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The impact of aid on total government expenditures

New evidence on fungibility

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Abstract Aid is said to be fungible at the aggregate level if it raises government expenditures by less than the total amount. This happens when the recipient government decreases domestic revenue, decreases net borrowing, or when aid bypasses the budget. This study makes three contributions to both fungibility and fiscal response literature. First, fungibility at the aggregate level is re-examined on a bigger recent panel dataset, distinguishing between short- and long-term impact of aid. The results indicate that aid is partly fungible in the long run and highly fungible in the short run. Second, to account for aid bypassing the budget, technical cooperation is used as a proxy for off-budget aid. Off-budget aid is found to be non-fungible and on-budget aid is partly fungible. Third, fungibility of bilateral and multilateral aid is analysed: the results indicate lower fungibility of multilateral aid.

Keywords: foreign aid, fungibility, fiscal response, government expenditures
JEL classification: E62, F35, H50, O23.

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1 Introduction

Over the last 40 years aid[1] has accounted for a substantial part of developing countries' GDP and has been one of the main sources of government revenues in these countries. The empirical literature has tried (especially from the mid 1990s) to quantify aid's impact on growth and well-being in developing countries. The results were mixed in the studies up to 2009 (for reviews and discussion see, for example, Tarp 2006; Roodman 2007; Arndt et al. 2010). However, the most recent literature (see Arndt et al. 2010, 2011, 2014; Alvi and Senbeta 2012; Juselius et al. 2014; Mekasha and Tarp 2013; Galiani et al. 2014) mostly reports a positive impact of aid, although smaller than expected in the 1970s and 1980s.[2] A large part of aid goes to the public sector. Therefore, to better understand the impact of aid on growth and poverty reduction, it is crucial to determine the impact of aid on the behavior of one of the major actors in the development process, i.e. the recipient government.

Two strands of literature focus on the impact of development assistance on the behavior of recipient governments: fungibility studies and fiscal response studies. This article contributes to both. Fungibility is a broad term that describes situations when recipients respond to aid by changing the way they use their own resources. Aid is called fungible if the provision of goods and services intended by the donor is not fully achieved, because aid was used for other purposes.[3] McGillivray and Morrissey (2004) and Morrissey (2014) distinguish three types of fungibility: general fungibility, sector (categorical) fungibility, and the additionality of aid.[4] General fungibility describes a situation when aid intended to finance public investment is diverted to government consumption. Aid is fungible on a sector (categorical) level if it is intended for one sector, but at the margin finances expenditures in other sectors.

This study focuses on the third aspect of fungibility: the additionality of aid.[5] It investi-

[1] This article uses standard terminology from the aid effectiveness literature. Official Development Assistance (ODA) is called aid, foreign aid, or development assistance. Also, the terms total aid and aggregate aid are used interchangeably to describe aid that is not disaggregated.

[2] Nevertheless, the debate is still ongoing. For example, Nowak-Lehmann et al. (2012) (and Herzer et al. 2014) find insignificant impact of aid on per-capita income, but their approach is criticized by Lof et al. (2014a) and Lof et al. (2014b).

[3] This is not the original meaning of this word, but this is the way fungibility is used in the literature. Owen Bader discusses the use of fungibility in development context in his blog: http://www.owen.org/blog/3224 (accessed May 2014). To avoid confusion, the current paper defines the way the term fungibility is used in the introduction.

[4] A theoretical discussion of fungibility is presented in McGillivray and Morrissey (2000, 2001b).

[5] Note that the concerns that fungibility may be a red herring and that it distracts attention from more important issues, expressed by McGillivray and Morrissey (2000) and McGillivray and Morrissey (2001a),

gates by how much an additional euro of aid increases total government expenditures. At the aggregate level,[6] aid is fungible when one additional euro of aid increases total government expenditures by less than one euro, and fully fungible when government spending does not increase at all. This can happen when aid channeled through the budget substitutes for other sources of government revenue. This way the government is able to decrease taxes, decrease borrowing, or increase its reserves.

Morrissey (2014) points out that there is surprisingly little evidence on the additionality of aid. Although there is some evidence that aid is partly fungible at the aggregate level, the extent of fungibility of aid and its components and the importance of fungibility for the development process are still under debate. This study provides evidence on the extent of fungibility at the aggregate level, using a rich dataset of 118 countries for the period 1980–2012. I take into account the dynamic properties of the process, discuss endogeneity of aid in regressions, and explicitly distinguish between the short- and long-term impact of aid. The focus of the fungibility literature is on the short-term effects of aid: it tests whether aid increases government expenditures in the same year. However, aid may also have a long-term effect on the level of government expenditures. Investment in e.g. water supply and sanitation may reduce water-related diseases and in the long term decrease health spending and total government expenditures. Moreover, since aid is usually committed for a longer period, donors may be more interested in a long-term impact of aid on government behavior rather than short-term adjustments. The inclusion of lagged government expenditures and data averaged over several years allow to estimate the long-term impact of aid on government expenditures. Furthermore, a change in government expenditures may be different depending on whether aid is increasing or decreasing, especially if the change in aid disbursement is unexpected. This study also tests the hypothesis of symmetric response to increases and decreases of aid.

If government expenditures do not increase by the amount of aid disbursed, it follows from the government budget constraint that domestic revenues adjust, or the net borrowing

relate mostly to categorical fungibility. McGillivray and Morrissey (2001a) stress that "*the relevant concern is not fungibility* per se *but how aid impacts on total spending and financing and how spending plans are implemented*" (p. 118).

[6]Following Chatterjee et al. (2012) and Devarajan and Swaroop (2000) the term "fungibility at the aggregate level" is used interchangeably with "additionality of aid." Moreover, unless otherwise specified, fungibility refers to fungibility at the aggregate level, and not to general or categorical fungibility.

adjusts, or that aid bypasses the budget. This study investigates two out of these three channels: off-budget aid and government revenues.[7]

A large part of aid is never recorded in the budget, either because it is spent in the donor country, or because it directly reaches ultimate beneficiaries. The differences between these two components of aid should be taken into account, as on-budget aid has a direct impact on government expenditures, whereas the impact of off-budget aid is indirect because it is not recorded in the budget. Van de Sijpe (2013b) made the first attempt at distinguishing between recorded and unrecorded aid flows at the sectoral level. I follow this approach at the aggregate level and estimate the impact of on- and off-budget aid on government expenditures.

The impact of aid on government revenues is especially interesting for donors, as they are worried that aid may discourage tax effort and lead to lower domestic revenues of the government. This study provides additional evidence on the impact of aid on total government revenues and contributes to the fiscal response literature.

Fungibility of aid has been tested at the aggregate, sectoral, and regional level. Aid can also be disaggregated into bilateral and multilateral components. Ram (2003) points out that bilateral and multilateral aid differ for at least three reasons: (i) donor motives, (ii) aid conditionalities, and (iii) closeness of the relationship between the donor and the recipient. Therefore, fungibility analysis should account for possible differences. To my knowledge, the fungibility of bilateral and multilateral aid has not been investigated using data from the last two decades. This study fills this gap.

The paper proceeds as follows. The next section presents a literature review. Section three describes the data. Section four focuses on methodology and the choice of controls. Afterwards, the results for aggregate aid are presented in section five. Section six discusses and presents results for off- and on-budget aid, and section seven for bilateral and multilateral aid. The robustness of the results is tested in section eight. Section nine concludes.

[7]Since data on domestic revenues are not available, this article investigates the impact of aid on total government revenues. Moreover, reliable data on net borrowing are not available (see Appendix A).

2 Literature review

There is a large literature that investigates categorical and general fungibility.[8] Generally, aid is found to be fungible at both sector and general levels, however Morrissey (2014) points out that the extent of general and categorical fungibility is overstated because part of aid never reaches the recipient country's budget.

Fungibility detected at the sectoral or regional level does not mean that aid is fungible at the aggregate level. Aid intended for the health sector that is diverted to roads may still increase total government expenditures by the full amount. In this case aid is not fungible at the aggregate level. For example, Devarajan et al. (2007) report fungibility of aid at the sectoral level, while finding that at the aggregate level each dollar of aid leads to a 90 dollar cent increase in government expenditures in a sample of 18 Sub-Saharan African countries in the period 1971–1995. In a similar study, Feyzioglu et al. (1998) show that for their sample of 14 countries aid is not fungible at the aggregate level and that there is no tax relief that could be associated with fungibility. However, the number of observations is very small and, additionally, this result is not robust. Namely, when the number of countries is increased, aid appears to be fungible.[9] Remmer (2004) uses an error correction model and finds a positive relationship between aid and government expenditures both in the short and in the long term. Arndt et al. (2014) investigate the cumulative effect of aid over 40 years treating the impact of aid on government consumption and government revenues as an intermediate result. They find a positive effect of aid on both measures.

Chatterjee et al. (2012) is the closest study to the current article. They analyze fungibility at the aggregate level and the impact of disaggregated aid (into investment aid, non-investment aid, and social infrastructure aid) on various measures of government expenditures. The major differences compared to the current study are: (i) their sample covers the period 1972–2000, and consists of 67 countries, (ii) off-budget aid is not taken into account, (iii) they do not distinguish between the short- and long-term impact of aid, (iv) I investigate bilateral and multilateral aid, they focus on investment and non-investment aid, and aid to social infrastructure. In addition to the fixed effects model, they use difference and system

[8] See for example: Pack and Pack (1990, 1993); Feyzioglu et al. (1998); Swaroop et al. (2000); Van de Walle and Cratty (2005); Van de Walle and Mu (2007); Pettersson (2007a,b); Van de Sijpe (2013b,a). The literature reviews are provided by McGillivray and Morrissey (2001b); Morrissey (2014).

[9] McGillivray and Morrissey (2000) point out concerns about this study.

General Method of Moments (GMM) estimators, as well as IV methods (both discussed in Marć 2015). The dynamic specification is not used. They find that at the aggregate level the coefficient of aid's impact is 0.3, and the results are similar for the methods that try to account for the endogeneity of aid.[10]

Fungibility of aid at the aggregate level may indicate that recipient governments are decreasing their own tax efforts and that aid is substituting government revenues. As it is a particular concern for donors, parallel literature of fiscal response studies is investigating the impact of aid on government revenues and borrowing, often uses methods and datasets similar to the fungibility literature. Clements et al. (2004) find, for a sample of 107 countries in the period 1970–2000, that concessional loans increase domestic revenue, whereas grants are found to be fungible. Crivelli et al. (2012) confirm this result for a sample of 118 countries for the period 1980–2009 in a follow-up study. Clist and Morrissey (2011) change this specification slightly and conclude that both grants and loans are encouraging tax effort.

A wide review of the fiscal effects of aid (in particular, fungibility and fiscal response studies) was provided by McGillivray and Morrissey (2001b). Morrissey (2012, 2014) provides a recent literature review on the effects of aid on government spending and tax efforts. He points out that there is very little evidence on whether government expenditures increase fully by the amount of aid received, which is the main topic of this article.

