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Throwing Foreign Aid at HIV/AIDS in Developing Countries: Missing the Target*

Peter Nunnenkamp and Hannes Öhler

Abstract: We assess empirically whether foreign official development assistance (ODA) has been effective in alleviating HIV/AIDS epidemics, which figures prominently among the Millennium Development Goals. We employ a difference-in-difference-in-differences approach to identify the treatment effect of ODA specifically meant to fight sexually transmitted diseases on HIV/AIDS-related outcome variables. We do not find that ODA has prevented new infections to an extent that would have reduced the number of people living with HIV. By contrast, ODA has contributed effectively to the medical care of infected people. However, conclusive evidence on significant treatment effects on AIDS-related deaths only exists for the major bilateral source of ODA, the United States. In particular, targeted US assistance programs appear to be more effective than the activities of multilateral organizations.

Keywords: HIV prevalence, AIDS-related deaths, official development assistance, aid effectiveness, major donors, difference-in-difference-in-differences

JEL classification: F35; I19

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1. Introduction

Five years after starting operations in 2002, the Global Fund to Fight AIDS, Tuberculosis and Malaria boasted of having saved 1.8 million lives as the result of financially supported programs.[1] By the end of 2009, the number of lives the Global Fund claims to have saved had reached almost five million.[2] The public-private partnership which is funded by various governments, multilateral institutions and private foundations is less explicit in explaining how it arrives at these impressive numbers.[3] Yet the specific claims of the Global Fund are in striking contrast to the general verdict of Easterly (2006) that foreign aid has done "so much ill and so little good." They also contradict Allen's (2004: 1123) earlier conclusion that HIV/AIDS policies have been "seriously inadequate."

The Global Fund is the most important multilateral donor engaged in the fight against HIV/AIDS, contributing about one-fifth of total official development assistance (ODA) disbursed in 2008 to prevent and treat sexually transmitted diseases – notably HIV/AIDS.[4] The United States stands out among the bilateral donors. The Bush administration launched the President's Emergency Plan for AIDS Relief (PEPFAR) in 2003. PEPFAR originally committed US$ 15 billion over five years to contain the HIV/AIDS pandemic. In 2006-2008 the United States directed 14 percent of its overall ODA commitments to HIV/AIDS. Commitments from all sources of ODA, as reported by the OECD's Creditor Reporting System (CRS), for preventing and treating sexually transmitted diseases soared from US$ 200-400 million annually in 1995-1998 to US$ 7.8 billion in 2008 (in constant prices of 2008).

Nevertheless UNAIDS, the Joint United Nations Programme on HIV/AIDS, estimates that 33.4 million people were living with HIV in 2008.[5] This number was still increasing even though the number of new infections had slightly declined to an estimated 2.7 million since the peak in the mid-1990s. New infections continued to exceed the number of adult and child deaths due to AIDS of about two million in 2008.

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[1] See: http://www.theglobalfund.org/documents/publications/brochures/whoweare/TGFBrochure_FundingInAction.pdf ; accessed: July 2010.

[2] See: http://www.theglobalfund.org/documents/replenishment/2010/Progress_Report_Summary_2010_en.pdf; accessed: July 2010.

[3] In its 2007 Results Report, the Global Fund states: "Based on the reported ARV [antiretroviral treatment] figures each year, we computed scenarios with and without treatment to see the difference as 'lives saved'. Annual survival rates were assumed in line with the mortality assumptions in UNAIDS estimation models" (Global Fund 2007: 76, Box 24). In addition, a so-called resource input model is used to estimate lives saved due to averted HIV infections. See also Global Fund (2009: 5-63).

[4] See section 3 for details on HIV/AIDS-related ODA.

[5] See: http://data.unaids.org/pub/FactSheet/2009/20091124_FS_global_en.pdf, accessed: July 2010.

The combination of donor generosity and persistent human suffering calls for an assessment of bold claims about the effectiveness of HIV/AIDS-related ODA. We argue in Section 2 that analyzing the effects of specific ODA items on specific outcome variables may help overcome the stalemate with respect to the effectiveness of aggregate ODA in promoting economic growth or alleviating poverty in the recipient countries. We propose a difference-in-difference-in-differences (DDD) approach to identify the treatment effect of ODA specifically meant to fight sexually transmitted diseases on HIV/AIDS-related outcome variables (Section 3). While ODA has not reduced the number of people living with HIV, we find that ODA has contributed effectively to the medical care of infected people. However, conclusive evidence on significant treatment effects on AIDS-related deaths only exists for the major bilateral source of ODA, the United States (Section 4).

2. Assessing aid effectiveness: An alternative approach

The aid effectiveness literature has been preoccupied with the nexus between aggregate ODA and economic growth until recently. A consensus has remained elusive; even surveys on this strand of the literature come to opposite conclusions (McGillivray et al. 2006; Doucouliagos and Paldam 2009). A more focused view on aid effectiveness may offer a way out of this stalemate. Donors typically stress the multidimensionality of their objectives, which suggests assessing the impact of specific ODA items on narrower outcome variables than economic growth. Previous examples of this more modest approach include: the effects of aid for education on school enrollment (e.g., Michaelowa and Weber 2007; Dreher et. 2008); the impact of aid for health on outcome variables such as infant mortality (e.g., Williamson 2008; Mishra and Newhouse 2009); aid for promoting democracy and better governance (e.g., Finkel et al. 2007; Busse and Gröning 2009; Kalyvitis and Vlachaki 2010). Öhler et al. (2010) employ a DDD approach, as we will do in the following, to assess whether an innovative US aid scheme, the Millennium Challenge Corporation, was successful in fighting corruption in recipient countries.

There are very few studies assessing the links between specific ODA items and HIV/AIDS-related variables such as the prevalence and incidence of HIV and the number of deaths due to AIDS. Lieberman (2007) finds that ethnic fractionalization in recipient countries has a negative influence on the policy responses to HIV/AIDS epidemics, including the responses of foreign donors. This study addresses the allocation of ODA, rather than its effectiveness. Burns (2010) laments a dearth of funding and conceptual flaws that undermine the effectiveness of Japan’s HIV/AIDS programs in Asian recipient countries. Peiffer and

Boussalis (2010) consider antiretroviral treatment coverage rates and some other intermediate outcomes (tuberculosis treatment of HIV infected persons and HIV education in schools) in one particular year, as reported in UNAIDS Country Progress Reports in 2008, as dependent variables. According to their cross-country regressions, an increase in HIV/AIDS-related ODA by one dollar per capita of the recipient countries' population would increase the odds of complete coverage with antiretroviral treatment by 3-5 percent.

We are aware of just one study whose approach is similar to ours. Bendavid and Bhattacharya (2009) analyze the effects of PEPFAR on HIV/AIDS-related outcome variables in sub-Sahara Africa. The authors perform separate regressions with annual data for the periods 1997-2002 and 2004-2007, i.e., before and after PEPFAR started operations. Bendavid and Bhattacharya find a significant difference between PEPFAR's focus countries and the control group with respect to the number of deaths due to AIDS in the period 2004-2007. Their study pays only scant attention to the fact that other major donors such as the Global Fund scaled up operations in line with PEPFAR. Moreover, their results may be biased as their estimation strategy does not systematically control for variables possibly affecting the link between ODA and HIV/AIDS outcomes.

The scarcity of empirical evaluations of the effectiveness of ODA in containing HIV/AIDS is surprising. Human suffering has been as severe and widespread, notably in sub-Sahara Africa, for the fight against the pandemic to be listed among the so-called Millennium Development Goals (MDGs). MDG 6 requests the international community to "have halted by 2015 and begun to reverse the spread of HIV/AIDS" and to "achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it." Both altruistic donors being committed to alleviate the suffering in the afflicted countries as well as self-interested donors mainly concerned about security repercussions of the pandemic at home should be interested to assess the effectiveness of their ODA.[6]

3. Data and method

We assess the effects of ODA on two HIV/AIDS outcome variables: the number of AIDS-related deaths of adults and children and the number of people living with HIV. UNAIDS provides point estimates for both variables covering a large number of countries and the period 1990-2007.[7] The number of AIDS-related deaths should decline if ODA is effective in

[6] For example, the United States has considered the HIV/AIDS pandemic to be a national security issue since the late 1990s; see Allen (2004) and, for a detailed discussion of US foreign policy in the context of HIV/AIDS, Fidler (2004).

