a comprehensive list of keywords relevant in the context of climate change mitigation (i.e. both, renewable energy and energy efficiency). These keywords were derived from project types found in the Clean Development Mechanism (CDM) as listed by UNEP Riso Centre (2010). These keywords include: energy, fuel switch, methane, carbon capture, industrial gas, HFC, N_2O, PFC, SF_6, afforestation, reforestation, forestry, transport, renewable, biomass, geothermal, hydro, solar, photovoltaic, wind, power, landfill, composting, waste, stove, charcoal, retrofit, rehabilitation, cogeneration, electricity, boiler, heating, flaring, steam, efficiency, manure, and biogas. This keyword search led to an overall output of over 30 000 projects potentially relevant for mitigation.

Second, we manually assessed the actual relevance of these projects. This procedure led us to delete the vast majority of the above projects because the keywords appeared in a context unrelated to mitigation activities.

Third, we double checked the mismatches between our coding and the more general donor coding for climate change mitigation related projects available since 1995 to verify that no project was omitted in our coding simply for having escaped our initial mechanical search procedure. This led us to reconsider a total of 8 854 projects which did not previously appear in our list of climate-relevant projects. Where necessary, our own mitigation codes were revised accordingly.[2,3]

The explanatory variables are drawn from different sources. Oil prices are obtained from Energy Information Administration (2010a). Donor's comparative advantage in renewable energy is drawn from a variety of sources for wind, hydropower, geothermal and photovoltaics (see Appendix 1). Green public preferences in donor countries are measured as the percentage of green seats in national parliaments (Armingeon et al. 2008). Finally, environmental preferences of the donor government are proxied by the index of cabinet composition developed by Schmidt (1992) and updated by Armingeon et al. (2008). The index takes on values from 1 (hegemony of right-wing and center parties), to 5 (hegemony of social-democratic and other left parties). As ecological preferences are only imprecisely reflected on a left-right dimension (Knill et al. 2010, p. 304), the ideal indicator would more closely reflect party positions (e.g., the indicator based on the assessment of party manifestos by Cusack and Engelhardt 2002), but such data is not available for the whole time period under consideration.

To reflect direct policy change in response to international agreements we construct dummy variables for the periods from 1992 (post Rio), from 1997 (post Kyoto), and from 2005 (post Kyoto ratification) onwards.

[2] Roberts et al. (2008) and Roberts, Weissberger and Peratsakis (2010) use more sophisticated coding methods based on a sub-sample of projects and machine based recoding using a learning algorithm. We could not follow their procedures because we required information on all projects and detailed sub-categories within very limited time. However, the order of magnitude for the share of projects in the overall mitigation category seems to correspond between their approach and ours.

[3] For further details on our coding procedure, see Michaelowa and Michaelowa 2010, Appendix 1.

Before considering all these variables jointly in a multivariate regression model, we will now first look at the development of aid for energy efficiency and renewable energy over time, and see, whether this directly suggests certain relationships.

4. Renewable energy and energy efficiency in the PLAID database since 1970 – an overview

Considering all mitigation projects jointly, we cover the overall development of aid for renewable energy and energy efficiency. Figure 1a shows mitigation projects as a share of overall projects while Figure 1b shows the corresponding shares in terms of commitments.[4] We add another time series for the development of oil prices in Figure 2. Comparing Figure 1a and 1c it is directly evident that projects contributing to the mitigation of climate change show a distinct peak during the second oil shock 1979-1985. It appears plausible that during this period renewable energy projects became fashionable to reduce the oil import bill of developing countries. After the oil price crash in 1986, project inflow remained stable throughout the 1990s, before decreasing with a certain lag after the oil price low of the late 1990s.

At the same time, there is no visible impact of the climate policy decisions of the 1990s such as the signing of the UNFCCC in 1992, its entry into force in 1994 and the signing of the Kyoto Protocol in 1997. Even after the entry into force of the Kyoto Protocol in 2005, and the debates about massively increasing financial flows to developing countries in the run-up to the Copenhagen Conference in late 2009 mitigation project shares did not rise significantly above the level of the 1990s.

In terms of commitments, inter-annual variability is much larger due to “lumpy” large projects (see Figure 1b). Still, two peaks during the second oil shock and the mid-1990s – which might be linked to the Rio Summit and UNFCCC entry into force – can be distinguished. However, just like in the case of project numbers, there is no long-term increase in mitigation-related assistance, a fact that rather supports the thesis of “old wine”. Overall, mitigation projects are larger than the average development assistance project.

To see which changes happened in detail, we will now proceed with a more fine-grained assessment of projects according to different categories. In order to avoid the dominance of single large projects in our graphical representation, we thereby focus on project shares. We also expect that aid agency staff may concentrate on specific aid activities within their reach, rather than to optimize overall expenditure related to climate policy. If this is true, it should be easier to explain project shares than shares in overall aid commitments.

4.1 Renewable energy

We start with a discussion of hydro and geothermal power, technologies that have been mature for a long time. After covering those, we look at more novel technologies, many of which were initially developed in industrialized countries as a reaction to the two oil shocks of the 1970s/1980s.

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[4] It does not make sense to consider absolute numbers here, because both project numbers and financial volumes have considerably increased over time. Overall commitments covered by the PLAID have increased from 20 billion USD (const. 2000) in 1973 to almost 100 billion in 2008.

Financial volumes can be measured only in terms of commitments, not in terms of disbursements, since, at least at project-level, this variable has too many missing values in the dataset. Since the 1990s, aid reporting shows a tendency to split large projects in many smaller ones.

Figure 1: Overall development of mitigation aid over time

Figure 1a: Share of climate change mitigation projects in total aid projects

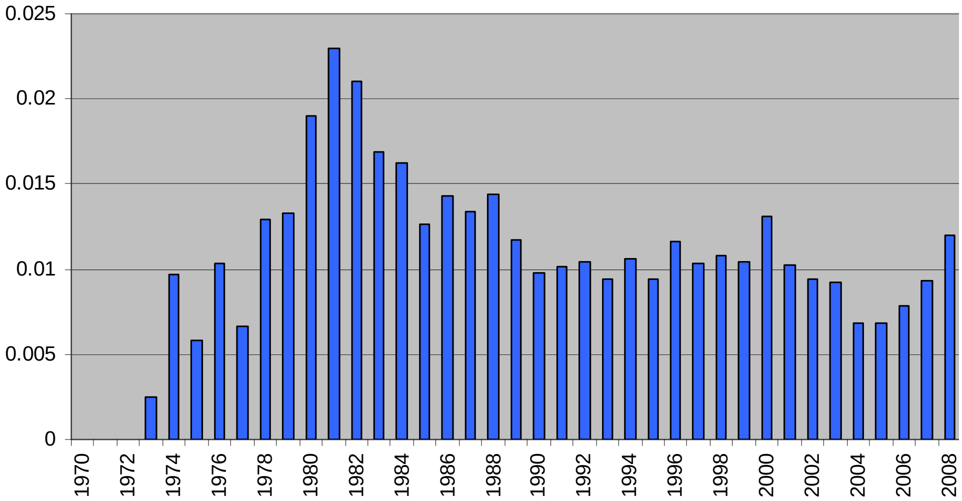
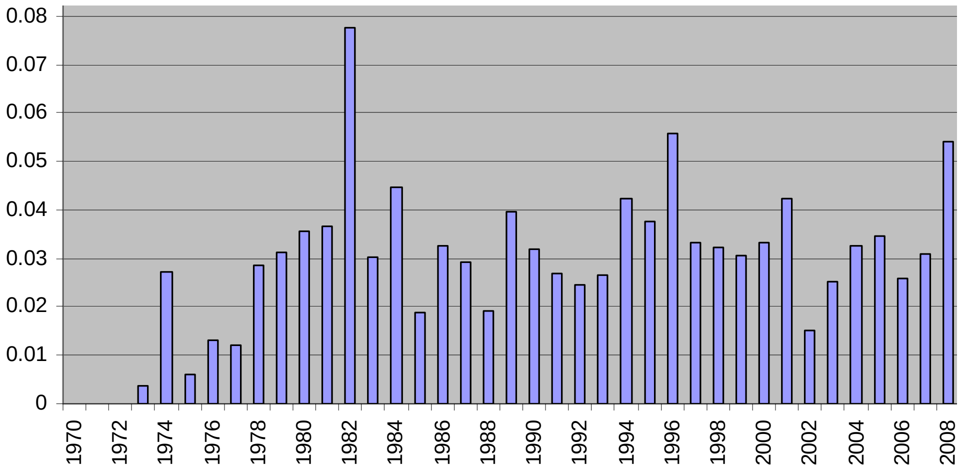
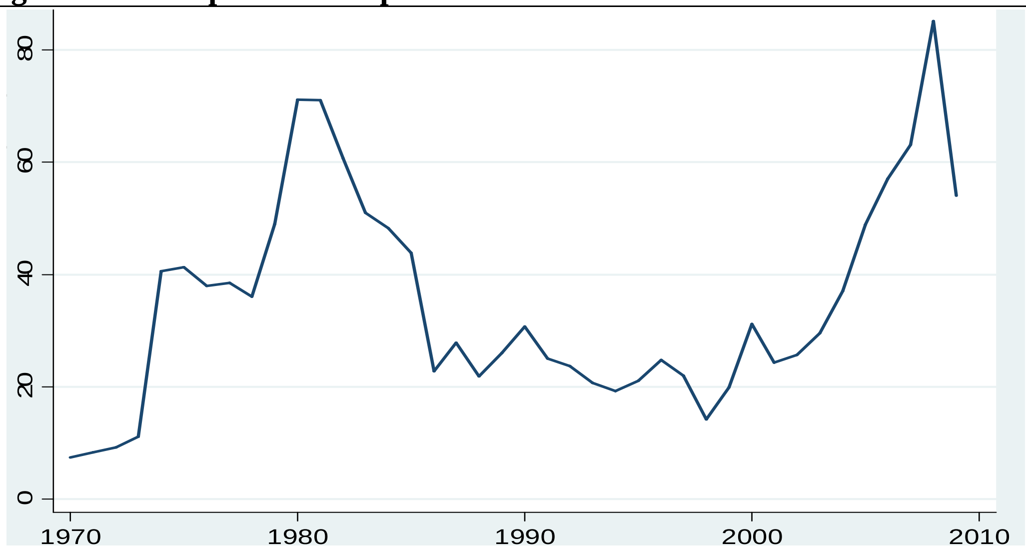