The impact of bilateral and multilateral aid on government expenditures is analyzed by Cashel-Cordo and Craig (1990). They use a sample of 46 Least Developed Countries in the period 1975–1980. Bilateral aid, which is described as a relatively unconstrained type of development assitance, is found to be primarily a substitute for own government expenditures, while more constrained multilateral aid has a significant impact on expenditures. However, Gang and Khan (1990), analyzing India's expenditures, find that grants, loans, and multilateral aid have no significant impact on government expenditures, while bilateral aid induces transfers of domestic public resources from non-investment to investment for development purposes.

[10] In the working paper version (Chatterjee et al., 2007), the link between fungibility and growth is made. Chatterjee and coauthors suggest that since there is no significant effect of foreign aid on growth in the presence of fungibility, fungibility can be the missing link that explains the mixed results of growth regressions. Conversely, Pettersson (2007b), using 57 country-specific estimates of fungibility incorporated into a growth model, finds no evidence that non-fungible aid is more effective for growth than fungible aid. Morrissey (2014) reviews the literature and notes that fungible aid does not seem to be less effective than non-fungible aid.

3 Data

This study employs the most recently available data that cover the period 1980–2012 for 118 countries. The analysis is limited to countries that have received aid inflows in this period and are listed as Least Developed Countries and Other Low Income Countries (together called LDCs henceforth), Lower and Middle Income Countries and Territories (LMICs), and Upper and Middle Income Countries (UMICs). Countries were classified according to the World Development Classification for 2009 (see Appendix B for the list of countries and a discussion). The 118 countries in the sample can be classified as follows: 35 LDCs, 50 LMICs, and 33 UMICs. There are 49 African countries, 31 are from Asia, 8 are from Europe, 7 are from Oceania, and 23 are from Central and South America. Compared to the previous studies that analyzed fungibility at the aggregate level presented in the literature review, the sample covers more countries and more years, which results in a substantially larger number of observations. Moreover, it can be expected that the data collection mechanisms have improved over the years, and thus that the recent data are of a better quality.

The data and sources are described in more detail in Appendix A. In general, the variables used in this study can be divided into three types: public spending variables, aid variables, and control variables. The dependent variable is total government spending or government revenue[11] as a share of GDP from the International Monetary Fund's (IMF's) World Economic Outlook (WEO). Among the independent variables, the Official Development Assistance (ODA) is of the main interest. The data for aggregate aid disbursements, as well as for bilateral aid, multilateral aid, and technical cooperation (all in current dollars) are obtained from OECD's Development Assistance Committee database, Table DAC2a.[12] All aid variables are expressed as a share of the aid-recipient's GDP, where GDP (in current dollars) is taken from the WEO. The control variables are obtained mostly from the World Development Indicators (WDI): agricultural value added as a share of the aid-recipient's GDP, annual growth of GDP (%), GDP per capita in constant dollars (PPP), literacy rate, annual population growth (%), population, and sum of exports and imports of goods and

[11] Government revenue is described as the sum of "taxes, social contributions, grants receivable, and other revenue" (WEO dataset). Therefore, it also includes at least part of on-budget aid. It does not include net borrowing and lending. To make the distinction clear, the term domestic revenues is used to describe government revenues minus any financing from abroad.

[12] Available at http://stats.oecd.org/, under Development → Other.

services as a share of GDP. Furthermore, the annual inflation rate (%) is obtained from the WEO. Finally, the U.S. Census Bureau's international database (IDB) provides the data on infant mortality rates.

The control and aid variables are almost complete for the whole period. Therefore, the sample size is determined by the availability of the dependent variables: for many countries government expenditures and government revenues are missing in the 1980s, and for some countries in the 1990s. The data are almost complete from 2000 onwards.

Table 1: The share of government expenditures and aid by several characteristics, unweighted (Un) and weighted by GDP (W)

	Gov. (% GDP)		Aid (% GDP)		Bil aid (% GDP)		Mul aid (% GDP)	
	Un	W	Un	W	Un	W	Un	W
All	28,49	24,26	8,58	0,90	5,46	0,58	2,89	0,29
LDCs	21,92	19,10	13,59	9,01	7,87	5,43	5,47	3,47
LMICs	31,82	22,80	8,69	0,59	6,12	0,41	2,29	0,17
UMICs	30,59	30,17	2,77	0,46	1,71	0,30	0,94	0,15
Africa	26,60	28,50	10,75	3,20	6,26	1,98	4,27	1,17
Asia	26,49	22,07	5,47	0,51	3,19	0,35	1,81	0,14
Europe	37,99	37,90	3,53	0,71	1,91	0,36	1,47	0,33
Oceania	45,75	32,45	21,94	8,31	18,48	7,24	3,38	1,05
Latin America	25,55	25,75	4,10	0,70	2,53	0,52	1,53	0,18
1980-1989	27,85	23,06	8,30	1,17	5,13	0,70	2,66	0,40
1990-1999	27,71	20,70	9,40	1,16	5,86	0,74	3,39	0,39
2000-2012	28,87	25,25	8,19	0,81	5,40	0,54	2,68	0,26
China	19,96	20,15	0,24	0,13	0,16	0,09	0,07	0,03
India	25,66	26,27	0,48	0,28	0,24	0,16	0,24	0,12

Notes: own calculations based on IMF and OECD data. Total aid includes aid from non-DAC (Development Assistance Committee) donors.

Table 1 reports the means of the main variables. The unweighted share of government expenditures in GDP is the smallest among LDCs and at a similar level among LMICs and UMICs. Europe and Oceania have a much higher level of expenditures than the remaining three continents. For the total sample the share of government expenditures remained relatively constant over the last 30 years. As expected, LDCs receive substantially more aid in relation to their GDP than higher income countries. Therefore, Africa and Oceania,

continents with a large number of LDCs, are the biggest aid recipients in relation to their GDP.[13]

Unweighted averages do not account for the fact that the biggest (both in terms of population and the size of economy) countries receive less per capita aid, and aid accounts for a small share of GDP. For example, India's share of aid surpassed 1% of GDP only in the early 1980s, while for China the highest share was in 1992 and equalled 0.6%. Table 1 also presents calculations weighted by total GDP (giving higher weight to bigger economies, but also to recent years, when GDP in most countries was higher than in the 1980s). When the size of the economy is taken into account, aid accounts for 0.90% of aid-recipients' GDP. The difference between LDCs and LMICs is even more stricking: aid constitutes more than 9.01% of GDP in the LDCs, which is more than 15 times the percentage it constitutes in the LMICs (which include China and India). In addition, differences between continents are substantial: Europe, South America, and Asia—continents with almost exclusively LMICs—have low shares of aid in GDP. Africa, having the majority of LDCs, and Oceania have a relatively high share. As a robustness check, I include regressions weighted by population and GDP to account for different patterns of the distribution of aid with respect to the size of countries.

4 Methodology and empirical framework

4.1 Analytical framework and the basic fixed effects model

The government budget constraint in any given period can be written as follows:[14]

$$GovernmentExpenditures = Revenues + Aid + NetBorrowing \tag{1}$$

where *Revenues* are domestic revenues from taxes, natural resources, and other sources. In this equation, *Aid* represents the part of the ODA that goes through and is recorded in the budget. It follows from this equation that in response to an increase of on-budget aid,

[13]Due to the concerns about the data quality and due to the fact that off-budget aid accounts for a very small (less than 0.5%) share of GDP, non-DAC members donations are not included in the analysis of disaggregated aid.

[14]The analytical framework follows e.g. Clements et al. (2004) with modifications.

government can either: (i) adjust its expenditures, (ii) adjust domestic revenues, (iii) adjust borrowing, or do any combination of the three. These possibilities are discussed by Clements et al. (2004).

At the aggregate level, the fungibility literature focuses on the impact of aid on total government expenditures. The approach most widely used in the literature is a panel data regression with country and year fixed effects, using annual data. For aggregate aid, the reduced form equation is the following:

$$GovExp_{it} = \alpha AID_{it} + \beta X_{it} + \gamma_t + \delta_i + \varepsilon_{it} \tag{2}$$

where $GovExp_{it}$ represents the share of government expenditures in GDP and AID_{it} the share of ODA (or its components) in GDP. X_{it} is a set of controls, γ_t are year fixed effects, δ_i represents the recipient country's fixed effects, and ε_{it} is an error term. Subscript 'i' refers to a recipient country and 't' to year. In this model, α is the coefficient of main interest: if α is equal to 1, aid is non-fungible. A value of α less than 1 but greater than 0 means that aid is partially fungible, and α equal to 0 indicates that aid is fully fungible.[15] In these cases, $(1 - \alpha)$ gives the extent of fungibility. Finally, α bigger than 1 provides evidence for the "crowding-in" effect (often referred to as the "flypaper effect" in the fungibility literature),[16] the situation in which one euro of aid leads to more than one euro increase in government expenditures.[17]

It is important to analyze the implications from the reduced form equation (2) in light of equation (1). If aid is estimated to be fully fungible, so that an increase in aid does not lead to an increase in government expenditures, this means that domestic revenues or net borrowing (or both) decrease. However, if total aid is not disaggregated into on- and

[15] Formally, full fungibility occurs if the impact of aid is not greater than the marginal effect of unconditional resources (domestic revenues and net borrowing) (Devarajan et al., 2007). However, as neither data for the domestic revenues, nor for the net borrowing are available, I assume that the marginal effect of unconditional resources is zero.

[16] Originally, the "flypaper effect" was used to describe the empirical phenomenon that grants from the higher level government to local governments increase local spending by more than local income of equivalent size would (see e.g. Hines and Thaler 1995). In the fungibility literature, the flypaper effect is also quite often used to describe a situation when recipient's expenditures increase by more than the amount of aid received (Leiderer, 2012; Pettersson, 2007b). See McGillivray and Morrissey (2000) for discussion.

[17] McGillivray and Morrissey (2001a) offer four theoretical scenarios where the inflow of aid leads to a greater increase in public expenditures than the value of aid in recipient countries. These may happen because of misconceptions or illusions regarding either the real or nominal value of the aid inflow. They show that it is even possible if own government revenues decrease.

off-budget components in equation (2), an estimate of α smaller than one may also mean that aid bypasses the budget (off-budget aid is discussed in Section 6).[18]

Equation (2) is a starting point to investigate the impact of aid on government expenditures using the panel dataset described in Section 3. Bertrand et al. (2004) and Cameron and Trivedi (2005) point out that outcomes are serially correlated in panel data. When serial correlation in errors is not accounted for, standard errors are underestimated and the null hypothesis of no effect is rejected too often. I use the Wald test to check for serial correlation of errors in the linear panel data model. The null hypothesis of no correlation is equivalent to the residuals having -0.5 autocorrelation in the first difference model. For all specifications, the hypothesis of no serial correlation is rejected. This result is confirmed by the autocorrelation test designed by Arellano and Bond (1991). On the basis of Monte Carlo simulations, Bertrand et al. (2004) suggest using a heteroskedasticity and autocorrelation consistent (HAC) estimate for the variance-covariance matrix as a solution to this problem. This solution works well when the number of groups is sufficiently large, which can be reasonably assumed in this sample consisting of 118 countries. Therefore, to account for autocorrelation, standard errors are clustered at the country level.