[7] See Appendix A for the definition of variables and details on the sources used. Note that the HIV/AIDS outcomes relate to the national level of developing countries. By contrast, the theoretical analysis of Sonntag

providing better treatment of HIV infected people.[8] By contrast, ODA may have ambiguous effects on the number of people living with HIV.[9] On the one hand, this number rises to the extent that ODA helps infected people to live longer. On the other hand, the number declines to the extent that ODA helps preventing new infections. To isolate both effects, one would optimally perform estimations with the number of new infections and the number of deaths as alternative dependent variables. Regrettably, country-specific estimates of the number of new HIV infections are not available from UNAIDS. We experimented with the difference in the number of people living with HIV in *t* and *t-1*, plus the number of AIDS-related deaths in *t* as a proxy of the number of new infections in *t*. However, the resulting number of new infections proved to be extremely volatile and we failed to detect any effect of ODA on this variable.[10] Apart from ODA effects on AIDS-related deaths, we therefore present estimation results only for the number of people living with HIV. ODA could be considered to be particularly effective if the impact on both outcome variables were significantly negative.[11]

The data on ODA are drawn from the OECD's Creditor Reporting System (CRS).[12] The CRS reports HIV/AIDS-related ODA mainly under purpose code 13040, i.e., "all activities related to sexually transmitted diseases and HIV/AIDS control, e.g., information, education and communication; testing; prevention; treatment and care" (http://www.oecd.org/dac/stats/crs/hivaids).[13] Another purpose code (16064) was created in 2005 to separately identify special ODA programs for social mitigation of HIV/AIDS. Examples include: supporting vulnerable groups and children orphaned by HIV/AIDS and the human rights of HIV/AIDS affected people. Overall ODA reported under purpose code 16064 was just a small fraction of ODA reported under purpose code 13040 (three percent in 2005-2007). Yet we employ the sum of both purpose codes in our estimations performed below.

(2010) focuses on specific HIV/AIDS interventions such as developing a vaccine from the perspective of effectively financing international public goods. For some countries and years, we take UNAIDS' lower or upper bound estimates, the average of the two (if both are available), or an estimate given by UNAIDS as "smaller than x" in order not to lose observations. We assess whether the results are sensitive to this procedure by excluding all observations for which a precise point estimate is lacking from UNAIDS in a robustness test (see below).

[8] Data on potentially superior measures of effective treatment, notably the number of disability adjusted life years (DALYs) gained, are not available for a sufficiently large panel of countries and years. For a discussion of measurement, notably on DALYs, see World Bank (1999), Gaffeo (2003), and Global Fund (2009).

[9] The same applies to the rate of HIV prevalence among adults, in percent of the population cohort aged 15-49. Taking the rate of HIV prevalence as the dependent variable, instead of the number of people living with HIV, does not offer additional insights. These results are not reported for the sake of brevity.

[10] These results are available on request. See also World Bank (1999: 54-56) on the relationship between HIV incidence (= new infections), HIV prevalence, and AIDS mortality.

[11] A significantly negative effect on the number of people living with HIV would then imply that the decline in new infections is larger than the decline in AIDS-related deaths.

[12] These data are available online since 1995.

[13] For a detailed description of aid activities related to HIV/AIDS as reported by the CRS, see OECD (2007).

Principally, disbursements of ODA should be preferred over commitments when assessing the effectiveness of ODA. Commitment data may be inflated by donor promises that are not kept at all or only with delay. However, data on ODA disbursements for specific purposes such as the fight against HIV/AIDS are available from the CRS database since 2002 only. Hence, we use commitments which are in constant prices of 2008. ODA is defined in per-capita terms of the recipient countries' population.

We perform difference-in-difference-in-differences (DDD) estimations to assess the effects of ODA on the number of AIDS-related deaths and the people living with HIV. While the data on HIV/AIDS and ODA are available for essentially all developing countries, our overall sample comprises only those developing countries for which the rate of HIV prevalence exceeded one percent of the adult population in 2003. In other words, we exclude all developing countries in which the HIV/AIDS epidemic cannot be considered "generalized."[14] This is in order to avoid our results to be biased in favor of finding ODA to be effective. Countries without pressing HIV/AIDS problems are unlikely to receive higher HIV/AIDS-related ODA, while HIV prevalence could only rise from practically zero. On the other hand, a higher threshold than one percent reduces the number of remaining observations considerably. Moreover, the World Bank (1999: 280) argued that donors should pay particular attention to countries with "nascent" epidemics where prevention is most cost-effective; this suggests that setting the threshold too high would miss relevant observations. The 47 sample countries included in the baseline estimations are listed in Appendix C.[15]

The overall sample is split into two almost equally large sub-samples, the treatment and the control group. The treatment group comprises those countries for which the increase in per-capita ODA from all (bilateral and multilateral) donors was relatively high, while the control group comprises those countries for which the increase in ODA was relatively low (plus two countries for which ODA declined). As stressed by the Global Fund (2009), there are major differences in external funding between countries with similar epidemics. The change in ODA is calculated by subtracting the period average for 1998-2002 from the period average for 2003-2007.[16] It appears to be most reasonable to base the before-and-after comparison on these periods. As noted by Allen (2004: 1125), international funding for HIV/AIDS control programs was "very limited" until recently. In June 2001, heads of state

[14] Note that the epidemic is often considered "generalized" if HIV prevalence exceeds one percent in antenatal clinics (e.g., Bendavid and Bhattacharya 2009). For reasons of data availability the one percent threshold applied here relates to HIV prevalence among all adults.

[15] In Section 4 we present several robustness tests with reduced samples.

[16] In the treatment group the average increase in ODA amounts to 8.75 US$ per capita. In the control group the average increase is just 0.97 US$. See the robustness tests below for alternative classifications of the treatment and control groups.

and government issued the Declaration of Commitment on HIV and AIDS at the special session of the United Nations General Assembly on HIV/AIDS. This UN session is considered "a major milestone in the AIDS response" helping "to guide and secure action, commitment, support and resources for the AIDS response."[17] The Global Fund to Fight AIDS, Tuberculosis and Malaria became operational in 2002, and PEPFAR was launched in 2003 as "the largest effort by any nation to combat a single disease" (http://www.pepfar.gov/about/index.htm). Overall ODA commitments for the control of sexually transmitted diseases, notably HIV/AIDS, by all donors more than doubled from US$ 1.47 billion in 2002 to US$ 3.08 billion in 2003 (in constant prices of 2008 as reported in the CRS database).

By applying the DDD estimator, we remove any fixed country effects (first differences) and any fixed time trends (second differences).[18] Formally, the DDD estimator for our baseline specification is as follows:

$$DDD = ((HIV_{2007}^{T} - HIV_{2003}^{T}) - (HIV_{2007}^{C} - HIV_{2003}^{C}))$$
$$- ((HIV_{2002}^{T} - HIV_{1998}^{T}) - (HIV_{2002}^{C} - HIV_{1998}^{C}))$$

with *HIV* being the level of either the number of people living with HIV or the number of AIDS-related deaths in treatment group *T* and control group *C*, respectively, in the years indicated. The estimator corresponds to the coefficient of the interaction term between a dummy for the treatment group and a dummy for the period 2003-2007 in the basic regression specification without control variables. This specification is then extended in several steps. First, we add the level of the dependent variable at the beginning of the first and second periods (i.e., 1998 and 2003). In this way we take into account that changes in the outcome variables may depend on their levels at the beginning of the periods of observation. Ignoring this factor may bias the effects of ODA.