Figure 1b: Share of mitigation projects in overall commitments



Source: AidData (2010), authors' coding.

Figure 2: Development of oil prices[1]



[1] In const. 2005 USD. For details see Annex 1.

Source: Energy Information Administration (2010a).

It seems that the second oil shock led indeed to a scramble for renewable energy in development assistance, epitomized by the United Nations Nairobi Conference on New and Renewable Sources of Energy in 1981. The conference proposed a 5 billion USD program for non-hydropower renewables just for feasibility studies, research and other pre-investment activities. This never materialized due to the oil price reduction starting in 1986. By the late 1980s, many donors had become disillusioned and many aid recipients had come to view renewables as second-class technologies that industrialized countries were unwilling to adopt themselves (Kozloff and Shobowale 1994). However, new renewables have seen a real upswing since the 1990s in which climate policy may have played an important role. In addition, the third oil shock of the mid 2000s appears to be relevant as a driving force.

Commercial hydropower exists for over 100 years and dominates electricity generation in a large number of countries. In the 1950s and 1960s, large dams were seen as panacea to mobilize energy that would then automatically lead to industrial development. These expectations were however often disappointed. One of the most famous examples is the Akosombo dam on the Volta river in Ghana completed in 1966. Darden Graduate School of Business Administration, University of Virginia (1999) nicely describes how Ghana suffered from the dam in many respects. Ghana financed 40% of the total dam and aluminum smelter cost of 250 million USD directly from the budget and another 40% were covered by loans from a variety of sources. Two thirds of the electricity was sold to an aluminum company at the derisory tariff of 0.26 c/kWh for a period of 50 years despite the recommendation of the World Bank to fix the tariff at 0.45 c/kWh (Faber 1990). Due to the strong hydrological variability, there was no firm power available for local industrial development and Ghanaian development failed to take off.

It seems that the mixed experiences with hydropower did, however, not deter donors to push hydro projects during the second oil crisis as the only large and technologically mature electricity generation alternative to fossil fuels (see Figure 3a). Since the late 1980s, hydro projects have been attacked by NGOs due to their negative consequences for the local population, with strong resistance focusing on dam projects in China (Three Gorges), India (Narmada) and Brazil (Amazonian dams like Tucurui). Moreover, environmentalists started to worry about methane emissions from rotting tropical biomass flooded by reservoirs (Fearnside 2002). An often overlooked but key reason for the decline of hydro projects was that power generation costs of fossil power plants fell from the 1980s onwards (IEA and NEA 2005 and 1998) while hydropower costs tended to increase. After the World Commission on Dams (2000) recommendations that managed to reduce the conflicts between dam builders and the local population, a stabilization of project inflow has been seen, albeit on a very low level.

Geothermal energy has been exploited commercially in Italy for over a century and in New Zealand and the US since the Second World War. As it requires volcanic heat, its application in developing countries has been concentrated in South-East Asia. The oil shocks of the 1970s and 1980s triggered large interest, as the technology could immediately be implemented on a large scale (see Figure 3b); with 56% it got the lion's share of funding for non-large hydro renewables in the period 1979-1991 (Kozloff and Shobowale 1994, p. 18). With the fall in oil and coal prices, geothermal power became uncompetitive. After the 1990s, the demise of the Suharto government in Indonesia, which had actively pushed geothermal development despite high costs (Waldman and Solomon 1998) led to a near freezing of project inflow.

Figure 3: Traditional renewable energy

Figure 3a: Hydro projects as a share of all aid projects

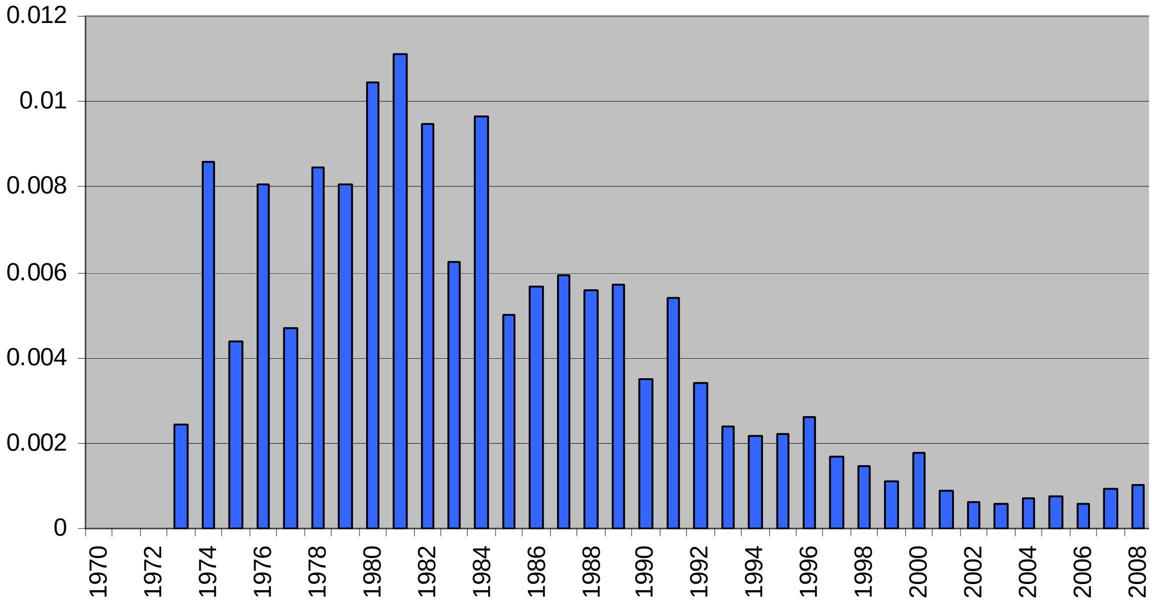
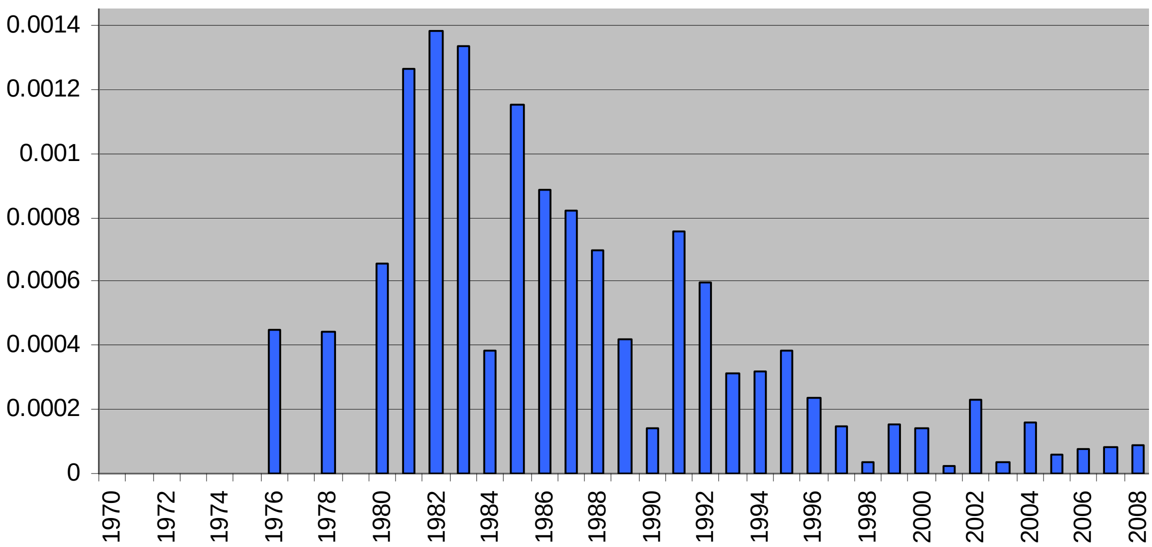