4.2 Dynamic panel data model

Van de Sijpe (2013b) points out that the presence of serial correlation may indicate the dynamic misspecification of the model. A second indication that the model may be dynamically misspecified comes from the comparison of fixed effects (FE) estimates (within-estimator) and the first difference (FD) model. The first difference estimates are found to be smaller than the fixed effects estimates suggesting a violation of the strict exogeneity assumption.[19] This indicates that both FD and FE estimates are inconsistent with different probability limits.

The autocorrelation and differences between FD and FE estimates suggest that a model of public expenditures requires a dynamic specification. Indeed, the correlation of current and lagged values of government expenditures is very high. Inclusion of the lagged dependent variable may solve this problem and remove autocorrelation in errors.

[18] It may also happen that the estimated impact of aid is downward biased because part of aid is embezzled before it reaches the government budget (and before it is recorded there).

[19] Detailed results are available upon request.

Roodman (2009) points out that when the number of periods is large, dynamic panel bias becomes insignificant[20] and the fixed effects estimator can be used. Compared to GMM models discussed in Marć (2015), this estimator requires fewer assumptions and the results are less sensitive to the researcher's choices. Therefore, in addition to a standard fixed effects model presented in the previous section, a fixed effects model with a lagged dependent variable is used as well. This model is of the form:

$$GovExp_{it} = \rho GovExp_{it-1} + \alpha AID_{it} + \beta X_{it} + \gamma_t + \delta_i + \varepsilon_{it} \tag{3}$$

The inclusion of a lagged dependent variable not only solves the dynamic misspecification problem, but also allows to estimate a long-run effect of foreign aid on government expenditures. In the steady state, equation (3) can be rewritten as:

$$GovExp_i = \frac{\alpha}{1-\rho} AID_i + \frac{\beta}{1-\rho} X_i + \frac{\delta_i}{1-\rho} + \frac{\varepsilon_i}{1-\rho} \tag{4}$$

The presence of a lagged dependent variable changes the way fungibility coefficients should be analyzed. In this equation α measures the short-term adjustment effect of aid on government expenditures, whereas the long-run effect is equal to $\alpha_{LR} = \alpha/(1-\rho)$.

Alternatively, to estimate medium- and long-term impact of aid on government expenditures, data are averaged over three, four, and five years, after which equations (2) and (3) are estimated. This approach has been widely used in the parallel literature on the impact of aid on growth, since averaged data reduce both business cycle effects and measurement errors. Furthermore, Arndt et al. (2010, 2014) argue that the impact of aid on growth is a long-term process, so that it is more appropriate to use long panels, or even to use averages of time-series of all available data for each country.

For the relation between aid and government expenditures, averaging can also help to reduce the problem of measurement error and account for a business cycle that may influ-

[20]Dynamic panel bias is a result of correlation between a regressor and the error term caused by the demanding process of mean subtraction in the within estimator. Nickell (1981) discusses this bias. For a reasonably large value of T the bias approximates to $(\widehat{\rho}\text{-}\rho) \simeq -\frac{1+\rho}{T-1}$, so the persistence of y is always underestimated for $\rho > 0$. For $T = 10$ and $\rho = 0.5$ the bias will be -0.167, and for T around 30 it will be three times smaller and close to -0.05. The fact that the lagged dependent variable is likely underestimated means that the long-term impact of aid derived in the following equations may be, *ceteris paribus*, also underestimated. However, the direction of the bias of aid and other parameters in the fixed effects model is ambiguous (Juodis, 2013).

ence both the level of aid and the level of government expenditures. What is more, if the actual level of aid disbursement in a given year is not known to the government before the budget is planned, the estimate of the immediate response of government expenditures to aid may reflect a government's short-term capacity to manage additional resources rather than government's preferences over the optimal aid allocation. Unexpected inflows and outflows may be averaged out when longer time periods are used. As a result, an estimate of the impact of averaged aid on averaged government expenditures will better reflect government preferences.

However, averaging comes at the cost of decreasing the number of periods in a panel data setting. The estimates from equation (3) may be biased due to the inclusion of a lagged dependent variable (the dynamic bias decreases with the number of periods, as previously noted).[21] The difference and system GMM estimators which are used to account for the dynamic panel bias are discussed and applied to the same dataset in Marć (2015).

4.3 Endogeneity

The process of aid determination makes it very likely for aid to be endogenous in various regressions. The issue of endogeneity has dominated the literature on the impact of aid on growth in the last 15 years. Various methods have been proposed to account for endogeneity, ranging from internal instruments in the difference or system GMM estimation (Alvi and Senbeta, 2012; Annen and Kosempel, 2009; Rajan and Subramanian, 2008), through a standard set of instruments that include recipient country characteristics and log of population size (proposed by Boone 1996), and often include also the donor-recipient interaction (among others: Burnside and Dollar 2000; Hansen and Tarp 2000, 2001; Dalgaard et al. 2004; Rajan and Subramanian 2008; Arndt et al. 2010, 2014), to quasi-experiments (Galiani et al., 2014). The majority of studies find evidence for the positive impact of aid on growth and argue that the new and improved instruments are valid. However, Clemens et al. (2012), reviewing instrumental variables used in aid-growth studies, conclude that the search for strong instrument that does not raise important questions about its validity has not finished.[22]

[21] This does not apply to the results from equation (2).

[22] Further improvements of instrumentation strategies have been suggested by Bazzi and Clemens (2013). For a criticism of instrumentation strategies in the aid-growth literature see Deaton (2010).

Clearly, aid may also be endogenous when the impact of aid on total government expenditures is analyzed:

1. The level of government expenditures may be decided simultaneously with the level of aid inflow: McGillivray and Morrissey (2000) suggest that often the recipient can decide on the timing of aid disbursement. Then, e.g. a negative shock to revenues may cause increased inflows of aid.
2. Donors may focus on the provision of merit goods in countries that fail to provide them.
3. Countries with good policies may be allowed to treat part of their aid as fungible (Pettersson, 2007b).

However, in spite of these important reasons, it can be argued that the problem of endogeneity is less severe than in aid-growth studies. The simultaneity problem (point 1) can be reduced by averaging aid and government variables over time. Fixed effects can account for aid dependency or the indirect effect of good policies (point 3), provided these do not change over time. Even if donors target countries that fail at providing merit goods (point 2), that does not necessarily mean that the targeting will affect the level of government expenditures and that donors target also total expenditures.
Thus, there is a potential bias due to endogeneity. However, because this bias is expected to be small and because of the previously mentioned concerns about instrument quality, this study relies on non-instrumental methods of causal inference only. The usefulness of two instrumental methods used in the fungibility literature (the difference/system GMM and the instrument based on cultural and geographical proximity) is discussed in Marć (2015).

4.4 Asymmetric response to increases and decreases

Estimating the impact of development assistance also raises an interesting empirical question that has been largely ignored in the fiscal response literature: whether the response of the recipient government to increases and decreases in aid levels is asymmetric. The behavioral response of a government depends on various factors, including: i) government preferences, ii) aid conditionalities, iii) access to financial markets, iv) and access to other sources of revenue. For example, if the access to financial markets or other sources of revenue is limited,

a decrease in aid levels, especially an unexpected one, may have a large and immediate impact on the level of government expenditures. Conversely, additional aid may simply be stored at the central bank, without increasing the government expenditures.

The asymmetric response to increases and decreases is a popular topic in the literature analyzing resource price changes (Bachmeier and Griffin, 2003; Kilian and Vigfusson, 2011; Radchenko, 2005) and intergovernmental grants (Gamkhar and Oates, 1996; Stine, 1994). Following the latter literature that uses fixed effects models, I use two specifications. Firstly, change in aid is included if aid increases:

$$GovExp_{it} = \alpha_1 AID_{it} + \alpha_2 I_t(AID_{it} - AID_{it-1}) + \beta X_{it} + \gamma_t + \delta_i + \varepsilon_{it} \tag{5}$$

$$I_t = 1 \quad if \quad AID_{it} > AID_{it-1}, \quad and \quad I_t = 0 \quad otherwise$$

where I_t is a dummy variable equal to 1 when the share of aid in GDP increases. The null hypothesis is $\alpha_2 = 0$, which indicates symmetric response to increases and decreases. If the null hypothesis is rejected, α_1 is the response of government expenditures to an aid decrease, and α_2 is the response of government expenditures to an increase in aid, whereas α_1 to an increase in aid level.
Secondly, change in aid is included if aid decreases:

$$GovExp_{it} = \alpha_1 AID_{it} + \alpha_2 D_t(AID_{it} - AID_{it-1}) + \beta X_{it} + \gamma_t + \delta_i + \varepsilon_{it} \tag{6}$$

$$D_t = 1 \qquad if \quad AID_{it} < AID_{it-1}, \quad and \quad D_t = 0 \quad otherwise$$

where D_t is a dummy variable equal to 1 when the share of aid in GDP decreases. Again, the null hypothesis is $\alpha_2 = 0$, indicating symmetric response to increases and decreases. If the null hypothesis is not rejected, α_1 is the response of government expenditures to aid increase. If the null hypothesis is rejected, α_1 measures the response to an aid level decrease, and α_2 to a reduction in aid.

Alternatively, the difference in the response can be estimated directly from:

$$GovExp_{it} = \alpha_1 I_t AID_{it} + \alpha_2 D_t AID_{it} + \beta X_{it} + \gamma_t + \delta_i + \varepsilon_{it} \tag{7}$$

where α_1 is the impact of aid increases on government expenditures, and α_2 is the impact of aid decreases.

4.5 Controls

Variables that may explain the size of government expenditures, and hence provide a more precise estimate of the coefficient of main interest, and/or variables that are correlated with aid and cause estimates to be biased if not controlled for, are included in the initial set of controls. Plausible controls are tested in various configurations, both for aggregated and disaggregated aid.[23]

Five variables are used as controls: annual GDP growth in percentages (GDP growth), lagged annual inflation rate (L.Inflation), lagged agricultural value added as a share of GDP (L.Agr VA), lagged sum of imports and exports of goods and services as a share of GDP (L.Exp+imp in GDP), and lagged infant mortality rate per 1000 births (L.Infant mortality).[24]

Following Feyzioglu et al. (1998), Clements et al. (2004), and Chatterjee et al. (2012), agricultural value added is used to control for spending in the agriculture sector and, additionally, for the level of development. The infant mortality rate serves as a proxy for health-care and social security spending.

The growth variable should control for the response of government spending to short-run shocks in GDP per capita (Van de Sijpe, 2013b). As has been noted before, McGillivray and Morrissey (2000) suggest that recipients tend to have a large freedom of choice over the extent to which committed aid is disbursed in a single year. Hence, any shock to expenditures (proxied by the growth rate) would also affect the amount of aid disbursed, and aid would be correlated with the error term.