Second, we include various other control variables (at the beginning of the first and second period) that may affect the changes in the outcome variables.[19] We include the countries' population as both dependent variables are defined in absolute numbers. The countries' GDP per capita may affect the dependent variables as higher average incomes provide better opportunities for costly treatment and prevention programs. The chances to fight HIV/AIDS might also be relatively favorable in countries with better control of

[17] See: http://www.unaids.org/en/AboutUNAIDS/Goals/UNGASS/default.asp.
[18] See also Johnson and Zajonc (2006).
[19] See Appendix A for definitions and sources, and Appendix B for summary statistics.

corruption. By contrast, local conditions appear to be particularly unfavorable in countries suffering from civil war.[20] Public health expenditure (as a share of GDP) may reflect the local government's commitment to tackle health problems, including HIV/AIDS.

Finally, we interact the level of the dependent variable as well as the other control variables with the dummy variable for the second period 2003-2007. The identifying assumption of our DDD estimator is that, in the absence of the treatment, the difference in the dependent variable between the two periods would have been the same, on average, in the treatment and control group. The plausibility of this assumption is debatable if the treatment and control group differ from each other in certain aspects that might be associated with the dynamics of the outcome variable (Abadie 2005). In our case, the two groups differ particularly with respect to the level of the outcome variables (see Appendix B). A relatively high initial level of the outcome variables is strongly associated with a relatively large increase in the outcome variables in the first period, while these correlations weaken considerably in the second period.[21] Ignoring these dynamics in the outcome variables would violate the identifying assumption and bias the results with respect to the treatment effect. The treatment and control groups also differ with respect to other control variables, though to a lesser extent. Again, the interaction of the control variables with the dummy variable for the second period accounts for different dynamics in the two groups.

4. Results

Baseline results

Table 1 reports our baseline results with the number of people living with HIV (columns 1-5) and the number of AIDS-related deaths (columns 6-10) as dependent variables. We also considered the rate of HIV prevalence and the number of new infections as dependent variables. For the reasons stated in Section 3 these estimations are not shown, however. We proceed in several steps to evaluate the treatment effect of ODA. In columns (1) and (6) of Table 1, we present the basic DDD estimations without any additional controls. In the next step, we add the number of people living with HIV in 1998 and 2003 (column 2) and, respectively, the number of AIDS-related deaths in 1998 and 2003 (column 7). In columns (3)

[20] Civil war conditions are proxied by setting a dummy variable equal to one if a major internal armed conflict (at least 1,000 battle-related deaths in one year) occurred in the recipient country during the respective period (1998-2002, 2003-2007).

[21] In the first period, the correlation between the initial level and the change in *People living with HIV* (*AIDS deaths*) amounts to 0.72 (0.64). In the second period, the correlation declines to 0.50 (0.12).

and (8), we enter the full list of control variables introduced above, in order to account for the effects of these variables on the changes in the outcome variable. In columns (4) and (9), we interact the level of the dependent variable with the dummy variable for the second period. Finally, we interact all control variables with the second period dummy in columns (5) and (10).

The results of the basic DDD estimations differ considerably between the two outcome variables. In column (1) with the change in the number of people living with HIV as the dependent variable, the negative coefficient of *Treatment * 2nd period* fails to pass conventional significance levels. In other words, there is no convincing evidence that ODA has been effective in causing a more favorable dynamic in the treatment group with respect to the change in the number of people living with HIV. It should be noted that this also holds when considering the rate of HIV prevalence, instead of the absolute number of people, as the dependent variable (not shown). The lack of convincing evidence might be attributed to the countervailing effects of ODA on this outcome variable. As noted above, effective prevention through ODA tends to reduce the number of people living with HIV, whereas effective medical care of infected persons tends to increase this number.

Indeed, the basic DDD estimation reported in column (6) of Table 1 reveals a significant treatment effect of ODA on the change in the number of AIDS-related deaths. Note that the dynamic of AIDS-related deaths is relatively unfavorable in the treatment group when considering the first period 1998-2002, compared to the control group.[22] However, the relatively unfavorable dynamic in the treatment group disappears in the second period 2003-2007. In other words, no significant difference between the treatment and the control group can be observed anymore.[23] Taken together the treatment effect of ODA is significant at the ten percent level. According to this estimate, the stronger increase in ODA in the treatment group, compared to the control group, led to 16,665 fewer AIDS-related deaths, on average, in a country of the treatment group in the second period.[24]

The different results for the two outcome variables are hardly affected when controlling for their levels at the beginning of the first and the second period in columns (2) and (7). This is even though the changes in the outcome variables strongly depend on initial levels. Higher initial levels are associated with a higher increase (or a smaller decline) in the number of people living with HIV as well as AIDS-related deaths, both at the one percent

[22] The marginal effect is significant at the five percent level.
[23] Throughout this section, the marginal effects and the significance levels of variables included in interaction terms are calculated with the "margins" command of Stata 11.0.
[24] The difference in the increase in ODA between the treatment and the control group amounts to 7.78 US$ per capita, on average.

level of significance. Yet the treatment effect of ODA remains as before – insignificant with respect to the number of people living with HIV, but significant (now at the five percent level) with respect to AIDS-related deaths. The major results also hold when adding the levels of a broader set of control variables at the beginning of the first and the second period. In fact, most of the additional control variables do not affect the changes in the outcome variables in columns (3) and (8) of Table 1. The only exception is the positive impact of a larger population on the change in the number of deaths (larger increase or smaller decline).

By contrast, the interaction of the level of the dependent variable with the dummy variable for the second period proves to be relevant. The results reported in columns (4) and (9) indicate that the positive effects of the levels on the changes in the outcome variables weaken considerably in the second period.[25] Given that the levels are, on average, considerably larger in the treatment group than in the control group, we can infer that the treatment effect of ODA would be overestimated if we ignored these dynamics. This bias appears to be minor in column (4). The treatment effect of ODA changes its sign from negative to positive, but it remains insignificant at conventional levels. The bias is more pronounced in column (9) where the treatment effect of ODA with respect to AIDS-related deaths is no longer significant. In other words, we no longer find ODA to be effective in reducing the number of AIDS-related deaths once it is taken into account that the treatment and control groups differ in the level of the number of deaths and that this difference is associated with the dynamics of this outcome variable.

Apart from the levels of the dependent variables, the relevance of most other control variables continues to be weak when taking account of the dynamics of their levels between the first and second period. In column (5), the positive effect of logged GDP per capita on the number of people living with HIV in the first period implies an unfavorable dynamic for countries that were relatively rich. However, the unfavorable dynamic disappears in the second period. This may indicate that relatively rich countries were able to take advantage of their relative wealth in providing costly treatment and prevention programs. Public health expenditure appears to have reduced the increase in the number of people living with HIV, but only in the first period. Importantly, the treatment effect of ODA on this outcome variable remains insignificant. In column (10) larger countries show an unfavorable dynamic in the first period, but this effect disappears in the second period. Considering that the countries in the control group are, on average, larger than the countries in the treatment group, we can infer that the treatment effect of ODA would be underestimated if we did not consider these

[25] In column (9) the effect of the level proves to be even insignificant in the second period.

dynamics. In fact, the treatment effect is, in absolute terms, larger in column (10) than in column (9). However, it still remains insignificant.

ODA from all donors: robustness tests

In Table 2 we report the results of four robustness tests. As before, the classification of the treatment and control groups is based on the increase in ODA per capita from all donors, as reported under purpose codes 13040 and 16064 in the CRS database. Once again we assess the treatment effect of ODA with regard to the number of people living with HIV and the number of AIDS-related deaths. The two periods under consideration, 1998-2002 and 2003-2007, are also the same as before.

The first robustness test reported in columns (1) and (5) excludes 13 countries from the treatment group that have HIV prevalence rates greater than the maximum level of HIV prevalence rates in the control group, i.e., 5.8 percent (in 2003).[26] Reducing the treatment group in this way serves to remove the considerable difference in the level of the outcome variables compared to the control group.[27] In other words, it provides an alternative to including the interactions of the level of dependent variables with the dummy variable for the second period. Importantly, this robustness test corroborates the previous finding that the treatment effect of ODA is insignificant for both outcome variables once we control for differences between the treatment and control groups in the level of the dependent variables.