Figure 3b: Geothermal projects as a share of all aid projects



Source: AidData (2010), authors' coding.

Solar energy is a decentralized energy form well suited for development of remote rural areas, if maintenance can be assured. As immediately evident from Figure 4a, it also benefited from the alternative energy push during the second oil crisis, but suffered from high costs and low performance. Therefore, it dwindled after 1986. Technological improvements with a concurring decline in costs led to a re-emergence from the mid-1990s. After the Rio Conference of 1992, a remarkable increase took place, which petered out in the late 1990s.
Wind power development for small applications started in the 1980s (see FigureFigure 4b). At this time, it was seen as rural development policy and did not really depend on oil prices, thus remaining at a high level until 1990. When the Danish and German development of wind technology led to robust large-scale wind turbines for electricity generation, a second peak of project development started in the mid 1990s where it almost reached the level of solar

projects. Since then, project inflow has decreased as wind power has become a large industry that is fully commercial with revenues from the Clean Development Mechanism (CDM).

Figure 4: Solar and wind

Figure 4a: Solar projects as a share of all aid projects

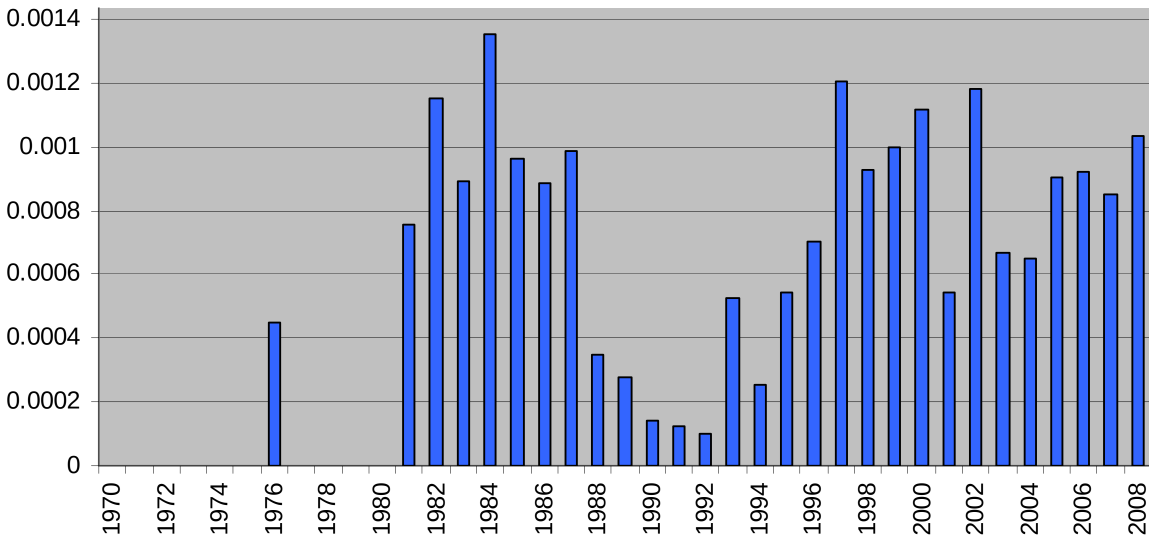
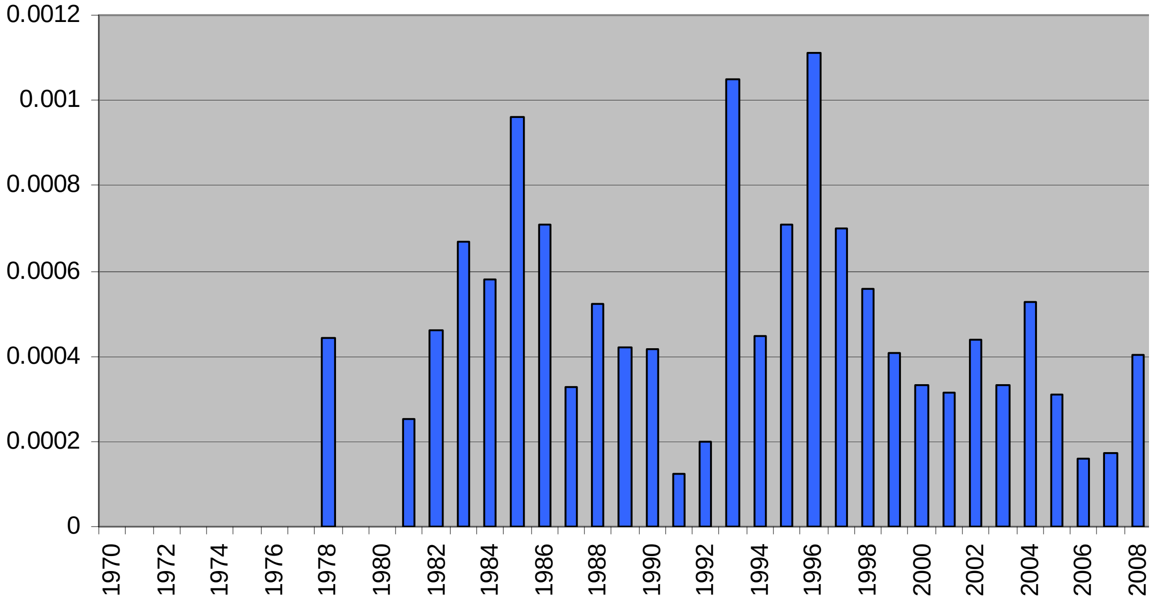


Figure 4b: Wind projects as a share of all aid projects



Source: AidData (2010), authors' coding.

Biomass power was part of the generic renewable energy upswing during the second oil crisis, but lost lustre after the oil price crash in 1986 (see Figure 5a). During the 1990s, successes with bagasse cogeneration in Brazil (Coelho and Bolognini 1999) led to renewed attempts to promote agricultural residue-based power plants. Moreover, by the 1990s the technology was fully mastered and could guarantee performance (Purohit and Michaelowa 2007). The slowdown in the first half of the 2000s cannot be attributed to any specific event. Maybe the availability of the CDM as alternative source of finance led to a reduction of the donors' willingness to support a technology that was seen as commercially viable with CDM revenues. Overall numbers of biomass projects were historically lower than for the other renewable energy types, but are now at par with wind.

Biogas plants are a modular technology with strong rural development benefits. The focus on alternative energy in the context of the second oil crisis in the 1980s triggered initial activities, but performance often was a problem and thus project numbers fell (see Figure 5b). Only very recently, an increase to 1980s levels could be observed. Overall project numbers are several times smaller than for other renewable energy technologies.