A ratio of a sum of imports and exports to GDP is used to capture the effect of openness of the economy on government expenditures. Rodrik (1998) shows that the size of government has been larger in most open economies due to the risk of external shocks. Alesina and

[23] Plausible controls are discussed in Appendix C. Regression results including these controls are discussed in Section 8.

[24] Some control variables may be non-stationary, for example agricultural value added or the infant mortality rate. Im-Pesaran-Shin and Fisher tests – stationarity tests that allow unbalanced panels – reject the null hypothesis that all panels contain a unit root for all variables in the sample. Moreover, the impact of aid on government expenditures remains similar when all control variables are excluded.

Wacziarg (1998) argue that this positive correlation is rather due to the country size, since trade openness and government expenditures are negatively correlated with the share of public consumption in GDP. This result was questioned recently by Ram (2009) who suggests that Rodrik's (1998) explanation may be the correct one. To show that, he uses a fixed-effects format to account for cross-country heterogeneity that was not taken into account by Alesina and Wacziarg (1998).

The inflation rate is included as a factor that has been found to be significantly related to cross-country variations in domestic revenues (Clements et al., 2004). It can increase revenues either when taxes are not indexed or through seigniorage.

Other controls include fixed effects that account for time-invariant factors like geography, colonial history, or the legal system. Additionally, fixed effects are expected to account for differences in reporting scopes of government expenditures (if the reporting methodology is constant over time). Year fixed effects are used to control for events that had an impact on all recipients in a given year.

Lagged control variables are used to account for potential simultaneity problems. The only exception is made for GDP growth, since it accounts for immediate responses of government expenditures to shocks. As a robustness check, current values of the control variables are used.

5 The impact of aggregate aid on total government expenditures

The first part of the analysis focuses on the impact of total aid on government expenditures. As noted before, an estimated coefficient of the share of aid smaller than one means that aid is partly fungible (fully fungible when the coefficient equals zero). If fungibility is detected, it means that part of aid is financing tax reductions, decreasing net borrowing, or bypasses the budget. As can be seen from Table 2, in the basic fixed effects specification, which is similar to specifications used in other fungibility studies (column [2]), fungibility of total aid $(1 - \alpha)$ is high for the sample of all countries and equals 0.855. This means that when the share of aid in GDP increases by one percentage point (pp), government expenditures as the share of GDP increase by 0.145 pp. The remaining 0.855 pp substitute expenditures, i.e.

are used to decrease taxes or borrowing needs, or bypasses the budget. Compared to the pooled Ordinary Least Squares (OLS) model (column [1]), which does not include country fixed effects, the estimate is smaller.

However, the Arellano-Bond test of autocorrelation rejects the null hypothesis of no autocorrelation for both models presented in columns [1] and [2], which suggests misspecification. As expected, including the lagged dependent variable accounts for autocorrelation. Tests for both first- and second-order serial correlation fail to reject the null of no autocorrelation in all three specifications with the lagged dependent variable. As has been noted before, even when strict exogeneity is violated due to the inclusion of a lagged dependent variable, for a long panel the dynamic bias becomes insignificant and the fixed effects estimator can be used (Roodman, 2009).[25]

The inclusion of the lagged dependent variable not only solves the problem of autocorrelation, but also allows to distinguish between short-term adjustments and long-term impact of aid on government expenditures. The fixed effects model in column [3] shows that approximately 92% of aid is fungible at the aggregate level in the short-run and 78% in the long run. This is confirmed in column [4] which includes total aid squared. Table 3 shows the results for three, four, and five year averages of data. These results suggest that the long-run estimate of the impact of aid on government expenditures is underestimated in the models that use annual data. The coefficient of short- (or medium-) term impact of aid increases in the number of years that the data are averaged over, and so does the estimate of the long-term impact. These results suggest that in the long run aid is partially fungible and government expenditures increase by 40–50% of aid.

Fungibility may be a non-linear function of aid. Pack and Pack (1993) suggest that fungibility may be inversely related to the share of aid in government expenditures since large aid flows decrease monitoring costs. To test this non-linearity, total aid squared is included as a regressor in column [4] of Table 2. The coefficient of aid squared is negative, although not significantly different from zero. The same results are found for OLS and FE models without the lagged dependent variable, as well as for the averaged data (not reported). Only in some specifications the coefficient is significantly different from zero.

[25] Alternatively, the difference and system GMM estimators can be employed. See Marć (2015) for the discussion.

Table 2: The impact of aid on government expenditures and revenues

	[1] EXP (OLS)	[2] EXP (FE)	[3] EXP (FE)	[4] EXP (FE)	[5] REV (FE)	[6] REV (FE)
Total aid	0.517***	0.145***	0.081***	0.084*	0.061	0.079**
	(0.19)	(0.05)	(0.02)	(0.05)	(0.06)	(0.03)
L.Gov. exp. in GDP			0.622***	0.621***		
			(0.03)	(0.03)		
GDP growth	-0.102	-0.035	-0.006	-0.006	0.115**	0.100**
	(0.09)	(0.04)	(0.03)	(0.03)	(0.06)	(0.04)
L.Inflation	0.004	0.002	0.000	0.000	0.000	-0.001
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
L.Infant mortality	-0.060*	0.013	-0.001	-0.001	-0.006	-0.004
	(0.03)	(0.03)	(0.01)	(0.01)	(0.03)	(0.02)
L.Exp+imp in GDP	0.037*	0.008	0.005	0.005	0.002	-0.003
	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)
L.Agr. VA	-0.274***	-0.209***	-0.040	-0.040	-0.207***	-0.068
	(0.06)	(0.07)	(0.03)	(0.03)	(0.08)	(0.05)
Total aid sq.				-0.363		
				(4.48)		
L.Gov. rev. in GDP						0.538***
						(0.09)
Constant	39.458***	27.167***	7.698***	7.690***	25.137***	11.817***
	(6.41)	(4.68)	(2.85)	(2.87)	(5.29)	(3.57)
LR total aid			0.216***	0.221*		
			(0.07)	(0.14)		
R-sqr	0.27	0.14	0.48	0.48	0.15	0.35
F-statistic	8.07	7.60	62.91	62.41	5.02	31.20
Obs.	2112	2112	2024	2024	2132	2045

Notes: The dependent variable is the share of government expenditures in GDP (%) (denoted as EXP) or the share of general government revenue in GDP (%) (denoted as REV). *Total aid* is measured as the share of aid in GDP (%). Year fixed effects are included in all models (also OLS), country fixed effects are included in the fixed effects model (FE), coefficients are not reported. Standard errors are clustered by country and are reported in parentheses. LR presents the long-run impact of aid on government expenditures from equation (4). $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$.

Thus, in contrast to what Pack and Pack (1993) suggest, evidence of non-linearity is not found in this analysis. However, the negative coefficient suggests that fungibility can be higher for high amounts of aid: the more aid is given to a particular country, the lower is the impact of aid on the level of government expenditures.

The impact of aid on government expenditures may differ depending on whether aid is increasing or decreasing. Section 4.4 discusses potential reasons for the asymmetry in response and offers three ways to investigate this hypothesis. Table 11 in Appendix D reports the results. At a 5% level the null hypothesis of symmetric response cannot be rejected (see columns [1]–[4]). Also, the estimates of the impact of aid when it is decreasing

Table 3: The impact of aid on government expenditures - averaged data

	[1] 3y	[2] 3y	[3] 4y	[4] 4y	[5] 5y	[6] 5y
Total aid	0.241***	0.206***	0.283***	0.265***	0.363***	0.402***
	(0.08)	(0.05)	(0.08)	(0.07)	(0.11)	(0.12)
L.Gov. exp. in GDP		0.378***		0.311***		0.188**
		(0.06)		(0.08)		(0.08)
GDP growth	-0.090	-0.019	-0.061	-0.035	-0.052	-0.019
	(0.07)	(0.08)	(0.08)	(0.08)	(0.08)	(0.11)
L.Inflation	0.000	0.002	-0.000	-0.001***	-0.001*	-0.001
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
L.Infant mortality	0.005	-0.002	-0.007	-0.014	-0.032	-0.037
	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)	(0.04)
L.Exp+imp in GDP	-0.006	-0.001	-0.003	-0.001	-0.019	-0.004
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)
L.Agr. VA	-0.219***	-0.138**	-0.213***	-0.176**	-0.230***	-0.169*
	(0.08)	(0.06)	(0.07)	(0.09)	(0.07)	(0.09)
Constant	33.310***	20.639***	33.045***	21.692***	33.345***	27.652***
	(3.23)	(3.39)	(3.36)	(4.96)	(4.04)	(3.42)
LR total aid		0.331***		0.384***		0.494***
		(0.09)		(0.10)		(0.14)
R-sqr	0.18	0.33	0.21	0.32	0.25	0.32
F-statistic	9.33	17.96	12.09	29.71	14.64	14.02
Obs.	734	650	550	474	434	364

Notes: The dependent variable is the share of government expenditures in GDP (%). *Total aid* is measured as the share of aid in GDP (%). Year and country fixed effects included in all models, coefficients are not reported. Standard errors are clustered by country and are reported in parentheses. LR presents the long-run impact of aid on government expenditures from equation (4). 3y, 4y, 5y means data averaged over 3, 4 and 5 years respectively. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$.

are close to the estimates when aid is increasing. Therefore, there is no evidence for the hypothesis of an asymmetric response. This means that when the share of aid in GDP decreases, the recipient country's government is able to increase domestic revenues or net borrowing to partly offset the decrease in aid.

As pointed out in Section 4, fungibility of aid at the aggregate level means that own government revenues adjust, or net borrowing adjusts, or that aid bypasses the budget. Reliable data on net borrowing and lending are not available.[26] The issue of off-budget aid is investigated in Section 6. The data on general government revenues as a share of GDP are available. However, in addition to tax revenues and other domestic revenues, these data also include grants, so at least part of on-budget aid is recorded as government revenues. Therefore, as pointed out before, government revenues are not equivalent to the domestic

[26] As discussed in Appendix A.

revenues variable from equation (1). The results of the impact of aid on government revenues are presented in columns [5] and [6] of Table 2. For both models, with and without lagged government revenues, the estimate of aid's impact is positive. When the lagged dependent variable is included, the impact is statistically different from zero, and 1 pp of aid in GDP increases government revenues by around 0.079 pp. The positive impact of aid on government revenues is expected because part of aid is included in government revenues in the WEO dataset. However, a low coefficient of the impact of aid on government revenues suggests that aid is substituting tax revenues or that it is bypassing the budget.

Since fungibility at the aggregate level has been tested before, the results presented above can be compared to other studies presented in Section 2. All studies listed below estimate equation (2) (with different controls), so results should be compared to column [2] of Table 2. Since the lagged dependent variable is not included and the error structure is not modeled, it is very likely that these studies suffer from autocorrelation problems. Devarajan et al. (2007) find, for a small sample of 18 sub-Saharan countries in the period 1971–1995, that around 10% of aid is used as tax relief (or bypasses the budget). Basic results of Feyzioglu et al. (1998) confirm that result: in a sample of 14 countries between 1970 and 1990 only 5% of aid is fungible. However, when the sample size is extended to 38 countries, 67% of aid is fungible, which is closer to the results presented in this study. Chatterjee et al. (2012) is closest to the current study. They find that the coefficient of aid's impact on government expenditures is 0.3,[27] which is slightly higher than the results found in my study for the same equation.