The next robustness test reported in columns (2) and (6) excludes the middle range of the overall sample, i.e., the nine countries with an increase in ODA per capita between the first and the second period of more than 1.6 US$ and less than 3.2 US$. This reduces the treatment and the control group to essentially the same extent and widens the gap between the groups with regard to the increase in ODA.[28] Compared to columns (5) and (10) in Table 1, the results are hardly affected. A minor exception is that the interaction of the level of AIDS-related deaths with the dummy variable for the second period loses its significance in column (6) of Table 2. Both treatment effects are insignificant once again.

Our major result also holds when restricting the estimations to sample countries located in sub-Sahara Africa (columns 3 and 7). This is not surprising as the 11 sample countries located in other regions spread across the whole spectrum as concerns the increase

[26] See Appendix D for the countries in the respective treatment and control groups.

[27] Now, the levels are even somewhat higher in the control group than in the treatment group: The level of the number of people living with HIV (AIDS-related deaths) amounts to 194,560 (17,430) in the treatment group and 251,013 (18,050) in the control group, on average.

[28] Now, the average increase in ODA amounts to 11 US$ per capita in the treatment group. In the control group it corresponds to 0.77 US$ only.

in ODA, even though their HIV prevalence rate was relatively low and varied only modestly (Appendix C). Finally, the exclusion of observations for which an exact point estimate of the outcome variables was not available from UNAIDS does not change our results either.

Differences between major donors

So far we have separated the treatment group from the control group on the basis of the increase in total HIV/AIDS-related ODA per capita received by a developing country from all sources. Subsequently we take into account that the effectiveness of ODA may differ between major sources. In particular, ODA from multilateral donors such as the Global Fund to Fight AIDS, Tuberculosis and Malaria is widely perceived to be superior to ODA from selfish bilateral donors, notably major DAC countries such as the United States.[29] The empirical evidence supporting this view is inconclusive, however (Ehrenfeld 2004). Ram (2003) even finds that positive economic growth effects of bilateral ODA are largely offset by negative growth effects of multilateral ODA.

Against this backdrop we replicate the estimations with changes in AIDS-related deaths as the dependent variable, reported in columns (6)-(10) of Table 1, by refining the treatment group.[30] In addition to belonging to the upper half of the sample in terms of the increase in ODA from all sources, we restrict the treatment group to either those recipient countries for which HIV/AIDS-related ODA comes mainly from bilateral sources (all DAC countries) or those for which ODA comes mainly from (all) multilateral sources. The results for the treatment group with the DAC countries as the major source of ODA are reported in columns (1)-(5) in Table 3, and those for the treatment group with multilateral organizations as the major source in columns (6)-(10). It may be noted that multilateral organizations contributed almost one third to ODA flows reported by the CRS under purpose codes 13040 and 16064 to all recipient countries during the period 2003-2007.

Table 3 reveals that the results for the control variables, including the levels of the dependent variables, are largely as before in Table 1. This implies that the effects that most of the control variables exert on the change in the number of AIDS-related deaths do not differ considerably between the estimations with DAC countries as the major source of ODA and those with multilateral organizations as the major source. An exception is the dynamics of the

[29] For instance, *The Economist* has argued repeatedly that multilateral organizations "reach the poor more accurately" (March 14th, 2002), whereas "bilateral aid is of dubious quality" (June 2nd, 2005) because of strategic and commercial self-interest of donor countries such as the United States.

[30] We also replicated the estimations with changes in the number of people living with HIV as the dependent variable. These estimations did not offer additional insights and are not reported. The results are available on request.

output variable due to a country's population, which can be observed in the case of bilateral aid only. At the same time, the results clearly show that the treatment effects presented before for ODA from all sources are driven by ODA effects in those countries receiving ODA mainly from DAC countries. The treatment effect proves to be insignificant throughout columns (6)-(10) with multilateral organizations as the major source of ODA. This finding sharply contradicts the widely held belief that multilateral ODA is more effective in promoting economic and social development, including by fighting HIV/AIDS.

By contrast, the treatment effect is significantly negative in columns (1)-(3) with bilateral donors as the major source of ODA. According to these estimates, the stronger increase in ODA in the treatment group, compared to the control group, leads to 25,000-29,000 fewer AIDS-related deaths, on average, in a country of the treatment group in the second period.[31] The impact is thus more pronounced than that reported in columns (6)-(8) of Table 1. As before in Table 1, the treatment effect loses its significance when controlling for the dynamics in the outcome variable by the interaction of its level at the beginning of the two periods with the dummy variable for the second period (column 4). In other words, the treatment effect is overestimated once again if we do not control for these dynamics. However, when controlling for the dynamics due to the countries' population in the full specification (column 5), the treatment effect is only insignificant at the margin. It also increases in size, compared to column (4).[32]

Importantly, the results in Table 3 point to striking differences when accounting for the source of ODA. It should be noted in this context that, in most countries with a particularly large increase in ODA, the funds come mainly from bilateral sources (see Appendix D). This implies that the difference in the increase of ODA between the treatment and the control group is more pronounced when bilateral donors represent the major source, compared to multilateral donors being the major source. The differences found in the effectiveness of bilateral and multilateral ODA are probably related to this pattern. In particular, bilateral donors are more likely to make a difference as they tend to focus on a few recipient countries.[33] The World Bank (1999) observed more than a decade ago already that the allocation of HIV/AIDS-related ODA across recipient countries differed between bilateral

[31] Now, the average increase in ODA amounts to 11.04 US$ per capita in the treatment group. Thus, the difference in the increase in ODA between the treatment and the control group amounts to 10.07 US$ per capita, on average.

[32] Note that, as in Table 1, the treatment effect is biased downwards if we do not account for the dynamics due to the countries' population. Interestingly, the coefficients of the level of the outcome variable and of its interaction with the second period lose almost their significance when controlling for the dynamics due to the countries' population.

[33] This becomes apparent when looking at the countries in the control group where HIV/AIDS-related ODA comes mainly from multilateral sources.

and multilateral donors: Bilateral donors appeared to be particularly concerned about HIV/AIDS in recipient countries where the epidemic was most severe – either because they were altruistically responding to serious suffering in these countries, or because they viewed "their self-interest as jeopardized most acutely by countries where there are large numbers of infected people" (World Bank 1999: 250). The World Bank posited that, compared to bilateral donors, multilateral organizations were less focused, spreading ODA more widely including to countries with nascent epidemics and minor HIV/AIDS problems.

This issue is investigated further by concentrating on two dominant donors, the United States among DAC countries and the Global Fund among multilateral organizations. Both donors accounted for about 70 percent of bilateral and, respectively, multilateral ODA flows reported under purpose codes 13040 and 16064 to all recipient countries during the period 2003-2007. At the same time, the United States and the Global Fund represent examples of the different allocation behavior noted above. According to Bendavid and Bhattacharya (2009: 688), PEPFAR, the major US scheme, "is unique in its distinctive approaches and disproportionate funding of a few countries." Indeed, about 72 percent of country-specific ODA reported by the United States under the above purpose codes was concentrated in just ten recipient countries in 2003-2007; the corresponding share of the top-10 recipients of ODA from the Global Fund accounted for just 46 percent of the Fund's overall commitments (CRS database).

The results shown in Table 4 indicate that the US approach was quite successful in containing the number of AIDS-related deaths.[34] Similar to the previous procedure, two criteria apply for countries in the treatment group: an increase in ODA from all sources above the median of the overall sample, and either the United States (columns 1-10) or the Global Fund (columns 11-15) representing the major donor. The results for the Global Fund mirror those for all multilateral organizations as the major source of ODA for countries in the treatment group: the treatment effect remains insignificant throughout at conventional levels. This is not surprising as the treatment group comprises almost the same set of countries independent of whether all multilateral organizations or the Global Fund is regarded as the major donor (Appendix D). By contrast, the results with the United States as the major donor show a significant treatment effect not only in the specifications without the interactions of the control variables with the second period dummy (as before for all DAC countries), but even in the full specification in column (5). Moreover, the quantitative impact increases to almost 30,000 fewer AIDS-related deaths. Note that the level of the outcome variable and its

[34] Again, we do not report the results with the number of people living with HIV as the dependent variable. US ODA did not appear to be superior to ODA from the Global Fund in this regard.

interaction with the second period dummy are no longer significant when controlling for the dynamics due to the countries' population. The results indicate that the treatment effect is underestimated if no dynamics of any kind are taken into account (as in columns 1-3).