Figure 5: Biomass and biogas

Figure 5a: Biomass projects as share in all development assistance projects

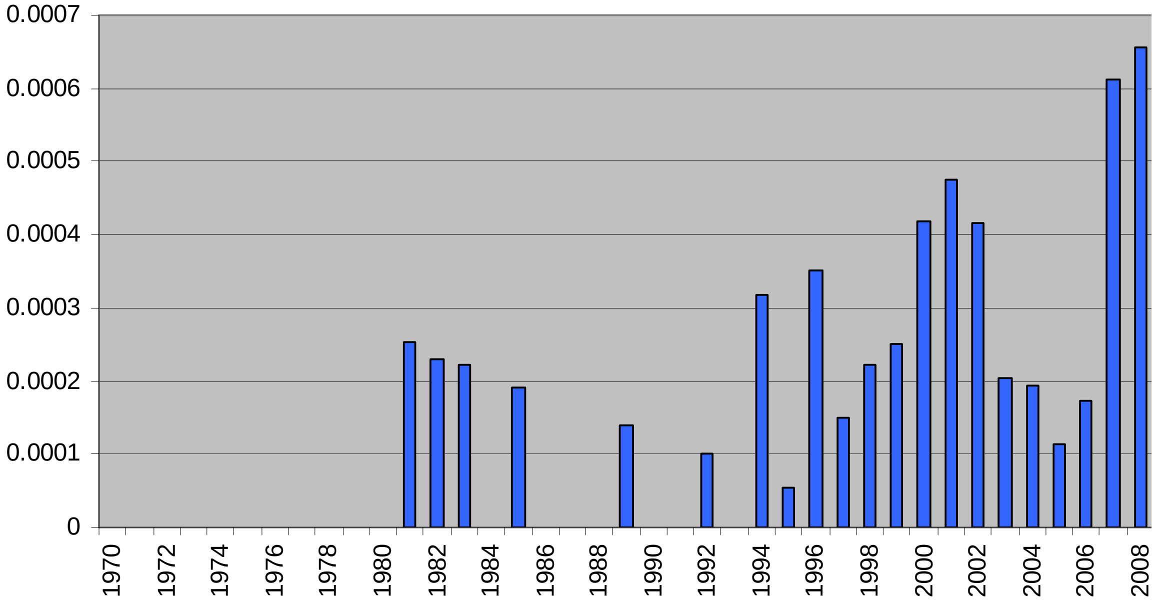
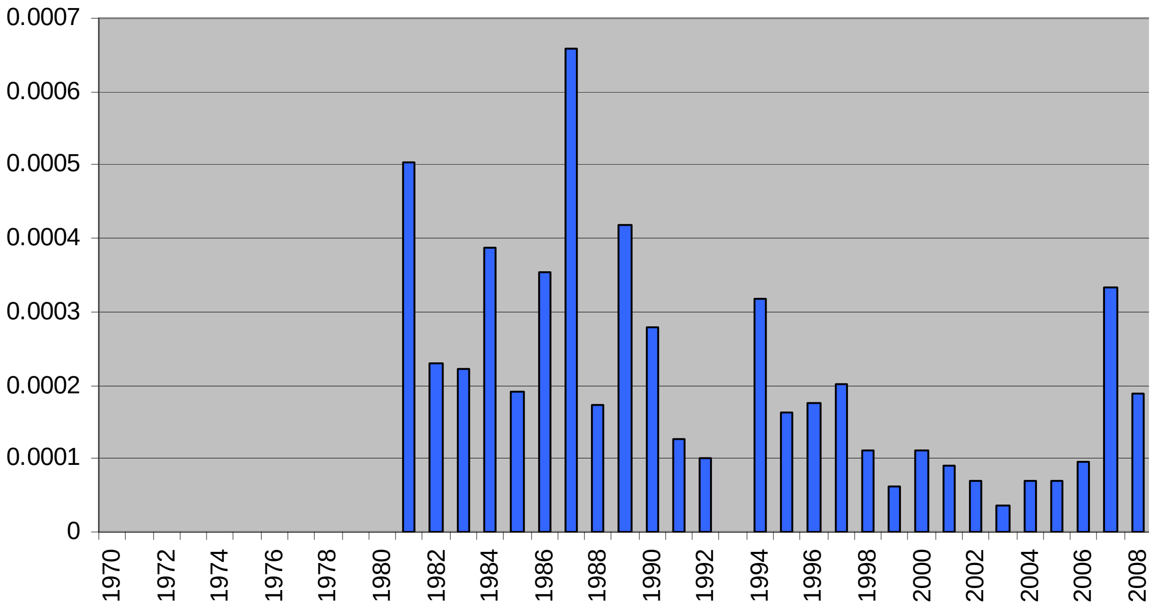


Figure 5b: Biogas projects as a share of all aid projects



Source: AidData (2010), authors' coding.

Other renewable energy projects are even more recent. Landfill gas projects focus on advanced countries that have a development level sufficient to ensure a coordinated waste management strategy; landfills need to be lined and delivery of organic waste ensured. As their energy benefit is relatively small but the greenhouse gas benefit large due to the high warming potential of methane, they have only been discovered since the Kyoto Protocol. After it became clear since 2005 that the CDM would generate sufficient revenues to mobilize landfill projects, donor interest decreased. Many of the projects do not generate energy but just flare the methane. Project numbers are comparable to those for biogas (see Figure 6a).

Finally, there are also cross-sectoral projects that address renewable energy in general, such as support in developing incentives for renewable investments, resource measurements and multi-technology activities. They had their first great upswing during the second oil shock, when alternative energy was seen as the answer (see Figure 6b). But initial high expectations were disappointed when performance problems plagued the projects. Nevertheless, projects continued to come in, albeit on a lower level. Only after signature of the Kyoto Protocol a significant increase is visible. The third oil shock appears to have triggered a further increase, reaching a value double that of the largest single-technology category.

Figure 6: Other renewable energy and combined projects

Figure 6a: Landfill gas projects as a share of all aid projects

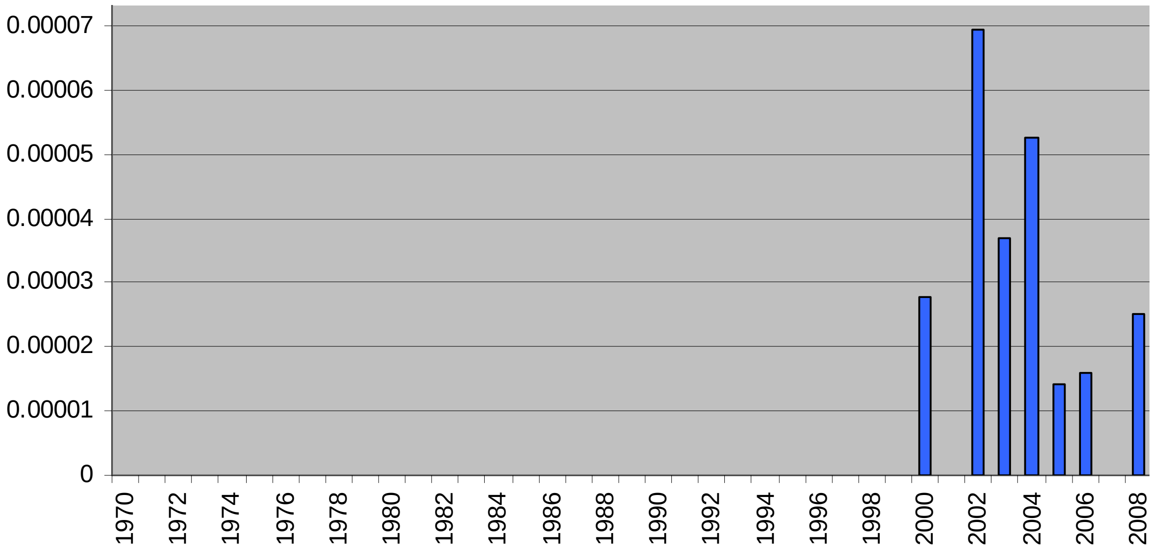
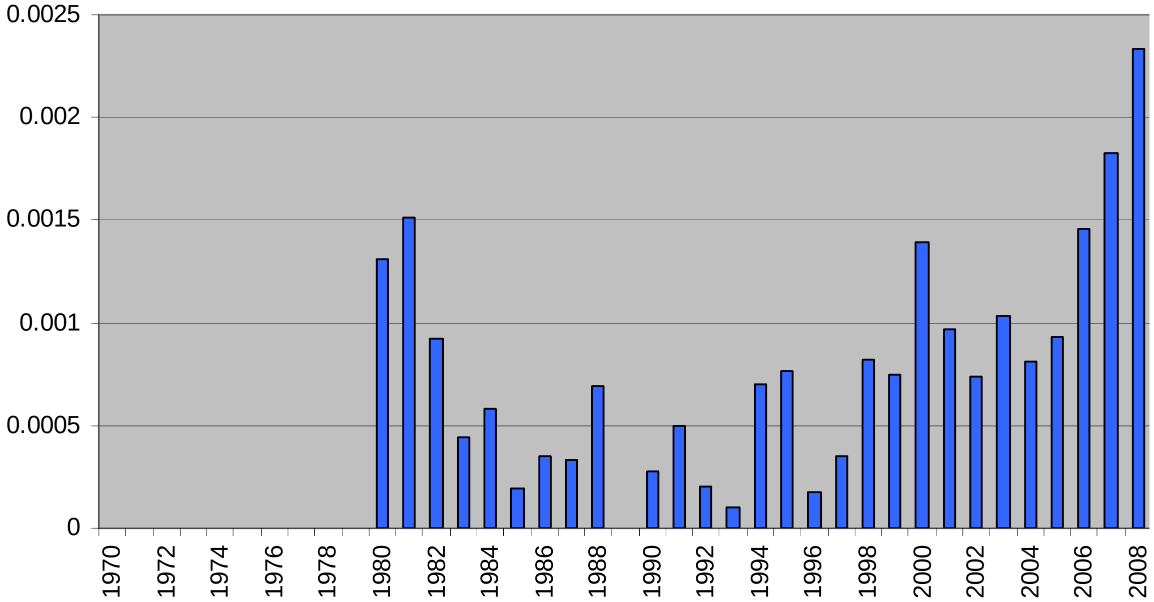