To sum up, fungibility at the aggregate level has been re-examined on a rich panel of 118 countries for the period 1980–2012. Short- and long-term impact of aid on the government expenditures is estimated thanks to the inclusion of the lagged dependent variable and thanks to the use of averaged data. In the long run, aid is partially fungible and increases government expenditures by around 40–50%. The adjustment process is gradual as aid is highly fungible in the short run. Given that the impact of aid on government revenue is lower than that on expenditures, it means that one of the following happens: (i) aid is substituting tax revenues, (ii) the government immediately decreases its own borrowing needs in response

[27] They find similar results when the difference GMM estimator is used and when an instrument based on geographical and cultural proximity is used. The robustness of these results is tested in Marć (2015).

to additional aid, or (iii) that aid is bypassing the budget.

6 The impact of off- and on-budget aid on total government expenditures

Morrissey (2014) starts his review of fungibility and fiscal response studies by observing that the amount of aid reported by donors is substantially higher than the amount spent in recipient countries. This discrepancy can be explained by the large amount of money spent in the donor country on technical assistance. This category of aid includes development consultancy and training, as well as scholarships given to students from developing countries to finance their education in donor countries. There is also a discrepancy between the amount of aid that reaches the recipient country and the amount recorded in the budget. A part of aid directly reaches ultimate beneficiaries in developing countries through e.g. donor operated projects, and thus bypasses the budget. Even if aid does not reach the recipient country government's budget, it may still influence government behavior. For example, off-budget aid[28] may finance the projects that would be otherwise financed by government expenditures. The issue of off-budget aid in the context of fungibility has been noted by Devarajan et al. (2007), Holmqvist (2000), McGillivray and Morrissey (2000), and analyzed extensively by Van de Sijpe (2013b).

The presence of off-budget aid should be acknowledged when the impact of total aid on government expenditures is analyzed. The left-hand side of fungibility equations (2) and (3)—the share of government expenditures (or government revenues) in GDP—includes only on-budget aid, whereas total aid that is on the right-hand side includes both on- and off-budget aid reported by donors. Therefore, if off-budget aid is not accounted for, aid's impact coefficient is expected to be biased downwards since off-budget aid is not directly increasing budget expenditures.[29] Therefore, a marginal effect smaller than one may be a

[28] In this study, the term "off-budget aid" is used to describe any aid disbursement that is not recorded in the recipient country government's budget.

[29] Assuming that aid is not fungible, so that it does not change the way recipient governments spend their own resources, then if all aid is channeled through the budget, one euro of aid increases government expenditures by exactly one euro. However, when half of aid bypasses the budget, then one euro of aid increases government spending only by 50% (so by the amount of on-budget aid), while the other 50% are not recorded in the budget. If no distinction between off- and on-budget aid is made, the estimate of the fungibility coefficient (0.5) will be biased downwards compared to its true value of one. Moreover, Van de

result of the fact that part of aid is not recorded as government spending. Off-budget aid is fungible if it results in a decrease of the government's own spending (when the coefficient next to off-budget aid is smaller than zero). The interpretation of on-budget aid stays the same as for the models with total aid—aid is fungible if one euro of aid results in less than one euro increase in government spending. However, since the presence of off-budget aid is accounted for, fungibility of on-budget aid means that the government has either adjusted domestic revenues or net borrowing.[30]

Van de Sijpe (2013b) uses technical cooperation (TC) as a proxy for off-budget aid and the value of sector programme aid as a proxy for on-budget aid, and investigates fungibility in health and education sectors.[31] He finds that off-budget aid is, at most, substituting a small part of own government expenditures in the health and education sectors. The results for on-budget aid are inconclusive.

Table 4: Mean of on- and off-budget aid as a percentage of the recipient country's GDP, unweighted and weighted by GDP

	Total aid		Bilateral aid		Multilateral aid	
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
On-budget	7.13	0.97	3.80	0.56	3.06	0.36
Off-budget	2.33	0.28	1.89	0.24	0.43	0.04

Notes: Total aid also includes aid from non-DAC countries

Using Van de Sijpe (2013b)'s methodology, I analyze whether off-budget aid is non-fungible at the aggregate level and investigate whether not accounting for off-budget aid biases fungibility estimates. Technical cooperation is used as a proxy for off-budget aid. In the OECD's DAC2a Table the data on sector programme aid are not available[32] therefore

Sijpe (2013b) shows in a simple analytical framework that when off-budget aid is not accounted for, estimates of fungibility may be biased.

[30]Van de Sijpe (2013b) also discusses previous studies in the context of off-budget aid. Those relying on aid data provided by donors, i.e. among others McGillivray and Ouattara (2005); Osei et al. (2005); Pettersson (2007a,b), overestimate the extent of fungibility. That argument applies also to the analysis in the previous sections. There are studies (e.g. Pack and Pack, 1990, 1993) that used recipient-based aid data where off-budget aid is treated as an omitted variable. Then, since on- and off-budget aid are generally correlated, the estimate of fungibility of on-budget aid is biased unless the marginal effect of off-budget aid on government expenditures is zero (Van de Sijpe, 2013b).

[31]In the aid-growth literature, Annen and Kosempel (2009) discuss the impact of technical cooperation and non-technical cooperation on growth.

[32]OECD's Credit Report System (CRS) includes data spent on 'sector programme'. However, the CRS dataset is incomplete having many missing values, especially in the 1980s and the 1990s.

the difference *Total aid − technical cooperation* is taken as a proxy for on-budget aid. It is, admittedly, an imperfect proxy since it includes the off-budget elements as well. Hence, if not accounting for off-budget aid indeed lowers the estimate of aid's impact on government expenditures, the current study's results for fungibility of on-budget aid should be treated as an upper bound. Or, in other words, as a lower bound for the impact of aid on government expenditures.[33]

Even when only approximated by the technical cooperation, the share of off-budget aid in GDP is substantial (see Table 4). Technical cooperation accounts for a quarter of total aid, while for bilateral aid this share is even higher: 33%. The large share of off-budget aid indicates that aid bypassing the budget may be an important explanation for partial fungibility of aggregate aid.

Ex ante, it is most likely that off-budget aid is non-fungible. However, it is also possible that partial fungibility or, conversely, the crowding-in effects are present. As technical cooperation constitutes a substantial part of total aid, it may be expected that the government will react to the inflow of off-budget aid (at least to the part that reaches the recipient country) by decreasing own expenditures in similar categories. However, aid illusion regarding off-budget aid may lead to non-fungibility of off-budget aid. While governments are internalizing the expected size and arrival of on-budget aid and treat it (to a large extent) as a substitute for government expenditures, information regarding off-budget aid may not be available, hence government spending is not decreasing. It may also happen that while the government is aware of the inflow of off-budget aid, it spends low amounts of its domestic revenues on expenditures that can be classified as technical cooperation, therefore substantial reduction that would offset inflows of aid is not possible (Van de Sijpe, 2013b). There are even some situations that may lead to the crowding-in effect of off-budget aid. Technical cooperation may be pushing for other types of expenditures. For example, if doctors are taught how to do new diagnostic tests they may simultaneously increase pressure on the government to provide required equipment. Eventually, the fungibility of off-budget aid is an empirical question.

[33]Foster (2005) analyzes 14 donors and finds that on average out of any dollar of aid 30 cents are not recorded in the balance of payments, and 20 cents are recorded in the balance but not in the government budget. This means that around 50% of aid is off-budget. Gottret and Schieber (2006) point out that off-budget aid is common in the health sector, with more than 50% of total health spending in Uganda and 46%

Table 5: The impact of on- and off-budget aid on government expenditures and revenues

	[1] EXP (OLS)	[2] EXP (FE)	[3] EXP (FE)	[4] EXP (FE)	[5] REV (FE)	[6] REV (FE)
Off-budget aid	2.034**	-0.211	-0.109	0.227	-0.720*	-0.347
	(0.95)	(0.17)	(0.09)	(0.25)	(0.40)	(0.28)
On-budget aid	0.182	0.191***	0.104***	0.106**	0.162***	0.133**
	(0.13)	(0.04)	(0.02)	(0.05)	(0.06)	(0.06)
L.Gov. exp. in GDP			0.619***	0.616***		
			(0.03)	(0.03)		
GDP growth	-0.042	-0.042	-0.009	-0.011	0.100*	0.091**
	(0.08)	(0.04)	(0.03)	(0.03)	(0.05)	(0.04)
L.Inflation	0.006	0.001	0.000	0.000	-0.001	-0.001
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
L.Infant mortality	-0.057*	0.013	-0.001	0.001	-0.005	-0.004
	(0.03)	(0.03)	(0.01)	(0.01)	(0.03)	(0.02)
L.Exp+imp in GDP	0.029	0.010	0.006	0.007	0.008	0.001
	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)
L.Agr. VA	-0.267***	-0.202***	-0.037	-0.042	-0.193**	-0.064
	(0.06)	(0.07)	(0.03)	(0.03)	(0.08)	(0.05)
Off-budget aid sq.				-231.578*		
				(137.93)		
On-budget aid sq.				-1.058		
				(4.45)		
L.Gov. rev. in GDP						0.525***
						(0.09)
Constant	37.403***	27.417***	7.910***	7.489**	25.574***	12.232***
	(5.68)	(4.75)	(2.96)	(2.93)	(5.34)	(3.76)
LR off-budget			-0.286	0.59		
			(0.22)	(0.63)		
LR on-budget			0.273***	0.276*		
			(0.06)	(0.14)		
R-sqr	0.33	0.15	0.49	0.49	0.17	0.36
F-statistic	9.08	12.56	64.68	59.55	5.72	29.75
Obs.	2112	2112	2024	2024	2132	2045

Notes: The dependent variable is the share of government expenditures in GDP (%) (denoted as EXP) or the share of general government revenue in GDP (%) (denoted as REV). *Aid* is measured as the share of aid in GDP (%). Year fixed effects are included in all models (also OLS), country fixed effects are included in the fixed effects model (FE), coefficients are not reported. Standard errors are clustered by country and are reported in parentheses. LR presents the long-run impact of aid on government expenditures from equation (4). $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$.

The impact of off-budget and on-budget aid on government expenditures and revenues is presented in Table 5. This table shows that the estimated coefficient of on-budget aid is higher than for total aid, and around 19–27% of on-budget aid is increasing government expenditures. The estimates of the long-run impact are volatile. Each euro of on-budget aid increases government expenditures by 27 cents (for annual data, Table 5) to 59 cents (for

in Tanzania classified as off-budget.