The quantitative impact increases further to about 35,000 fewer deaths when replicating the full specification with an additional requirement for countries to be included in the treatment group. In columns (6)-(10) the United States must not only be the major donor, but the recipient countries must also be on the list of PEPFAR's so-called focus countries. The significant treatment effect of ODA in PEPFAR's focus countries is in line with the earlier findings of Bendavid and Bhattacharya (2009). In all other respects, the results in columns (6)-(10) differ only marginally from those in columns (1)-(5) of Table 4. This is plausible considering that the overlap between recipient countries where the United States is the major donor and the focus countries of PEPFAR is almost perfect, with Cambodia representing the only exception (Appendix D).

Finally, we show in Table 5 that the treatment effects of ODA reported in this sub-section are robust to the exclusion of observations for which UNAIDS does not provide exact point estimates of the number of AIDS-related deaths.[35] Once again, multilateral ODA as well as ODA from the Global Fund proves to be ineffective.[36] Also as before, the treatment effect is significant at the five percent level and quantitatively most pronounced when the treatment group is restricted to PEPFAR's focus countries. The concentration on a few needy recipient countries appears to have helped ODA effectiveness. This is even though PEPFAR was widely criticized for earmarking a part of its funds for abstinence-only programs and refusing to cooperate with partner organizations offering counseling on abortion (e.g., Burns 2010: 160).

5. Summary and conclusion

We contribute to the nascent literature on the effectiveness of foreign official development assistance (ODA) that focuses on particular items of ODA meant to achieve specific objectives. The fight against HIV/AIDS epidemics figures prominently among the Millennium Development Goals agreed by the international community in 2000. Donor countries and multilateral organizations have mobilized steeply increasing resources in recent years to halt and reverse the spread of HIV/AIDS. Donors should know about the

[35] We report only the preferred full specification with the interactions included.
[36] Note that the treatment group is identical for the estimations with all multilateral donors and the Global Fund reported in Table 5.

effectiveness of their ODA independent of whether they are altruistically committed to alleviate the suffering in the afflicted countries, or mainly concerned about security repercussions of the pandemic at home.

We employ a difference-in-difference-in-differences (DDD) approach to identify the treatment effect of ODA specifically targeted at sexually transmitted diseases on HIV/AIDS-related outcome variables. Controlling for various factors that may affect the dynamics of the number of people living with HIV and AIDS-related deaths, our empirical findings clearly indicate that any generalized verdicts on the effectiveness of ODA are unwarranted. The treatment effect of ODA varies considerably between different outcome variables and critically depends on the source of ODA.

Optimally, ODA would help prevent new HIV infections as well as provide better care for the infected. Our results indicate that ODA-financed prevention has been insufficient to reduce the number of people living with HIV. By contrast, ODA has contributed effectively to medical care. However, conclusive evidence on significant treatment effects on AIDS-related deaths only exists for the major bilateral source of ODA, the United States. The treatment effect proved to be insignificant when multilateral organizations represented the major source of ODA. In particular, our findings are in sharp conflict with claims of the most important organization in this field - the Global Fund to Fight AIDS, Tuberculosis and Malaria - that its performance based support has saved almost five million lives by the end of 2009.

A recent US assistance program, the President’s Emergency Plan for AIDS Relief (PEPFAR), appears to be particularly effective in reducing the number of AIDS-related deaths. The treatment effect is significant across a number of different specifications, including when controlling for various factors affecting the dynamics of the outcome variable. At the same time, the quantitative impact is considerable with about 35,000 fewer deaths in a recipient country receiving an above-median increase in ODA mainly from PEPFAR in 2003-2007. This may be surprising recalling the harsh critique leveled against PEPFAR for earmarking a part of its funds for abstinence-only programs.

We suspect that the concentration of PEPFAR’s financial support in a few recipient countries has helped ODA effectiveness. However, it cannot be ruled out that factors other than different allocation rules are underlying the inferiority of ODA from other sources. For instance, the focus of specific programs may also play an important role. Medical care for infected people may have effects that are easier to detect in the shorter run, compared to efforts to prevent HIV infections. The striking differences in the effectiveness of ODA from different sources clearly deserve more attention in future research.

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Table 1: ODA effects on the number of people living with HIV and AIDS-related deaths: Baseline results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
			People living with HIV					AIDS deaths		
2nd period	-15,379	-22,055	-31,468	30,805	-67,584	-6,700	-7,811	-9,356	-2,532	512
	(57,922)	(48,915)	(53,609)	(43,392)	(103,765)	(5,943)	(5,653)	(6,019)	(5,353)	(12,451)
Treatment	74,840	15,246	20,561	-50,243	-59,788	12,285**	8,839	8,159	1,753	2,683
	(58,548)	(50,386)	(55,519)	(45,175)	(51,718)	(6,007)	(5,800)	(6,234)	(5,601)	(6,396)
Treatment * 2nd period	-71,225	-82,195	-72,585	23,073	48,131	-16,665*	-18,994**	-16,303*	-8,130	-11,572
	(82,800)	(69,929)	(74,256)	(63,423)	(71,992)	(8,496)	(8,098)	(8,357)	(7,895)	(8,942)
People living with HIV		0.144***	0.136***	0.303***	0.356***					
		(0.024)	(0.032)	(0.035)	(0.050)					
People living with HIV * 2nd period				-0.240***	-0.303***					
				(0.043)	(0.060)					
AIDS deaths							0.155***	0.094	0.473***	0.335***
							(0.047)	(0.062)	(0.088)	(0.121)
AIDS deaths * 2nd period									-0.419***	-0.245*
									(0.101)	(0.138)
Log population			0.00040		-0.00181			0.00022*		0.00038**
			(0.00107)		(0.00144)			(0.00012)		(0.00017)
Log population * 2nd period					0.00232					-0.00047**
					(0.00187)					(0.00022)
Log GDP per capita			11.038		33.553*			1.199		1.124
			(14.295)		(20.116)			(1.606)		(2.425)
Log GDP per capita * 2nd period					-31.688					0.451
					(25.337)					(3.048)
Control of corruption			48,414		55,411			4,953		5,114
			(38,926)		(46,208)			(4,316)		(5,498)
Control of corruption * 2nd period					-23,527					-1,042
					(67,175)					(7,960)
Public health expenditure			-14,608		-50,623**			1,339		1,320
			(17,877)		(24,754)			(2,001)		(2,962)
Public health exp. * 2nd period					42,287					-811
					(31,568)					(3,776)
Civil war			-19,388		-38,680			-4,262		-10,103
			(59,059)		(64,837)			(6,633)		(7,894)
Civil war * 2nd period					32,761					10,204
					(103,647)					(12,475)
Constant	37,817	8,288	54,362	-24,162	96,350	6,254	4,575	2,912	1,121	-996
	(40,957)	(34,916)	(66,505)	(30,779)	(78,663)	(4,202)	(4,023)	(7,477)	(3,793)	(9,466)
Observations	94	94	90	94	90	94	94	90	94	90
Number of countries	47	47	45	47	45	47	47	45	47	45
R-squared	0.033	0.319	0.353	0.495	0.566	0.158	0.250	0.331	0.372	0.489

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2: ODA effects on the number of people living with HIV and AIDS-related deaths: Robustness tests