Figure 6b: Renewable energy cross-cutting projects as a share of all aid projects



Source: AidData (2010), authors' coding.

4.2 Energy efficiency

It is not easy to obtain a comprehensive overview of energy efficiency projects because they can occur in many different guises. We focus on key technologies, such as power plant rehabilitation, cogeneration and cookstove efficiency.

Efficiency improvement in power generation and industry requires specific engineering expertise which is usually not prevalent in development assistance administrations. In general, such measures have very low costs but face numerous commercial and political barriers as well as split incentives – i.e. a commercially attractive project is not undertaken because the tenant benefits but the landlord would have to undertake the investment. In the mid-1990s, large energy efficiency projects were fashionable due to the end of the cold war and the related market transformation activities in many formerly socialist countries (see Figure 7a). However, the gap in the early 2000s is difficult to explain. Maybe donors thought that rising oil prices would mobilize efficiency improvements without any need for donor involvement. Project volumes have reached a level comparable with the larger renewable energy categories. Cogeneration projects are large and only make sense in relatively advanced countries with a substantial industrial activity. They were completely absent before the 1990s and focused on countries in transition in the post-communist period (see Figure 7b). They thus can be seen as less linked to development assistance, than as climate mitigation without any effect on poverty alleviation strategies. Overall project numbers have remained very small.

As opposed to cogeneration, cookstove efficiency improvement projects can be nicely integrated into integrated rural development strategies in very poor countries, particularly Sub-Saharan Africa. They were very fashionable in the 1980s (Hyman 1987), before performance problems with the many competing stove designs led to a "hangover" (see Figure 7c). After the success of the Kenyan "Jiko" stove, of which over 2 million were sold through private entrepreneurs during the 1990s (Theuri 2005), stove projects picked up again from 1999, especially given their substantial CO_2 reduction contribution at low cost. But they have not reached their former peaks, probably due to an increase of competing NGO activities and a tendency to operate them on a private business model (Bailis et al. 2009). Project numbers have reached less than half of the average of renewable energy technologies with the exception of the "fashion period" in the mid-1980s.

4.3. Some preliminary conclusions

The detailed discussion of individual project types shows that not all of them have evolved in the same way. Differences are related to technological development and to the extent to which certain technologies have been seen as cost-efficient substitutes for other energy sources. At the same time, we observe trends that seem to be related to certain fashions and even to the success of specific marketing campaigns. Overall, the oil price appears to play a dominant role leading to distinct peaks of project shares in the early 1980s for virtually all renewable energy and energy efficiency projects, except for those which were simply not known at that time. This provides strong support for the related "old wine" hypothesis. At the same time, only a few projects types also show trends that coincide with the development of international climate policy and are thus consistent with a certain political drive generated by the Rio and Kyoto conferences.

In the following section, we will see whether, as a whole, these global political developments have a significant effect. In addition, we will examine whether we can observe any effect of political developments at the national level in donor countries. With respect to the *"old wine"* model, we will more systematically examine not only the relevance of the oil price, but also the relevance of any given donor's comparative advantages.