Table 6: The impact of off- and on-budget aid on government expenditures - averaged data

	[1] 3y	[2] 3y	[3] 4y	[4] 4y	[5] 5y	[6] 5y
Off-budget aid	-0.367	-0.013	-0.167	0.158	-0.362	-0.137
	(0.25)	(0.21)	(0.23)	(0.24)	(0.29)	(0.35)
On-budget aid	0.339***	0.239***	0.366***	0.284***	0.490***	0.485***
	(0.07)	(0.04)	(0.09)	(0.07)	(0.11)	(0.12)
L.Gov. exp. in GDP		0.372***		0.307***		0.182**
		(0.06)		(0.08)		(0.08)
GDP growth	-0.114	-0.030	-0.080	-0.040	-0.105	-0.062
	(0.07)	(0.09)	(0.08)	(0.08)	(0.08)	(0.11)
L.Inflation	0.000	0.002	-0.000	-0.001***	-0.001**	-0.001
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
L.Infant mortality	0.006	-0.001	-0.005	-0.013	-0.031	-0.035
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
L.Exp+imp in GDP	-0.004	-0.001	-0.001	-0.001	-0.015	-0.003
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)
L.Agr. VA	-0.205**	-0.132**	-0.210***	-0.175**	-0.214***	-0.161*
	(0.08)	(0.07)	(0.07)	(0.09)	(0.07)	(0.08)
Constant	32.918***	20.687***	32.774***	21.901***	33.736***	24.309***
	(3.31)	(3.46)	(3.39)	(4.91)	(4.06)	(4.57)
LR off-budget		-0.021		0.22		-0.168
		(0.34)		(0.31)		(0.42)
LR on-budget		0.380***		0.410***		0.592***
		(0.07)		(0.11)		(0.13)
R-sqr	0.20	0.33	0.22	0.32	0.27	0.33
F-statistic	10.99	20.76	11.79	29.66	16.30	14.09
Obs.	734	650	550	474	434	364

Notes: The dependent variable is the share of government expenditures in GDP (%). *Aid* is measured as the share of aid in GDP (%). Year and country fixed effects included in all models, coefficients are not reported. Standard errors are clustered by country and are reported in parentheses. LR presents the long-run impact of aid on government expenditures from equation (4). 3y, 4y, 5y means data averaged over 3, 4 and 5 years respectively. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$.

the 5 year average, Table 6). As expected, on-budget aid increases government revenue.

The coefficient of off-budget aid is statistically insignificant, but negative in almost all specifications. The interpretation of this insignificant result is different than for on-budget aid: the hypothesis of off-budget aid being non-fungible cannot be rejected and the recipient government does not increase government expenditures in response to the inflows of off-budget aid. The negative sign indicates that off-budget aid may be affecting government expenditures and may be (indirectly) substituting some of them. Moreover, the coefficient of the impact of off-budget aid on government revenue is negative (column [5] and [6] of Table 5), which suggests that it may be replacing domestic revenue.

In conclusion, aid recorded in the budget turns out to be partly fungible in the long

run. Projects that bypass the recipient country's budget are non-fungible, and there are some signs of a small crowding-out effect. These results suggest that, as expected, when the distinction for on- and off-budget aid is not made, the impact of aid is downward biased (so the fungibility is overestimated). However, the bias is small and statistically insignificant.

7 The impact of multilateral and bilateral aid on total government expenditures

The extent of fungibility may differ for different types of aid. Many studies focus on sectoral disaggregation of aid and find significant differences in the extent of fungibility. However, to my knowledge recent studies have not included an analysis of disaggregation into bilateral and multilateral aid.

Ram(2003) lists three main differences between bilateral and multilateral aid:

1. Donor motives: Economic and strategic interests are likely to be more important for bilateral aid. For example, starting with the Marshall Plan, US aid closely followed changes in strategic points on the world map, switching its focus to East Asia, Middle East, or Latin America conditional on the geopolitical situation and current foreign policy aims, like the Cold War or the War on Terror (Lebovic, 1988; Todaro and Smith, 2003; Fleck and Kilby, 2010). Japan concentrates its aid on East Asia, particularly neighboring economies that are also major recipients of Japanese foreign direct investments or major trade partners (Berthélemy, 2006; Todaro and Smith, 2003; Ram, 2003). Great Britain and France allocate their aid in their former colonies, while the OPEC supports Arab League countries (Boone, 1996). Berthélemy (2006) finds that all donors (except for Switzerland) allocate more aid to their main trading partners. Younas (2008) confirms this by stating that OECD countries allocate more aid to recipient nations that import goods in which the donor nation has a comparative advantage in production. Alesina and Dollar (2000) summarize evidence for bilateral aid as follows: "*there is considerable evidence that the direction of foreign aid is dictated as much by political and strategic considerations, as by the economic needs and policy performance of the recipients. Colonial past and political alliances are major determinants of foreign aid*" (p. 33). Conversely, multilateral aid seems to be more policy and poverty oriented (Maizels and Nissanke, 1984; Dollar and Levin, 2006), and is allocated to countries

with good policies (Burnside and Dollar, 2000).

2. Aid conditionalities: Ram (2003) and Berthélemy (2006) point out that multilateral and bilateral aid packages differ in the conditions attached. Multilateral institutions, like the World Bank and the IMF, have conditioned for a long time their aid on so called *structural adjustment and reform programs*. Bilateral donors usually did not use this type of requirement. However, DAC has been working on the harmonization of donor practices for more than 20 years (OECD, 2003), and some bilateral donors follow allocation practices of multilateral organizations, *implicitly* conditioning their aid allocation.

3. Closeness of the relationship between the donor and the recipient: Bilateral donors often have long-lasting relationships with recipients (dating back to colonial times) and therefore often have similar institutions, the same language, a history of personal and commercial interactions, and country-specific knowledge. These factors may facilitate interactions and lead to a better understanding of the recipient country's needs (Ram, 2003 after Cassen and associates, 1994). However, as has been previously argued (Alesina and Dollar, 2000; Burnside and Dollar, 2000), multilateral institutions seem to pay more attention to the recipient country's needs than bilateral donors.

These three main differences suggest important differences between bilateral and multilateral aid, hence even at this level of aggregation the degree of fungibility may be different.[34] *A priori*, it is not clear whether multilateral aid is more or less fungible than bilateral. One of the main reasons of fungibility is that preferences between donors and recipients are not perfectly aligned. There are reasons to believe that multilateral aid is less fungible. Under the (idealistic) assumption that recipient governments care about pro-poor actions, since—as argued before—multilateral agencies seem to especially pay attention to poverty, one would expect smaller fungibility of funds from multilateral agencies. Additionally, due to attached conditions that may require a recipient government's own contribution, multilateral funds may be less likely to substitute government spending. However, Morrissey (2004) points out

[34]Furthermore, Ram (2003, 2004) analyzed the impact of bilateral and multilateral aid on growth. He showed that both parameters are significant and sizeable, but have opposite signs. This may suggest that the small and sometimes statistically insignificant impact of aid on growth can be decomposed into two statistically significant effects: a strong positive effect of bilateral aid, offset by a strong negative effect of multilateral aid on growth. However, in both studies aid is not instrumented for to account for endogeneity in regressions. Also for the OLS regressions, Burnside and Dollar (2000) find that bilateral aid increases government consumption, while the coefficient of multilateral aid is statistically insignificant.

Table 7: The impact of bilateral and multilateral aid on government expenditures and revenues

	[1] EXP (OLS)	[2] EXP (FE)	[3] EXP (FE)	[4] EXP (FE)	[5] REV (FE)	[6] REV (FE)
Bilateral aid	0.621	0.032	0.034	0.017	-0.058	0.014
	(0.41)	(0.07)	(0.04)	(0.07)	(0.11)	(0.06)
Multilateral aid	0.297	0.321***	0.146***	0.178**	0.259**	0.188
	(0.44)	(0.11)	(0.05)	(0.08)	(0.13)	(0.12)
L.Gov. exp. in GDP			0.621***	0.621***		
			(0.03)	(0.03)		
GDP growth	-0.096	-0.044	-0.009	-0.009	0.106**	0.095**
	(0.09)	(0.04)	(0.03)	(0.03)	(0.05)	(0.04)
L.Inflation	0.003	0.001	0.000	0.000	-0.000	-0.001
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
L.Infant mortality	-0.059*	0.013	-0.001	-0.001	-0.005	-0.004
	(0.03)	(0.03)	(0.01)	(0.01)	(0.03)	(0.02)
L.Exp+imp in GDP	0.038*	0.009	0.005	0.005	0.003	-0.002
	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)
L.Agr. VA	-0.263***	-0.209***	-0.040	-0.040	-0.208***	-0.070
	(0.06)	(0.07)	(0.03)	(0.03)	(0.08)	(0.05)
Bil. aid sq.				3.457		
				(14.09)		
Mul. aid sq.				-9.770		
				(19.89)		
L.Gov. rev. in GDP						0.535***
						(0.09)
Constant	39.278***	27.210***	7.772***	7.797***	25.125***	11.911***
	(6.47)	(4.71)	(2.88)	(2.90)	(5.27)	(3.59)
LR bilateral			0.089	0.05		
			(0.11)	(0.19)		
LR multilateral			0.386***	0.469**		
			(0.13)	(0.22)		
R-sqr	0.27	0.14	0.48	0.48	0.15	0.35
F-statistic	9.99	9.04	62.26	72.52	4.85	36.35
Obs.	2112	2112	2024	2024	2132	2045
Equal coeff.	0.69	0.06	0.18	0.19	0.13	0.30

Notes: The dependent variable is the share of government expenditures in GDP (%) (denoted as EXP) or the share of general government revenue in GDP (%) (denoted as REV). *Aid* is measured as the share of aid in GDP (%). Year fixed effects are included in all models (also OLS), country fixed effects are included in the fixed effects model (FE), coefficients are not reported. Standard errors are clustered by country and are reported in parentheses. LR presents the long-run impact of aid on government expenditures from equation (4). $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$.

that there is consensus in the literature that aid conditionality does not produce desired effects. Despite the attached conditions governments do not undertake the required reforms. Even if governments are planning to undertake the reforms, imposing conditionality may be unnecessary and possibly even damaging.