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		People living with HIV				AIDS deaths		
2nd period	2,819	-67,021	-122,408	-94,862	-5,110	293	-2,238	2,778
	(41,994)	(126,232)	(115,295)	(106,319)	(5,632)	(15,243)	(13,828)	(17,362)
Treatment	-29,873	-40,349	-89,212	-52,755	-371	4,197	1,100	4,474
	(20,186)	(69,772)	(62,774)	(51,774)	(2,767)	(8,775)	(7,881)	(8,113)
Treatment * 2nd period	4,850	37,288	71,866	39,157	-4,258	-16,895	-15,596	-13,247
	(28,148)	(97,513)	(87,702)	(72,519)	(3,769)	(12,392)	(11,022)	(11,211)
People living with HIV	0.099**	0.344***	0.345***	0.386***				
	(0.049)	(0.058)	(0.057)	(0.052)				
People living with HIV * 2nd period		-0.294***	-0.299***	-0.334***				
		(0.070)	(0.068)	(0.062)				
AIDS deaths					0.089	0.327**	0.336**	0.282*
					(0.116)	(0.142)	(0.137)	(0.152)
AIDS deaths * 2nd period						-0.221	-0.248	-0.145
						(0.163)	(0.156)	(0.171)
Log population	0.00115	-0.00149	-0.00060	-0.00251*	0.00040***	0.00042**	0.00045**	0.00042**
	-0.00077	(0.00178)	(0.00166)	(0.00151)	(0.00010)	(0.00021)	(0.00018)	(0.00020)
Log population * 2nd period	-0.00155***	0.00220	0.00149	0.00293	-0.00054***	-0.00051*	-0.00043*	-0.00055**
	-0.00051	(0.00233)	(0.00217)	(0.00195)	(0.00008)	(0.00028)	(0.00025)	(0.00026)
Log GDP per capita	2.672	76.091**	85.643***	33.789*	0.190	4.439	5.717	3.515
	(7.672)	(36.199)	(30.283)	(20.104)	(1.027)	(4.427)	(3.618)	(3.725)
Log GDP per capita * 2nd period	-0.754	-71.782	-77.427*	-31.642	0.231	-1.312	-1.360	-1.799
	(9.656)	(43.874)	(38.856)	(25.325)	(1.292)	(5.338)	(4.608)	(5.127)
Control of corruption	-38,634**	62,059	98,170*	56,632	-1,184	4,991	7,698	5,904
	(18,507)	(58,031)	(51,453)	(47,653)	(2,495)	(6,960)	(6,081)	(8,144)
Control of corruption * 2nd period	25,804	-28,583	-49,113	-21,346	-2,142	-789	-149	-1,004
	(27,569)	(80,270)	(77,763)	(68,815)	(3,690)	(9,588)	(9,104)	(11,232)
Public health expenditure	3,906	-67,209**	-83,493***	-62,818**	-1,338	265	-583	1,161
	(12,851)	(31,365)	(30,057)	(25,752)	(1,716)	(3,796)	(3,629)	(4,132)
Public health exp. * 2nd period	6,681	55,881	72,773*	54,901*	1,441	783	1,070	-1,652
	(17,914)	(39,194)	(37,220)	(32,526)	(2,416)	(4,738)	(4,465)	(4,957)
Civil war	-38,522	-33,682	-46,544	-71,864	-7,961**	-9,827	-11,421	-7,795
	(24,905)	(75,707)	(72,949)	(67,846)	(3,325)	(9,266)	(8,841)	(9,367)
Civil war * 2nd period	61,603	11,874	40,931	71,310	11,906**	6,219	12,526	7,177
	(40,579)	(126,515)	(122,580)	(105,918)	(5,584)	(15,344)	(14,641)	(14,171)
Constant	-32,842	98,090	163,360*	124,318	2,048	-2,071	3,474	-1,436
	(31,022)	(97,842)	(86,741)	(81,652)	(4,147)	(11,825)	(10,497)	(14,205)
Observations	64	72	70	86	64	72	70	72
Number of countries		36	35	43		36	35	36
R-squared	0.616	0.596	0.644	0.588	0.720	0.506	0.577	0.504

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
columns (1) and (5): countries with HIV prevalence > 5.8 excluded from the treatment group;
columns (2) and (6): countries with increase in ODA > 1.57 and < 3.15 excluded;
columns (3) and (7): only countries in sub-Sahara Africa;
columns (4) and (8): excl. observations for which UNAIDS does not provide clear point estimates.

Table 3: ODA effects on AIDS-related deaths: DAC countries versus multilateral organizations as major donors

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Treatment group: DAC countries major donor					Treatment group: Multilateral major donor				
2nd period	-6,700	-7,969	-10,004	-3,287	1,735	-6,700**	-7,646**	-7,529**	745	-1,551
	(6,391)	(6,043)	(6,446)	(5,952)	(15,433)	(3,068)	(2,937)	(3,202)	(2,109)	(5,652)
Treatment	18,667**	12,262*	12,064	1,851	6,215	2,357	2,289	3,842	2,031	1,023
	(7,446)	(7,314)	(8,068)	(7,784)	(9,007)	(4,154)	(3,950)	(4,174)	(2,560)	(3,114)
Treatment * 2nd period	-25,193**	-29,245***	-25,269**	-13,697	-21,543	-3,400	-3,767	-414	-2,969	-2,367
	(10,530)	(10,018)	(10,190)	(10,865)	(13,056)	(5,874)	(5,587)	(5,788)	(3,622)	(4,382)
AIDS deaths		0.177***	0.107	0.463***	0.289*		0.132***	-0.184	0.633***	0.601***
		(0.056)	(0.075)	(0.111)	(0.152)		(0.048)	(0.129)	(0.062)	(0.203)
AIDS deaths * 2nd period				-0.374***	-0.160				-0.664***	-0.481**
				(0.126)	(0.175)				(0.072)	(0.237)
Log population			0.00024*		0.00046**			0.00033**		0.00002
			(0.00014)		(0.00020)			(0.00013)		(0.00015)
Log population * 2nd period					-0.00056**					-0.00021
					(0.00028)					(0.00021)
Log GDP per capita			1.667		2.710			-0.736		-0.508
			(2.672)		(3.476)			(0.889)		(0.999)
Log GDP per capita * 2nd period					-1.687					0.676
					(5.195)					(1.260)
Control of corruption			5,883		6,191			-1,090		-1,005
			(5,459)		(6,854)			(2,809)		(2,596)
Control of corruption * 2nd period					-687					-2401
					(10,537)					(3,910)
Public health expenditure			1,264		849			309		-119
			(2,928)		(3,707)			(1,450)		(1,813)
Public health exp. * 2nd period					534					-977
					(5,788)					(2,200)
Civil war			-6,798		-8,646			-4,080		-6,625*
			(7,522)		(9,032)			(4,212)		(3,652)
Civil war * 2nd period					5,144					8,802
					(15,111)					(5,827)
Constant	6,254	4,337	3,397	1,220	-2,155	6,254***	4,825**	3,363	-617	930
	(4,519)	(4,307)	(8,809)	(4,223)	(10,855)	(2,169)	(2,127)	(4,397)	(1,499)	(4,409)
Observations	76	76	72	76	72	66	66	62	66	62
Number of countries	38	38	36	38	36	33	33	31	33	31
R-squared	0.191	0.290	0.388	0.369	0.507	0.125	0.222	0.346	0.679	0.739

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4: ODA effects on AIDS-related deaths: United States and Global Fund as major donor