Figure 7: Energy efficiency

Figure 7a: Efficiency projects as a share of all aid projects

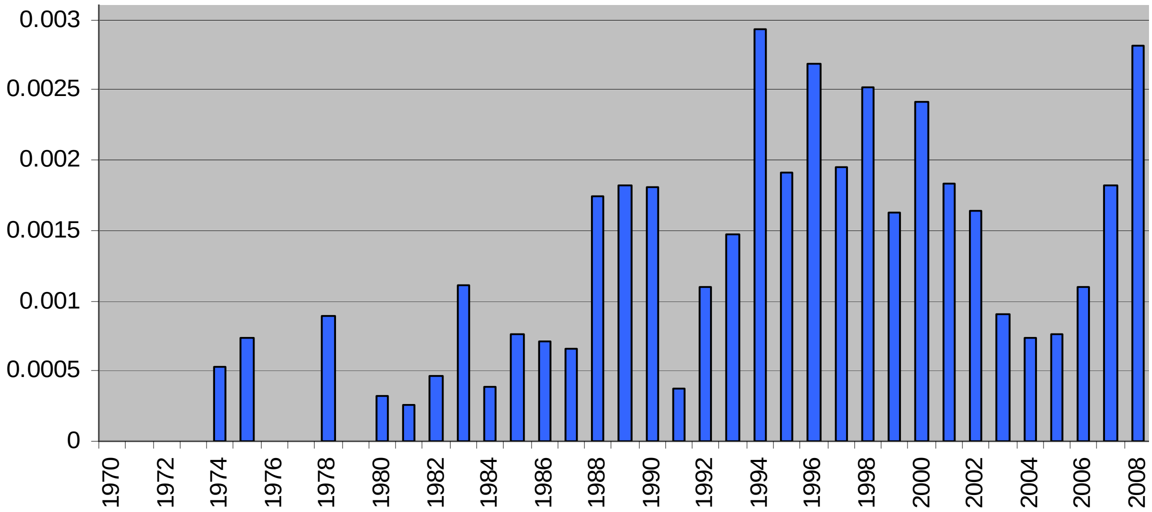


Figure 7b: Cogeneration projects as a share of all aid projects

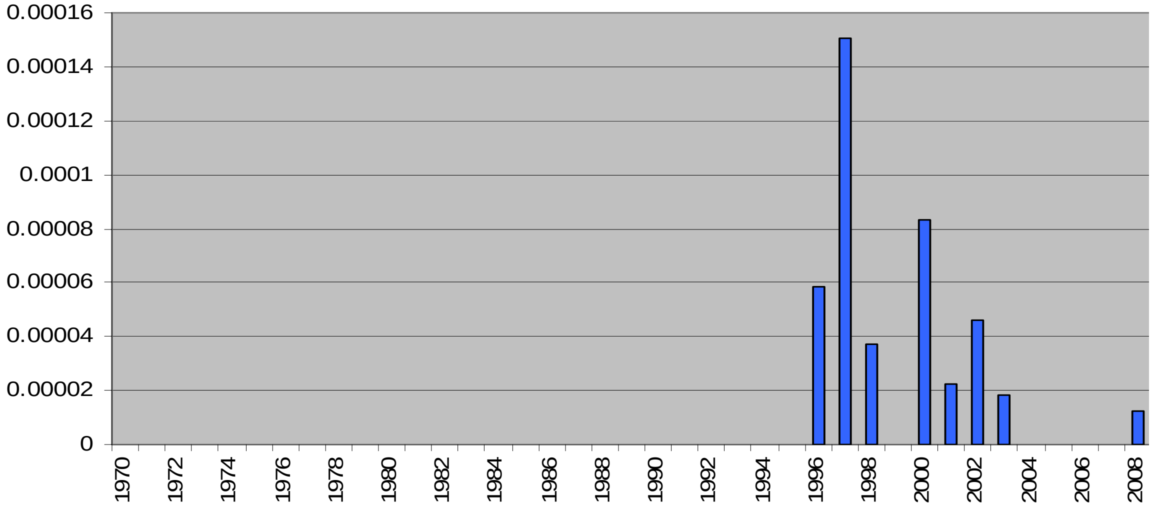
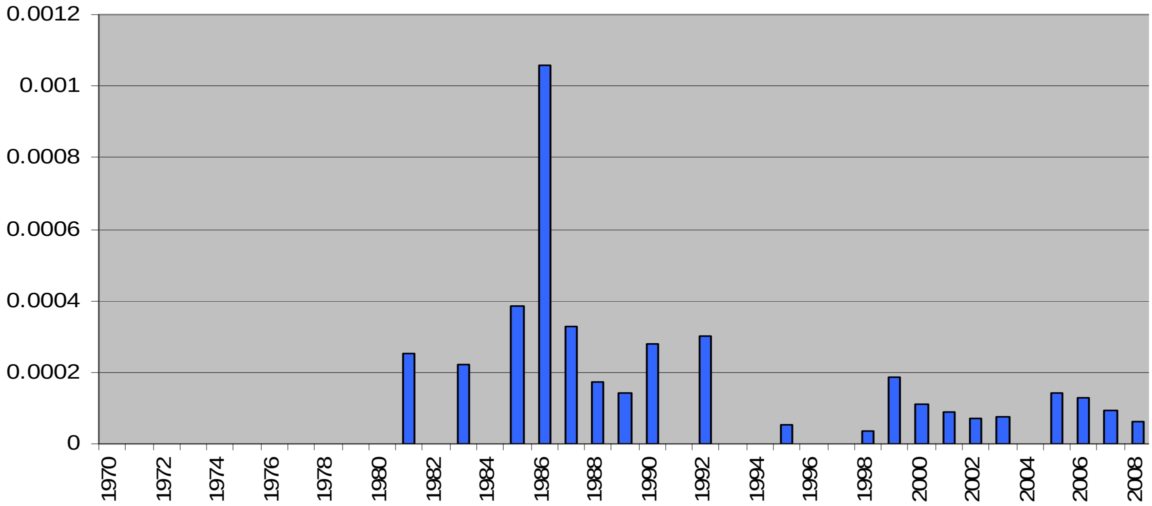


Figure 7c: Cookstove efficiency projects as a share of all aid projects



Source: AidData (2010), authors' coding.

5. Econometric analysis

The regression analysis is carried out for all renewable energy and energy efficiency projects (i.e., in fact, all mitigation projects) jointly because the sub-sectors considered above may partially be a substitute for each other when governments try to adjust their aid budgets to policy change or change in traditional determinants such as the oil price.

As their can be no negative project shares, the data are censored at zero. One option to econometrically deal with this type of data is to use a tobit model. Results of this estimation are shown in column 1 of Table 1. However, the tobit model is problematic when the general decision about aid activities in the area of mitigation ("selection equation") is not driven by the same determinants as the decision on project numbers or actual aid volume given that mitigation aid is non-zero ("allocation equation"). To find out whether such problems may be present, we also present the selection and the allocation equation separately (columns 2 and 3 versus columns 4 and 5). The analysis shows that for certain variables, the coefficients do show the opposite signs (compare, e.g., the coefficients of Regression 3 and Regression 5 for solar production). This leads us to prefer the separate estimations.

In addition, a Hausman test strongly suggests the use of donor fixed effects to avoid bias. This also favors the separate estimation of the selection and the allocation equation since the tobit model is based on a random effects approach.

Unfortunately, estimating the selection equation separately with a logit fixed effects approach also creates problems. First, we may face an incidental parameter problem. Circumventing this problem through the use of a conditional logit would make us lose a substantial amount of observations since year to year changes from zero to positive mitigation project numbers are not very frequent. However, as our time series is relatively long (covering almost 40 years), the potential inconsistency implied by a standard fixed effect logit model should be rather limited.

Second, and more difficult to solve here, is the fact that the standard logit model explains our results too well. Out of 780 donor/year observations, it completely determines one failure and 68 successes. This generated some instability in the estimation and made it impossible to compute marginal effects at the mean of the explanatory variables.

To be sure our results are meaningful we thus also carry out a simple OLS fixed effects regression for the selection equation. This linear probability model is shown in Regression 3.

Finally, we present two different allocation equations limiting the sample to those observations with non-zero values of mitigation aid. The first of these (Regression 4) uses our key dependent variable, namely the share of mitigation related projects within overall aid. The second (Regression 5) uses the share of commitments rather than the share of individual aid projects. Based on our discussions in Section 4, which points to a reaction of donors through new projects rather than higher volumes, we would expect this last regression to have less explanatory power than Regression 4.

All explanatory variables relating either to the "old wine" model or the policy change model are included simultaneously in the regressions in order to avoid omitted variable bias.

Results in all regressions related to project numbers clearly confirm the significance of the oil price. Considering the results of equation 2 and 3 implies that an increase of the oil price by 10 USD leads to a 7% higher probability for mitigation aid, and to an increase in the project share of mitigation projects by 0.15 percentage points. Considering that the average project share is only 1%, this increase is substantial.

As could be expected from the visual analysis of Figures 1b and 2 in Section 4, no such effect is observed for mitigation related commitments.

With respect to the other "old wine" variables, the picture is less clear. The indicators of donors' comparative advantage in different renewable energy sectors tend to have the expected positive effect for the decision whether at all to provide mitigation aid, but are less clearly significant in the aid allocation equations. This is true, in particular, for hydro power, where the donor's home country experience with the technology seems to have a strong impact on the country's decision to provide some aid in the area, but does not seem to drive the decision on either the number of projects or the financial volume committed. In the allocation regression of project shares, only the donors' capacity in wind energy, and in the regression of commitment shares, only the donors' production of solar energy turns out to be significant.

Table 1: Determinants of mitigation aid

Dep. Var.	Regression 1 Tobit Mitigation project share		Regression 2 Logit, FE Dummy for Mitigation project share>0		Regression 3 OLS, FE Dummy for Mitigation project share>0		Regression 4 OLS, FE Mitigation project share (for share>0)		Regression 5 OLS, FE Mitigation commitment share (for share>0)	
"Old wine"										
Oil price	0.000446	**	0.055	**	0.0073	**	0.000156	*	0.000072	
	(0.00)		(0.00)		(0.00)		(0.02)		(0.62)	
Capacity hydro	0.000174		0.369	**	0.0152	**	-0.000012		-0.000451	
	(0.21)		(0.00)		(0.00)		(0.97)		(0.47)	
Capacity wind	0.000001		0.004	*	0.0000		0.000001	*	0.000001	
	(0.26)		(0.01)		(0.79)		(0.02)		(0.23)	
Capacity geothermal	0.000004		0.040	*	0.0002	*	0.000000		-0.000002	
	(0.29)		(0.01)		(0.01)		(0.99)		(0.79)	
Production solar	-0.000036	*	0.026		-0.0005	*	-0.000019		0.000058	*
	(0.01)		(0.92)		(0.03)		(0.06)		(0.01)	
"Policy change"										
post RIO	0.019321	**	2.799	**	0.3471	**	0.004223		0.001143	
	(0.00)		(0.00)		(0.00)		(0.09)		(0.83)	
post Kyoto	-0.006632	*	1.083		0.0633		-0.010265	**	-0.013824	*
	(0.02)		(0.11)		(0.14)		(0.00)		(0.01)	
post Kyoto ratification	-0.014477	**	-3.418	**	-0.1780	**	-0.007963	*	-0.006786	
	(0.00)		(0.00)		(0.00)		(0.02)		(0.35)	
Green seats	0.001784	**	0.469	**	0.0502	**	-0.000932	*	-0.000293	
	(0.00)		(0.00)		(0.00)		(0.04)		(0.76)	
Cabinet composition	-0.000543		-0.179		-0.0111		0.000292		0.000028	
	(0.37)		(0.08)		(0.22)		(0.61)		(0.98)	
Overall sign. p-value	0.00		0.00		0.00		0.00		0.00	
R^2 (within)					39.93%		12.37%		5.34%	
N	780 (287 censored+493 uncensored)		780		780		493		493	
No of donors	21		21		21		21		21	

Notes: Constant and fixed effects (FE) not shown. P-values in parentheses, ** for coefficients significant at the 1% level, * for coefficients significant at the 5% level.