Furthermore, bilateral aid is often used as a way to promote products from the donor

Table 8: The impact of bilateral and multilateral aid on government expenditures - averaged data

	[1] 3y	[2] 3y	[3] 4y	[4] 4y	[5] 5y	[6] 5y
Bilateral aid	-0.029	0.092	0.049	0.148	0.231	0.313**
	(0.14)	(0.15)	(0.15)	(0.18)	(0.14)	(0.14)
Multilateral aid	0.642***	0.365**	0.610***	0.414*	0.580**	0.533**
	(0.16)	(0.18)	(0.19)	(0.21)	(0.23)	(0.24)
L.Gov. exp. in GDP		0.371***		0.306***		0.185**
		(0.06)		(0.09)		(0.08)
GDP growth	-0.113	-0.028	-0.071	-0.043	-0.056	-0.028
	(0.07)	(0.08)	(0.08)	(0.08)	(0.08)	(0.11)
L.Inflation	0.000	0.002	-0.001	-0.001***	-0.001**	-0.001*
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
L.Infant mortality	0.006	-0.001	0.001	-0.010	-0.029	-0.036
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
L.Exp+imp in GDP	-0.004	-0.000	0.001	0.001	-0.017	-0.002
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)
L.Agr. VA	-0.220***	-0.136**	-0.221***	-0.179**	-0.234***	-0.171**
	(0.08)	(0.06)	(0.07)	(0.09)	(0.07)	(0.09)
Constant	33.148***	20.755***	32.595***	21.861***	33.237***	27.633***
	(3.26)	(3.50)	(3.35)	(5.00)	(4.04)	(3.38)
LR bilateral		0.147		0.13		0.384**
		(0.24)		(0.26)		(0.17)
LR multilateral		0.581**		0.596**		0.654**
		(0.27)		(0.30)		(0.28)
R-sqr	0.19	0.32	0.21	0.31	0.25	0.31
F-statistic	10.36	18.32	12.05	28.28	13.56	13.04
Obs.	734	650	550	474	434	364
Equal coeff.	0.02	0.39	0.07	0.47	0.24	0.45

Notes: The dependent variable is the share of government expenditures in GDP (%). *Aid* is measured as the share of aid in GDP (%). Year and country fixed effects included in all models, coefficients are not reported. Standard errors are clustered by country and are reported in parentheses. LR presents the long-run impact of aid on government expenditures from equation (4). 3y, 4y, 5y means data averaged over 3, 4 and 5 years respectively. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$.

countries. Tied aid packages require recipients to purchase goods or services produced in donor countries. Around half of the aid channeled to the Least Developed Countries is tied (OECD, 2001). Tied aid tends to favor projects that require capital intensive imports or donor-based technical cooperation, instead of smaller and more poverty-focused programmes, while at the same time being 15–30% more costly for the recipient[35] than untied aid (OECD, 2001). At the sectoral level, if products provided by the donor are not prioritized by the recipient, a diversion of funds is very likely. However, it is not clear what effect tied aid has

[35]Compared to the situation in which a recipient can purchase similar products or services at world prices. Effectively, tied aid is a way to subsidize the donor's domestic industry.

at the aggregate level. If donors provide products that would not be bought otherwise, then, paradoxically, aid should be non-fungible, since an optimizing government would allocate all other resources as if no aid was provided.

Given the considerations presented above, the assumption of the equality of coefficients of bilateral and multilateral aid can be relaxed. I test for equality of coefficients of bilateral and multilateral using an F-test. Under the null hypothesis that both coefficients are equal the constraint is binding. The p-values of this test are shown in rows *Equal coeff.* in Tables 7 and 8.

The estimated impact of bilateral and multilateral aid on government expenditures is volatile (see Tables 7 and 8). In all fixed effects models multilateral aid is statistically different from zero, but coefficients range from 0.32 to 0.64 for models without the lagged dependent variable, and between 0.38 to 0.65 for the long-term impact in the models including the lagged dependent variable. The coefficient of bilateral aid is close to zero and statistically insignificant in the models with annual data (see Table 7), and data averaged over three and four years (see columns [1]–[4] in Table 8). It is statistically significant only for the five year average when lagged government expenditures are included (see column [6] in Table 8). As the standard errors are high, the hypothesis of equal coefficients can be rejected at the 10% level in only three models (column [2] in Table 7, and columns [1] and [3] in Table 8). These results indicate that bilateral aid may be more fungible than multilateral aid.

8 Robustness

In order to test the robustness of the results, I discuss outliers, weighting, changes in controls variables, and the impact of military expenditures.[36]

To look for outliers, following Van de Sijpe (2013b), the results are tested by re-estimating the main equations eliminating one country at a time. All values for the estimate of off-budget aid coefficient are stable and between -0.14 and -0.06 (again, statistically insignificant), and for on-budget aid between 0.095 and 0.115. Estimates are also stable for total aid.

[36] All non-reported results are available upon request.

This exercise of removing one country at a time was also done at the very initial stage of the research. The Solomon Islands was found to be an outlier and was removed from the sample (details in Appendix B). The impact of the Solomon Islands, a remote country with a population of around half a million people, raises the question whether the results are not driven by small countries that are not representative for the whole sample, and hence are less interesting for donors. There are 25 countries, mostly islands, with an average population below 1 million during the period discussed. Removing them from the sample does not change the results. However, it makes the estimates less precise.

The results are also weighted by either population size or total GDP using the Weighted Least Squares method, where weights are given by the absolute or squared residuals. In both cases, the results stay very close to the original results.

I use lagged control variables (except for growth) arguing that current aid could affect spending through these control variables in the same period. For example, aid may reduce infant mortality, and as a result government expenditures will decrease. However, it can also be argued that blocking out this channel (by including current values of control variables) could provide a better estimate of what donors are mostly interested in—the direct effect of aid on fiscal policy choices. As a robustness check, instead of lagged values of the control variables, contemporaneous values are used. The estimates stay very close to the original ones both for the yearly and averaged data. Off-budget aid for averaged data becomes statistically significant (and negative) for the 3- and 5-year average. The impact of aid on government revenues becomes insignificant.

Regressions with additional controls (discussed in Appendix C) have been performed and the results are robust to the changes in the control set.

A particular concern for donors related to sectoral fungibility is a potential diversion of development assistance intended for poverty reduction purposes into military spending. Collier and Hoeffler (2007) point out that as recipient's budgets are partially financed by aid – directly or through fungible projects – aid may be inadvertently financing military expenditures. After instrumenting, they find that aid has a positive and significant effect on military expenditures. Some fungibility studies (Chatterjee et al., 2012) explicitly excluded military expenditures from government expenditures. In the main analysis I take the broadest possible definition of government expenditures (that includes military expenditures) to

keep the biggest sample. As a robustness check, the share of military expenditures in GDP is subtracted from the share of government expenditures in GDP, and the newly constructed variable is used as a dependent variable. This decreases the sample size by approximately 30%. Military expenditures are taken from two sources: WEO and from the database of the Stockholm International Peace Research Institute (SIPRI). Table 12 from Appendix E lists results for three dependent variables for a comparable sample: the share of total government expenditures, the share of total government expenditures minus the share of military expenditures according to WEO, and the share of total government expenditures minus the share of military expenditures according to SIPRI. The results for the alternative dependent variables are unchanged compared to the results for the total government expenditures.

9 Conclusions

This article investigates the impact of aid on government expenditures and government revenues in the short and long run and contributes to the fungibility and fiscal response literature.

Firstly, the question of fungibility at the aggregate level is re-examined using a bigger, more recent, and more balanced dataset than data used in previous studies, taking into account short-term adjustments and long-term impact of aid. Aid is partly fungible in the long run with around 40–50% of aid increasing government expenditures, whereas in the short run approximately 90% of aid substitutes for other sources of government revenue or bypasses the budget. Moreover, there is no evidence for asymmetric response of government expenditures to increases and decreases in aid. The fungibility of aid at the aggregate level means that aid is either substituting for domestic revenues (potentially decreasing taxes), reducing government's net borrowing, or bypassing the budget. Foreign aid inflows increase government revenues, however the coefficient of impact is small (and often insignificant) which suggests that foreign aid substitutes tax revenues.

Secondly, this study investigates the impact of on- and off-budget components on government expenditures, following Van de Sijpe (2013b) who accounted for off-budget aid in the analysis of fungibility in education and health sectors. To my knowledge the distinction between on-budget aid and aid that bypasses the budget has not been done in studies that

investigate fungibility at the aggregate level. Technical cooperation is used as a proxy for off-budget aid, and the rest of aid is treated as a proxy of on-budget aid. Off-budget aid is not fungible, and in some regressions there are signs of partial fungibility. Unsurprisingly, on-budget aid is found to be partially fungible.

Thirdly, aid is disaggregated into a bilateral and a multilateral component and the fungibility of both parts is examined. The results suggest that bilateral aid is more fungible than multilateral aid.

Overall, these results suggest that part of aid is financing other projects than intended by the donor and that the amounts spent on earmarking are at least partly wasted. Fungibility is not necessarily bad for development. Recipient countries may allocate aid to more needed investments and aid may decrease taxes, which are often distortionary. Therefore, partial fungibility of aid means that at the macro level, aid's impact is a sum of increased spending, increased private consumption and savings (due to tax decreases), and potential improvements in the structure and quality of government expenditures due to the donor involvement.

Appendix A: Data description

Table 9 describes the variables used in the paper and their sources. The data were downloaded in April 2014 from: the World Development Indicators (WDI) of the World Bank, the World Economic Outlook (WEO) of the International Monetary Fund, Table 2a of the Development Assistance Committee (DAC) of the Organization for Economic Cooperation and Development (OECD), and the U.S. Census Bureau's International Database (IDB).

Table 9: Data sources

Variable	Description	Source
GDP growth	Annual percentage growth rate of GDP	WDI
GDP per capita	GDP per capita, thousands constant 2005$, PPP	WDI
Lit. rate	Literacy rates, adults	WDI
Agr VA	Agricultural value added (% of GDP)	WDI
Dep. ratio	Population aged 65 and above (% of total)	WDI
Pop. growth	Population growth (annual %)	WDI
Exp+imp in GDP	Sum of exports and imports of goods and services as a share of GDP	WDI
Infant mortality	Infant mortality rate, both sexes	IDB
Inflation	Annual inflation rate	WEO
Population	Total population	WEO
Gov. exp. in GDP	Government expenditures as a share of GDP	WEO
Gov. rev. in GDP	Government revenue as a share of GDP	WEO
GDP curr $	GDP in current prices, dollars	WEO
Aid	Net ODA disbursement as a share of GDP	OECD DAC2a
Bil aid	Net ODA disbursement from bilateral donors as a share of GDP	OECD DAC2a
Mul aid	Net ODA disbursement from multilateral donors as a share of GDP	OECD DAC2a
Off-budget aid	Net ODA disbursement for technical cooperation as a share of GDP	OECD DAC2a
On-budget aid	Difference between total aid and technical cooperation as a share of GDP	OECD DAC2a

The advantage of the DAC2a OECD Table over the Creditor Reporting System (CRS), which is usually used to measure sectoral fungibility, is that DAC aid data are supposed to be more complete,[37] while CRS coverage for the 1980s and the 1990s is low. The DAC2a

[37]However, there are still some problems as noted in OECD (2011): *"While DAC statistics include the outflows from all major multilateral organizations, there is still progress to be made. Data coverage could*

Table contains data on aid disbursement from bilateral and multilateral DAC members. Additionally, the DAC2a Table provides data on bilateral aid flows from non-DAC countries that agreed to voluntarily report their disbursements and commitments to the OECD. I do not analyze bilateral non-DAC aid due to the following reasons: (i) it is not clear when the reporting process started and how complete the data are, (ii) in the literature, only bilateral aid from DAC countries is used, (iii) the share of non-DAC aid in aid-recipient's GDP is very small compared to bilateral and multilateral DAC aid (only 3% of total aid).

Arndt et al. (2010) argue (on the basis of information obtained from the OECD) that the majority of missing values for aid represents in fact unreported null values. Therefore, I replaced each missing aid value by zero. This enlarges the sample size by approximately 40 observations, but it does not have a significant impact on the results.