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Treatment group: US major donor					Treatment group: US major donor + PEPFAR					Treatment group: Global Fund major donor				
2nd period	-6,700	-8,140	-10,351	-3,762	-8,630	-6,700	-8,148	-10,423	-3,873	-10,653	-6,700**	-7,648**	-7,525**	720	-620
	(6,366)	(5,935)	(6,408)	(5,936)	(15,955)	(6,422)	(5,996)	(6,495)	(6,030)	(16,336)	(3,101)	(2,970)	(3,249)	(2,147)	(6,046)
Treatment	16,738**	10,435	9,882	1,853	7,436	18,321**	11,441	10,523	2,327	8,806	3,371	3,124	4,051	2,187	172
	(7,595)	(7,295)	(8,223)	(7,727)	(9,361)	(7,865)	(7,603)	(8,825)	(8,197)	(10,552)	(4,386)	(4,172)	(4,478)	(2,720)	(3,740)
Treatment * 2nd period	-21,492**	-25,632**	-22,730**	-12,967	-29,879**	-22,917**	-27,480**	-24,454**	-14,036	-35,049**	-4,600	-5,124	-1,428	-3,234	-1,971
	(10,741)	(10,060)	(10,378)	(10,793)	(13,440)	(11,123)	(10,447)	(10,814)	(11,434)	(14,933)	(6,203)	(5,902)	(6,125)	(3,851)	(4,910)
AIDS deaths		0.200***	0.144	0.473***	0.257		0.201***	0.149	0.468***	0.239		0.132***	-0.181	0.631***	0.615***
		(0.058)	(0.088)	(0.118)	(0.171)		(0.060)	(0.093)	(0.122)	(0.184)		(0.049)	(0.131)	(0.064)	(0.209)
AIDS deaths * 2nd period				-0.351**	0.013				-0.343**	0.061				-0.662***	-0.500**
				(0.134)	(0.200)				(0.138)	(0.214)				(0.074)	(0.242)
Log population			0.00019		0.00049**			0.00018		0.00050**			0.00033**		0.00001
			(0.00015)		(0.00021)			(0.00160)		(0.00022)			(0.00013)		(0.00016)
Log population * 2nd period					-0.00083***					-0.00088***					-0.00020
					(0.00030)					(0.00031)					(0.00021)
Log GDP per capita			1.719		3.162			1.772		3.314			-1.020		-0.963
			(2.820)		(3.594)			(2.884)		(3.667)			(1.177)		(1.475)
Log GDP per capita * 2nd period					-3.980					-4.536					0.648
					(5.246)					(5.341)					(1.784)
Control of corruption			4,358		6,531			4,209		6,309			-1,128		-1,550
			(5,625)		(6,707)			(5,707)		(6,816)			(2,935)		(2,929)
Control of corruption * 2nd period					-8,568					-8,558					-2,227
					(10,742)					(10,877)					(4,196)
Public health expenditure			1,361		-200			1,303		-695			404		473
			(3,577)		(4,623)			(3,779)		(4,967)			(1,540)		(2,308)
Public health exp. * 2nd period					6,544					8,187					-1,430
					(6,662)					(7,047)					(2,637)
Civil war			-7,886		-8,475			-8,085		-8,878			-4,165		-7,033*
			(7,529)		(8,763)			(7,673)		(8,957)			(4,339)		(3,825)
Civil war * 2nd period					1,397					2,358					8,786
					(14,726)					(14,948)					(6,011)
Constant	6,254	4,077	2,893	1,114	-683	6,254	4,065	2,941	1,166	-25	6,254***	4,821**	3,508	-602	114
	(4,502)	(4,234)	(9,226)	(4,217)	(11,282)	(4,541)	(4,279)	(9,446)	(4,286)	(11,615)	(2,193)	(2,151)	(4,484)	(1,526)	(4,866)
Observations	74	74	70	74	70	72	72	68	72	68	64	64	60	64	60
Number of countries	37	37	35	37	35	36	36	34	36	34	32	32	30	32	30
R-squared	0.156	0.281	0.369	0.347	0.518	0.163	0.285	0.371	0.346	0.525	0.133	0.229	0.351	0.678	0.743

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: ODA effects on AIDS-related deaths: Robustness tests for major donors

	(1)	(2)	(3)	(4)
		Multilateral		
	DAC countries	(Global Fund)	US	PEPFAR
2nd period	6,377	14,925	-6,779	-8,326
	(19,952)	(9,629)	(20,592)	(21,078)
Treatment	5,964	-2,736	6,865	7,843
	(10,702)	(4,359)	(10,556)	(11,929)
Treatment * 2nd period	-19,854	-849	-29,319*	-33,963**
	(14,988)	(5,780)	(14,910)	(16,645)
AIDS deaths	0.237	0.632***	0.209	0.197
	(0.187)	(0.219)	(0.198)	(0.211)
AIDS deaths * 2nd period	-0.068	-0.519*	0.134	0.174
	(0.210)	(0.275)	(0.228)	(0.243)
Log population	0.00051**	0.00003	0.00053**	0.00054**
	(0.00024)	(0.00016)	(0.00024)	(0.00025)
Log population * 2nd period	-0.00064*	-0.00022	-0.00096***	-0.00101***
	(0.00032)	(0.00025)	(0.00034)	(0.00350)
Log GDP per capita	3.094	-3.114*	3.519	3.599
	(4.274)	(1.776)	(4.274)	(4.363)
Log GDP per capita * 2nd period	-0.818	2.174	-4.341	-4.752
	(6.201)	(2.274)	(6.164)	(6.290)
Control of corruption	6,593	-12,992**	7,419	7,227
	(9,672)	(5,468)	(9,550)	(9,756)
Control of corruption * 2nd period	-712	6,027	-11,282	-11,264
	(13,081)	(7,162)	(13,264)	(13,515)
Public health expenditure	2,116	6,792**	895	574
	(4,733)	(3,279)	(5,884)	(6,218)
Public health exp. * 2nd period	-3,509	-7,466**	4,519	5,827
	(7,072)	(3,616)	(8,167)	(8,559)
Civil war	-6,073	-7,261*	-5,869	-6,189
	(10,541)	(4,189)	(10,047)	(10,349)
Civil war * 2nd period	1,729	7,633	-4,159	-3,264
	(16,829)	(6,819)	(16,174)	(16,535)
Constant	-3,766	-17,381**	-1,596	-1,190
	(15,932)	(8,459)	(16,582)	(16,985)
Observations	60	48	58	56
Number of countries	30	24	29	28
R-squared	0.517	0.812	0.546	0.552

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix A: Definition of variables and sources

Variable	Definition	Source
People living with HIV	Estimated number of people living with HIV by country, 1998-2007	UNAIDS (http://www.unaids.org/en/KnowledgeCentre/HIVData/ GlobalReport/2008/2008_Global_report.asp)
AIDS deaths	Number of AIDS deaths in adults and children by country, 1998-2007	UNAIDS
HIV prevalence rate	Adult (15-49) HIV prevalence, percent by country, 1998-2007	UNAIDS
ODA	Official development assistance, commitments, US$ per capita of the recipient country's population, constant prices of 2008, 1998-2007	OECD, CRS (http://stats.oecd.org/Index.aspx?DatasetCode=CRSNEW)
Population	Population of the recipient country at the beginning of each period (1998, 2003)	World Development Indicators (WDI), http://databank.worldbank.org/ddp/home.do (accessed: July 2010)
GDP per capita	GDP per capita of the recipient country at the beginning of each period (1998, 2003), US$, constant prices of 2000	World Development Indicators (WDI)
Control of corruption	Control of corruption of the recipient country at the beginning of each period (1998, 2003)	World Bank's Worldwide Governance Indicators (WGI), http://info.worldbank.org/governance/wgi/index.asp
Public health expenditure	Public health expenditure as a share of GDP of the recipient country at the beginning of each period (1998, 2003), in percent	Institute for Health Metrics and Evaluation (IHME), http://www.healthmetricsandevaluation.org/resources/datasets/2010/public_financing_health.html, variable: GHE-S/GDP, WHO
Civil war	Dummy variable set equal to one if a major internal armed conflict (at least 1,000 battle-related deaths in one year) occurred in the recipient country during the respective period (1998-2002, 2003-2007)	UCDP/PRIO Armed Conflict Dataset v.4-2009, http://www.pcr.uu.se/research/UCDP/data_and_publications/datasets.htm

Appendix B: Descriptive statistics (year 2003)

	Control group					Treatment group				
	Obs.	Mean	Std. Dev.	Min	Max	Obs.	Mean	Std. Dev.	Min	Max
People living with HIV (level)	24	251,013	486,786	2,200	2,400,000	23	740,244	1,138,644	4,600	5,300,000
AIDS deaths (level)	24	18,050	33,607	200	160,000	23	55,404	69,160	200	270,000
HIV prevalence rate (level)	24	2.3	1.4	1.1	5.9	23	9.7	8.6	1.2	26.6
Population	24	20,100,000	30,200,000	251,955	134,000,000	23	14,700,000	17,800,000	487,301	70,900,000
GDP per capita	23	1,006	1,285	83	4,020	23	1,364	1,961	124	8014.387
Control of corruption	24	-0.65	0.58	-1.51	1.22	23	-0.63	0.65	-1.74	1.07
Public health expenditure	23	1.68	0.94	0.00	4.56	23	2.35	1.61	0.55	7.29
Civil war	24	0.08	0.28	0	1	23	0.09	0.29	0	1