Turning to the variables of the policy change hypotheses we observe a positive effect of the Rio conference on the decision to provide some mitigation aid. The effect is very strong indicating that from 1992 onwards, the probability that donors would allocate at least some aid to mitigation increased by 35 percentage points (Regression 3). The Rio conference is also reflected in higher project numbers, albeit this effect is not significant at the 5% level (p-value of 9%).

After the Kyoto conference in 1997 and the ratification of the Kyoto Protocol in 2005, however, the trend is reversed. We obtain negative coefficients in almost all regressions, and the negative coefficients for the post-Kyoto dummy are significant in both allocation equations related to project numbers as well as commitments. In fact, the post-Kyoto dummy is one of only two variables significant in the commitment regression. Even more strikingly, the negative coefficients are so high (in absolute terms), that they over-compensate the positive effect of the Rio dummy. It seems as if donors tried to work on an integration of climate change mitigation into aid in the preparation of the Kyoto conference, while considering that enough time and effort was spent on this issue once the conference was over. Global political trends thus appear to play a role, but not always in the way on would expect.

Donors' national political trends towards environmental preferences also do not uniformly show the expected effect. The share of green parliamentarians is positively significant only in the selection equation while it is even negatively significant in the allocation equation. On average, greener donor parliaments thus seem to lead to a higher probability to be active in the area of aid related to renewable energy and energy efficiency, but does not increase the share of projects or commitments. This is in contrast to climate aid *reporting* in this area which was shown to be significantly and positively related to green voting preferences (see Michaelowa and Michaelowa 2010). The presence of left-wing or right-wing governments does not seem to have any effect either.

All in all, looking at the project shares, we find strong evidence for the "old wine" model driven by the oil price variable. We also find evidence for the policy change model, but this clearly works in the expected direction only for the impact of the Rio conference, and even shows a reverse trend thereafter. Local political variables do not show any clear effect.

As expected the explanatory power of the commitments regression is much lower, but even here, we find the negatively significant effect of the Kyoto conference. This is intriguing since it confirms that policy makers do react on global trends, but that large international conferences may sometimes mark the end of the efforts rather than their beginning.

It should be noted, though, that the overall picture drawn here may hide substantial differences between individual donors. While we consider fixed effects, we do not consider interaction terms with the different explanatory variables or individual regressions for each donor (which would be of limited value given the relatively small number of observations by country). Our analysis thereby only shows the effects on average.

Briefly returning to descriptive statistics to assess whether at least some donors show a clearly positive development of climate mitigation related aid along with global policy change, we can identify a few countries who have been traditionally active in development policy, whose governments see themselves as climate policy pioneers, and who indeed show increased activity not only during the second oil shock, but also, at least to some extent, at the time when climate policy became relevant. Germany exhibits a very strong mid-1990s peak – probably linked to the first Conference of the Parties to the UNFCCC held in Berlin in 1995, with minor peaks during the second oil shock and in the late 2000s. The Netherlands have a post-Kyoto peak and a second oil-shock peak. Norway has a late 1980s peak which coincides with a very active period of this country at the international climate policy negotiations. While equally perceived as a strong promoter of climate change mitigation, Sweden shows a peak during the second oil shock that is higher than the late 1990s one, and the country is on the verge of becoming a member of another group of countries with a long-term decline in mitigation aid.

Finally, some countries show no or only rare cases of projects in renewable energy and energy efficiency before the end of the 1980s, but continuous activity thereafter. They include countries with a long history of development cooperation (Denmark and Finland) but also relative newcomers (Austria and Spain). In these cases, it is likely that the rise of climate policy triggered the mitigation aid activities. Graphical illustrations of these country-cases can be found in Annex 2, Figures A1 and A2.

5. Conclusions

In contrast to popular belief and expectations in the scientific literature, the advent of international climate policy in the 1990s did not boost renewable energy and energy efficiency projects in bilateral development cooperation. Overall, the share of mitigation projects in total development assistance projects fell significantly from the second oil shock peak reached in 1981 and reached a low in 2005, only returning to 1990s averages in 2008. The Rio summit comes along with a significant increase in aid related to these projects, but the Kyoto conference in 1997 and the ratification of the Kyoto Protocol in 2005 did not reinforce, but rather reversed this trend.

The share of financial mitigation commitments shows two peaks – one during the second oil shock and one in the mid-to late 1990s. Again, Kyoto seems to have reduced climate related aid rather than to enhance it. This is one of the few variables with a significant effect on commitment shares.

A technology-specific assessment finds a strong decline in “traditional” renewable energy projects such as hydro and geothermal power from their peak in the early 1980s. The “new” renewables such as solar, wind and biomass show twin peaks in the early 1980s and the late 1990s. Only cross-technology renewable energy projects surpassed the early 1980s peak in the mid 2000s. Energy efficiency projects increased substantially until the mid 1990s, but went through a low phase in the mid-2000s.

Donor countries exhibit distinct patterns. Apart from certain countries with little or clearly decreasing engagement in the sector, there are countries like Germany, the Netherlands, Norway and Sweden, where mitigation-related aid does not exhibit a clear trend, but shows peaks related to both, the oil crises and global political developments. Yet another group of countries has started mitigation-related support only since the emergence of climate policy as a major issue in the late 1980s/early 1990s. It consists of Austria, Denmark, Finland and Spain. Only in these cases, it is obvious that really “new” mitigation development assistance has been provided.

All in all, fears that development assistance may have been deviated from its central priorities through a new policy drive towards climate mitigation do not seem to be justified. While the “policy change model” is correct in that international conferences appear to have been turning points for donors’ aid allocation, the turn did not always happen in the expected direction. At the same time, considering the existing aid related to renewable energy and energy efficiency only as “old wine” also appears to be only partially appropriate. Nevertheless, the single most robust variable in explaining the change of renewable energy and energy efficiency over time is the oil price – independently of any change in global or national environmental preferences.

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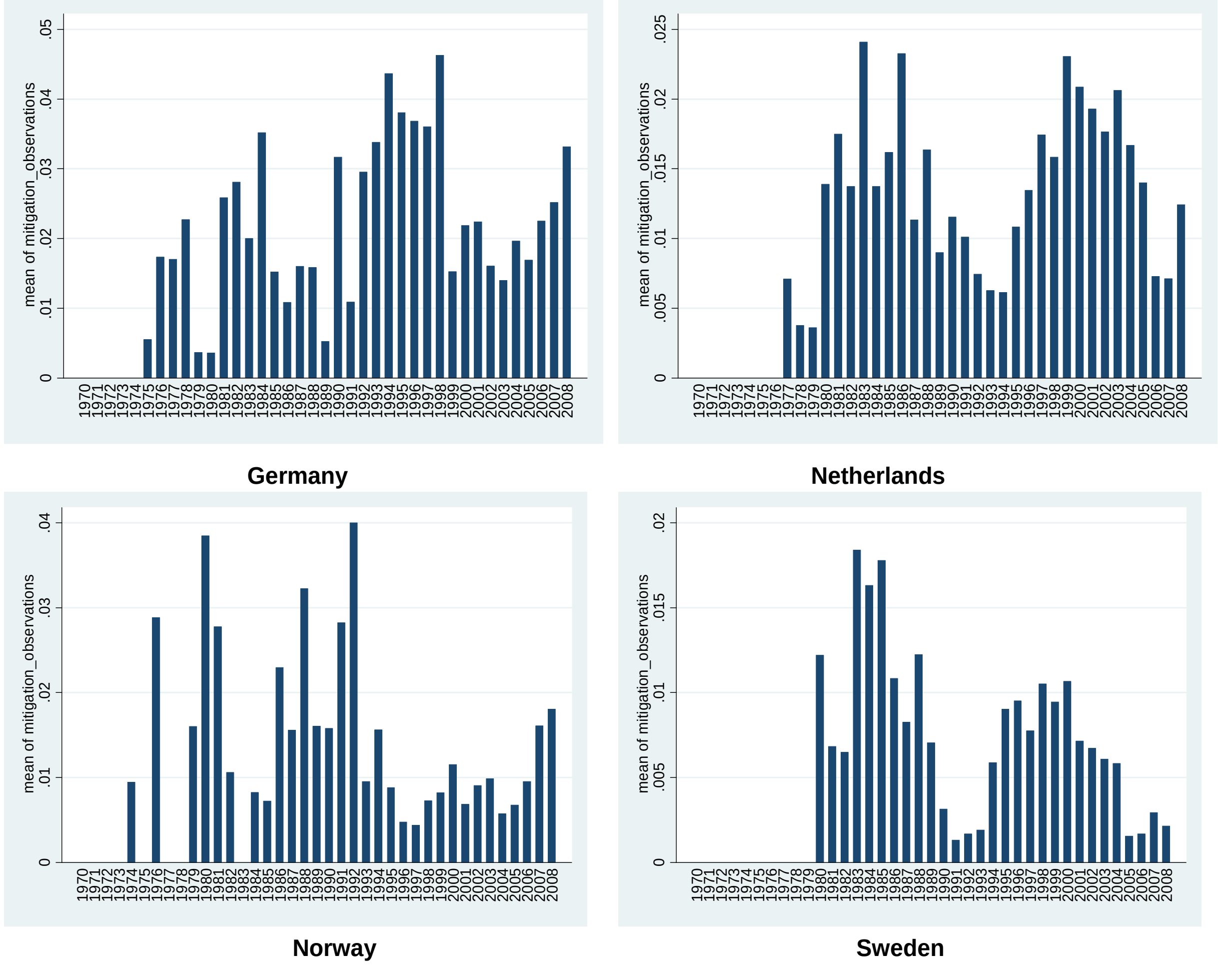
Appendix 1: Variable descriptions