Appendix C: HIV prevalence and ODA in sample countries (treatment and control group)

Country	HIV prevalence rate 2003	ODA pc 1998 -2002 (mean)	ODA pc 2003 - 2007 (mean)	Difference	Treatment group
Botswana	25.9	1.85	40.25	38.40	1
Namibia	15.2	2.90	36.09	33.20	1
Guyana	2.5	1.11	26.86	25.75	1
Swaziland	26.6	1.85	18.48	16.62	1
Lesotho	23.7	0.88	10.97	10.09	1
Zambia	15.2	2.30	12.13	9.82	1
Rwanda	3.7	1.03	9.06	8.03	1
Haiti	2.2	0.68	6.28	5.60	1
South Africa	17.9	0.41	5.80	5.38	1
Mozambique	11.5	1.23	6.56	5.33	1
Kenya	7.0	1.15	6.16	5.00	1
Uganda	6.9	1.39	6.09	4.70	1
Malawi	12.8	1.95	6.28	4.33	1
Tanzania, United Rep. of	6.7	0.83	4.83	3.99	1
Zimbabwe	22.7	1.50	5.48	3.98	1
Suriname	1.7	0.07	3.59	3.52	1
Equatorial Guinea	3.7	0.49	3.71	3.22	1
Cambodia	1.2	0.89	4.05	3.16	1
Ethiopia	2.2	0.32	2.93	2.61	1
Cote d'Ivoire	5.3	0.21	2.42	2.20	1
Trinidad and Tobago	1.4	0.22	2.40	2.18	1
Liberia	1.5	0.04	2.20	2.16	1
Central African Republic	6.4	0.57	2.61	2.04	1
Mali	1.5	0.35	2.36	2.01	0
Belize	2.1	0.15	2.14	1.99	0
Togo	3.5	0.08	2.04	1.97	0
Gabon	5.9	0.14	1.99	1.85	0
Dominican Republic	1.2	0.44	2.02	1.58	0
Benin	1.3	0.74	2.23	1.49	0
Angola	1.9	0.14	1.59	1.45	0
Burkina Faso	1.9	0.82	2.19	1.37	0
Barbados	1.2	0.00	1.25	1.25	0
Congo	4.0	0.41	1.56	1.16	0
Sierra Leone	1.5	0.30	1.26	0.96	0
Guinea-Bissau	1.9	0.29	1.19	0.90	0
Congo, Dem. Rep. of the	1.4	0.08	0.92	0.84	0
Burundi	2.9	0.87	1.68	0.80	0
Cameroon	5.7	0.40	1.14	0.74	0
Ukraine	1.1	0.00	0.64	0.64	0
Thailand	1.5	0.06	0.64	0.59	0
Nigeria	3.2	0.60	1.18	0.58	0
Ghana	2.2	1.08	1.59	0.51	0
Sudan	1.4	0.01	0.51	0.50	0
Guinea	1.4	0.71	0.98	0.27	0
Eritrea	1.2	2.02	2.20	0.18	0
Jamaica	1.5	2.92	2.81	-0.11	0
Chad	3.5	0.63	0.43	-0.21	0

Ranked according to difference in ODA, (2003-2007) minus (1998-2002)

Appendix D: Countries in the respective treatment and control groups

	Difference in ODA, (2003-2007) minus (1998-2002)	Table 1	Table 2					Table 3	
			Column (1), (5)	Column (2), (6)	Column (3), (7)	Column (4)	Column (8)	DAC countries	Multilateral
Treatment group									
Botswana	38.4	X		X	X	X	X	X	
Namibia	33.2	X		X	X	X	X	X	
Guyana	25.8	X	X	X		X		X	
Swaziland	16.6	X		X	X	X	X		X
Lesotho	10.1	X		X	X	X	X		X
Zambia	9.8	X		X	X	X	X	X	
Rwanda	8.0	X	X	X	X	X	X	X	
Haiti	5.6	X	X	X		X	X	X	
South Africa	5.4	X		X	X	X	X	X	
Mozambique	5.3	X		X	X	X	X	X	
Kenya	5.0	X		X	X			X	
Uganda	4.7	X		X	X	X	X	X	
Malawi	4.3	X		X	X	X	X		X
Tanzania, United Rep. of	4.0	X		X	X	X	X	X	
Zimbabwe	4.0	X		X	X	X	X	X	
Suriname	3.5	X	X	X		X			X
Equatorial Guinea	3.2	X	X	X	X	X			X
Cambodia	3.2	X	X	X		X	X	X	
Ethiopia	2.6	X	X		X	X	X		X
Cote d'Ivoire	2.2	X	X		X	X	X	X	
Trinidad and Tobago	2.2	X	X			X			X
Liberia	2.2	X	X		X	X	X		X
Central African Republic	2.0	X			X	X	X		X
Control group									
Mali	2.0	X	X		X	X	X	X	X
Belize	2.0	X	X			X		X	X
Togo	2.0	X	X		X	X	X	X	X
Gabon	1.9	X			X	X	X	X	X
Dominican Republic	1.6	X	X	X		X	X	X	X
Benin	1.5	X	X	X	X	X	X	X	X
Angola	1.4	X	X	X	X	X	X	X	X
Burkina Faso	1.4	X	X	X	X	X	X	X	X
(Barbados)	1.3	X	X	X		X		X	X
Congo	1.2	X	X	X	X	X	X	X	X
Sierra Leone	1.0	X	X	X	X	X	X	X	X
Guinea-Bissau	0.9	X	X	X	X	X		X	X
Congo, Dem. Rep. of the	0.8	X	X	X	X			X	X
Burundi	0.8	X	X	X	X	X	X	X	X
Cameroon	0.7	X	X	X	X	X	X	X	X
(Ukraine)	0.6	X	X	X		X		X	X
Thailand	0.6	X	X	X		X	X	X	X
Nigeria	0.6	X	X	X	X	X	X	X	X
Ghana	0.5	X	X	X	X	X	X	X	X
Sudan	0.5	X	X	X		X	X	X	X
Guinea	0.3	X	X	X	X	X	X	X	X
Eritrea	0.2	X	X	X	X	X		X	X
Jamaica	-0.1	X	X	X		X		X	X
Chad	-0.2	X	X	X	X	X	X	X	X

	Table 4		
	US	PEPFAR	Global Fund
Treatment group			
Botswana	X	X	
Namibia	X	X	
Guyana	X	X	
Swaziland			X
Lesotho			X
Zambia	X	X	
Rwanda	X	X	
Haiti	X	X	
South Africa	X	X	
Mozambique	X	X	
Kenya	X	X	
Uganda	X	X	
Malawi			X
Tanzania, United Rep. of	X	X	
Zimbabwe			
Suriname			X
Equatorial Guinea			X
Cambodia	X		
Ethiopia			X
Cote d'Ivoire	X	X	
Trinidad and Tobago			
Liberia			X
Central African Republic			X
Control group			
Mali	X	X	X
Belize	X	X	X
Togo	X	X	X
Gabon	X	X	X
Dominican Republic	X	X	X
Benin	X	X	X
Angola	X	X	X
Burkina Faso	X	X	X
(Barbados)	X	X	X
Congo	X	X	X
Sierra Leone	X	X	X
Guinea-Bissau	X	X	X
Congo, Dem. Rep. of the	X	X	X
Burundi	X	X	X
Cameroon	X	X	X
(Ukraine)	X	X	X
Thailand	X	X	X
Nigeria	X	X	X
Ghana	X	X	X
Sudan	X	X	X
Guinea	X	X	X
Eritrea	X	X	X
Jamaica	X	X	X
Chad	X	X	X

For countries in brackets control variables have missing values.