Variable	Mean	Std.Dev.	Min	Max	Source
Mitigation, project share	0.01	0.016	0	0.17	AidData (2010) / authors' coding[1]
Mitigation, commitment share	0.02	0.036	0	0.33	AidData (2010) / authors' coding[1]
Oil price: Refiner Acquisition Cost of Imported Crude Oil (IRAC), const 2005 USD	34.5	18.46	7.40	85.13	Energy Information Administration (2010a)
Capacity hydro: installed hydro power capacity in donor countries, in GW (imputed until 1980 and for 2008 using hydro power production in kWh)	14.42	20.19	0	90.3	Energy Information Administration (2010b)
Capacity wind: installed wind power capacity in donor countries, in MW	600.3	2412.4	0	25170	Worldwatch Institute, (2001), Chinese Renewable Energy Industries Association (2007) American Wind Energy Association (1999), GWEC (2009)
Capacity geothermal: installed geothermal power capacity in donor countries, in MW	130.1	465.39	0	3043	International Geothermal Association (2010), Bertani (2007), Geothermal Energy Association (2008), Geothermal Energy Association (2010), Amici de la Terra (2008), Cappetti et al. (2000), Kawazoe and Combs (2004), Cabeças et al. (2010), Sifford and Bloomquist (2000), US Department of Energy (1997), Lund (2004)
Production solar: Solar photovoltaic cell production in donor countries, in MW	15.76	96.2	0	1331	Worldwatch Institute (2004), Prometheus Institute (2007), Prometheus Institute and Greentech Media (2009), IEA (various years)
post Rio: dummy (=1 if year≥1992, =0 otherwise)	0.44	0.50	0	1	
post Kyoto: dummy (=1 if year≥1997, =0 otherwise)	0.31	0.46	0	1	
post Kyoto ratification: dummy (=1 if year≥2005, =0 otherwise)	0.10	0.30	0	1	
Green seats (share of seats in the national parliament, in %)	2.42	3.42	0	13.3	Armingeon et al. (2008)
Cabinet composition (Schmidt-index: from 1: hegemony of right-wing and center parties, to 5: hegemony of social-democratic and other left parties)	2.50	1.62	1	5	Armingeon et al. (2008) following Schmidt (1992)

[1] The base data to compute this share are available as an online appendix to Michaelowa and Michaelowa (2010) at http://www.cis.ethz.ch/publications/publications.

Appendix 2: The development of mitigation aid over time, selected country cases

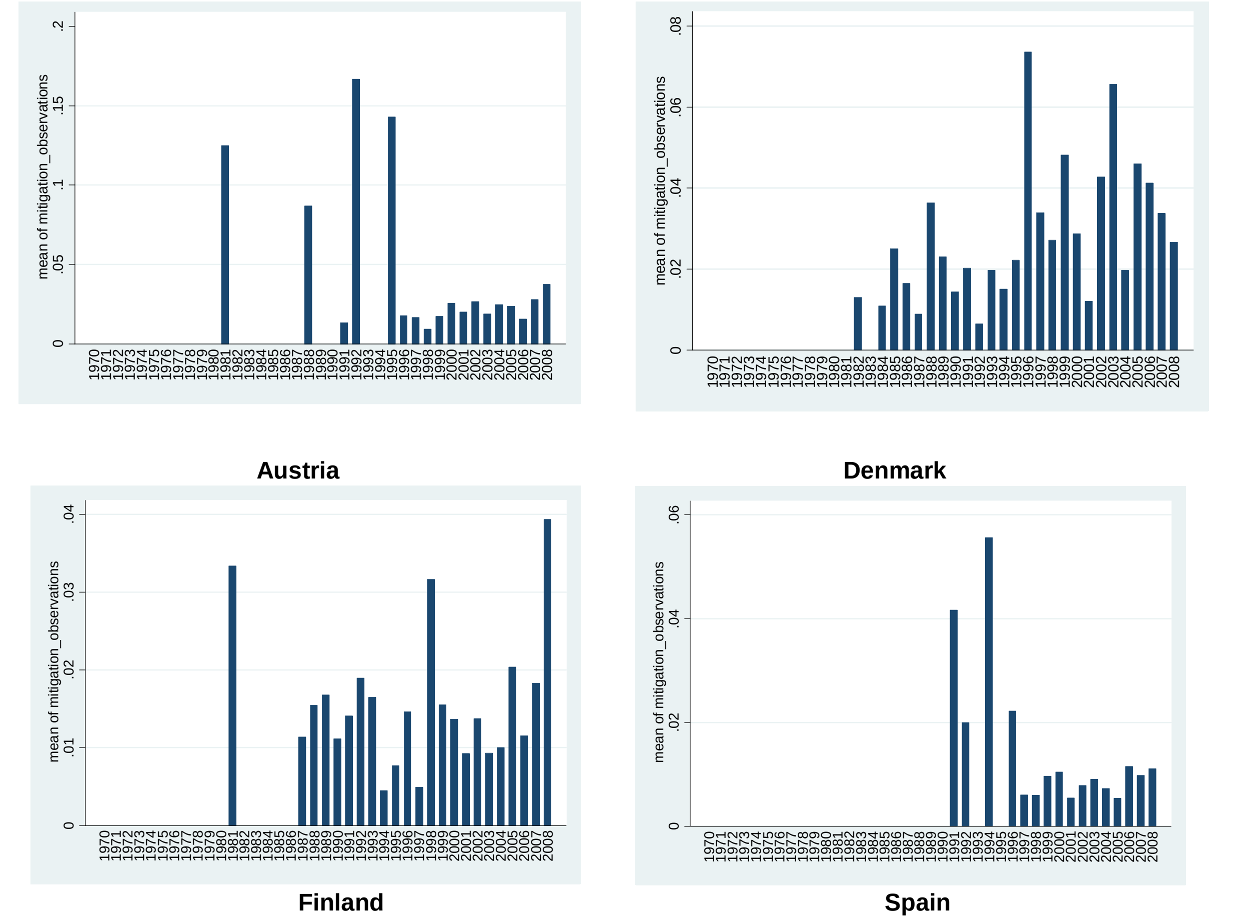
Figure A1: Oscillating aid for mitigation projects[1]



[1] Share of total number of development assistance projects

Source: AidData (2010), authors' coding.

Figure A2: Onset of aid for mitigation projects only after the start of climate policy[1]



[1] Share of total number of development assistance projects

Source: AidData (2010), authors' coding.