General government revenues are described in the WEO dataset as the sum of "taxes, social contributions, grants receivable, and other revenue"(WEO dataset). Hence, it also includes at least the grant element of on-budget aid and is different from the domestic revenues variable in equation (1). Data on net borrowing and lending are available in the WEO and WDI datasets. In the WEO dataset, net borrowing and lending is calculated as revenue minus total expenditures. In the WDI dataset, the cash surplus/deficit variable (similar in the description to net borrowing and lending) is also calculated as: "revenue (including grants) minus expense, minus net acquisition of nonfinancial assets"(WDI dataset). Moreover, there are only around 1000 yearly observations. Since for both datasets the real data on borrowing and lending are not available, I do not include them in the analysis. The data on tax revenues as a share of GDP, which could be used instead of government revenues, are available in the WDI dataset. However, the data are incomplete and more than 1000 observations would have to be excluded from the final sample.

Finally, although the infant mortality rate is also available in the WDI database, the data are incomplete. This prompted me to use the U.S. Census Bureau's International Database (IDB) instead.

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be improved for UN specialized agencies and trust funds, and the accuracy of sectoral information could be enhanced for a number of UN funds and programmes. The Secretariat is collaborating with the United Nations Department of Economic and Social Affairs (UNDESA) in this respect".

Table 10: The list of LDCs, LMICs and UMICs

Least Developed Countries and Other Low Income Countries (per capita GNI <= $995 in 2009)	Afghanistan, Bangladesh, Benin, Burkina Faso, Burundi, Cambodia, the Central African Republic, Chad, Comoros, the Democratic Republic of the Congo, Eritrea, Ethiopia, the Gambia, Ghana, Guinea, Guinea-Bissau, Haiti, Kenya, the Democratic Republic of Korea, the Kyrgyz Republic, the Lao PDR, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, Sierra Leone, the Solomon Islands, Somalia, Tajikistan, Tanzania, Togo, Uganda, Zambia, Zimbabwe.
Lower Middle Income Countries and Territories (per capita GNI $996–$3 945 in 2009)	Angola, Armenia, Belize, Bhutan, Bolivia, Cabo Verde, Cameroon, China, the Republic of the Congo, Cote d'Ivoire, Djibouti, Ecuador, the Arab Republic of Egypt, El Salvador, Georgia, Guatemala, Guyana, Honduras, India, Indonesia, Iraq, Jordan, Kiribati, Kosovo, Lesotho, Maldives, the Marshall Islands, the Federated States of Micronesia, Moldova, Mongolia, Morocco, Nicaragua, Nigeria, Pakistan, Papua New Guinea, Paraguay, the Philippines, Samoa, Sao Tome and Principe, Senegal, Sri Lanka, Sudan, Swaziland, the Syrian Arab Republic, Thailand, Timor-Leste, Tonga, Tunisia, Turkmenistan, Tuvalu, Ukraine, Uzbekistan, Vanuatu, Vietnam, the West Bank and Gaza, the Republic of Yemen.
Upper and Middle Income Countries (per capita GNI $3 946–$11 905 in 2009)	Albania, Algeria, American Samoa, Antigua and Barbuda, Argentina, Azerbaijan, Belarus, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Chile, Colombia, Costa Rica, Cuba, Dominica, the Dominican Republic, Fiji, Gabon, Grenada, the Islamic Republic of Iran, Jamaica, Kazakhstan, Lebanon, Libya, Lithuania, Macedonia FYR, Malaysia, Mauritius, Mexico, Montenegro, Namibia, Palau, Panama, Peru, Romania, the Russian Federation, Serbia, Seychelles, South Africa, St. Kitts and Nevis, St. Lucia, Vincent and the Grenadines, Suriname, Turkey, Uruguay, the Bolivarian Republic of Venezuela.

Appendix B: List of LDCs, LMICs and UMICs

Table 10 presents the list of LDCs, LMICs, and UMICs in 2009 taken from the WDI of the World Bank.[38] The following countries were removed from the sample:

[38]The classification started in 1987. However, in the end of 1980s and at the beginning of 1990s many countries were not classified due to the missing data. The countries that reached the high income status from 1987 include: (i) Central and Eastern European countries that democratized around the year 1990, latter joined the European Union, and some of them became DAC donors; (ii) other EU member states

- American Samoa, Bulgaria, Lithuania, Romania, and the Russian Federation, because these countries were not ODA recipients or aid inflows were not reported.
- Cuba, North Korea, Somalia, and the West Bank, because current GDP in the IMF dataset is missing.
- Argentina, Belarus, Brazil, Chile, Iran, Libya, Mexico, and Venezuela, because of the very small aid flows (on average smaller than 0.12% of GDP).
- Guinea-Bissau, Haiti, Iraq, Kosovo, the Marshall Islands, Micronesia, and Tuvalu, due to the missing control variables or missing government expenditures.
- Solomon Island because this country is an outlier.[39]

The final sample consists of 118 countries.

Appendix C: Discussion of control variables

In addition to the agricultural value added that is used to control for spending in the agriculture sector and for the level of development, Chatterjee et al. (2012) suggest that the real per capita GDP proxies for income, and thus can be used to control for the size of the government. Feyzioglu et al. (1998) refer to Wagner's law which states that development is accompanied by an increase of the share of government expenditures in GDP. Moreover, according to Van de Sijpe (2013b), aid expressed as a share of GDP is very likely to be correlated with GDP per capita. Additionally, Feyzioglu et al. (1998) point out that per capita GDP is correlated with the agriculture share in GDP, infant mortality rate, and school enrollment (so also with literacy rate). As a result the estimated coefficients of these variables may be affected if GDP per capita is not controlled for. However, this variable is likely to be non-stationary. The results do not change when per capita GDP or growth (which is first-differenced GDP) is included in the regressions.

Population growth and the dependency ratio are tested as proxies for the health-care

(Cyprus, Greece, Malta, Portugal) and fast growing economies (South Korea, Macao); (iii) relatively small islands (Barbados, New Caledonia, Puerto Rico, Trinidad and Tobago); (iv) resource rich small countries (Equatorial Guinea and Oman). It is unlikely that the exclusion of these countries affects the results, as most of them received on average low aid inflows.

[39]The Solomon Islands has been found to change the estimates, especially for off-budget aid. When the Solomon Islands is in the sample the coefficient of off-budget aid impact is between 0.1 and 0.2 in the fixed effects model. When it is excluded for all the remaining 118 countries it is smaller than -0.1 (in both cases, it is not statistically different from zero).

and social security spending (in addition to the infant mortality rate), while the literacy rate is used as a control for expenditures in the education sector. Population growth and the dependency ratio were found to be statistically insignificant at a 5% level and they neither affect the estimates of interest nor the precision of estimates. Therefore, both are excluded from the reminder of the analysis. Additionally, the Variance Inflation Factor (VIF) for projection of dependency ratio on the other variables equals 49, which is above the usually assumed cut-off values proposed in the literature (5 or 10). Therefore, the dependency ratio is not included as a regressor. The literacy rate among adults affects results. However, this is likely caused by the fact that for many countries this rate is almost constant over time. When the literacy rate is not controlled for, it is captured by the fixed effects, which causes it to be highly collinear with the recipient's fixed effects (VIF equals 270). Therefore, the literacy rate is not included as a regressor.

Appendix D: Asymmetric response to decreases and increases

Table 11: The impact of aid on government expenditures for increases and decreases of aid

	(1) Increase	(2) Increase	(3) Decrease	(4) Decrease	(5) Both	(6) Both
Total aid	0.209***	0.091**	0.146***	0.079***		
	(0.08)	(0.04)	(0.05)	(0.02)		
L.Gov. exp. in GDP		0.620***		0.626***		0.627***
		(0.03)		(0.03)		(0.03)
Aid change(decrease)			-0.046	0.057		
			(0.07)	(0.06)		
Aid change(increase)	-0.166*	-0.024				
	(0.09)	(0.06)				
Aid when decreasing					0.167**	0.050
					(0.07)	(0.03)
Aid when increasing					0.143***	0.083***
					(0.05)	(0.02)
GDP growth	-0.047	-0.008	-0.037	-0.003	-0.038	-0.001
	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)
L.Inflation	0.002	0.000	0.002	0.000	0.002	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
L.Infant mortality	0.016	-0.000	0.013	-0.001	0.013	-0.001
	(0.03)	(0.01)	(0.03)	(0.01)	(0.03)	(0.01)
L.Exp+imp in GDP	0.005	0.004	0.007	0.005	0.007	0.005
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
L.Agr. VA	-0.205***	-0.040	-0.208***	-0.040	-0.208***	-0.040
	(0.07)	(0.03)	(0.07)	(0.03)	(0.07)	(0.03)
Constant	26.682***	7.685***	27.138***	7.610***	27.110***	7.631***
	(4.63)	(2.86)	(4.68)	(2.83)	(4.66)	(2.82)
R-sqr	0.15	0.48	0.14	0.48	0.14	0.49
F-statistic	7.66	62.91	8.16	60.00	8.70	63.36
Obs.	2112	2024	2112	2024	2112	2024

Notes: The dependent variable is the share of government expenditures in GDP. *Total aid* is measured as the share of aid in GDP (%). Aid change (increase) is equal to $I_t(AID_{it} - AID_{it-1})$ from equation (5), and aid change (decrease) to $D_t(AID_{it} - AID_{it-1})$ from equation (6). Aid when decreasing is equal to $I_t AID_{it}$, and Aid when decreasing to $D_t AID_{it}$, both from equation (7). Year and country fixed effects are included in all models, coefficients are not reported. Standard errors are clustered by country, reported in parentheses. $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$.

Appendix E: Military expenditures

Table 12: The impact of total aid on government expenditures minus military expenditures

	(1) EXP	(2) EXP	(3) WO	(4) WEO	(5) SIPRI	(6) SIPRI
Total aid	0.157***	0.094***	0.159***	0.098***	0.159***	0.102***
	(0.03)	(0.02)	(0.04)	(0.02)	(0.04)	(0.02)
L.Gov. exp. in GDP		0.628***		0.568***		0.560***
		(0.05)		(0.05)		(0.05)
GDP growth	-0.023	0.009	-0.003	0.030	-0.005	0.025
	(0.05)	(0.04)	(0.04)	(0.03)	(0.04)	(0.03)
L.Inflation	-0.003	0.000	-0.001	0.000	-0.002	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
L.Infant mortality	-0.017	-0.013	-0.023	-0.021	-0.032	-0.028
	(0.04)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)
L.Exp+imp in GDP	0.017	0.010	0.014	0.011	0.017	0.012
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
L.Agr. VA	-0.172**	-0.026	-0.197***	-0.049	-0.183***	-0.053*
	(0.07)	(0.03)	(0.06)	(0.03)	(0.06)	(0.03)
Constant	27.704***	9.689***	25.924***	8.731***	25.293***	9.229***
	(5.37)	(2.26)	(4.47)	(2.18)	(4.77)	(2.16)
R-sqr	0.20	0.52	0.23	0.54	0.25	0.53
F-statistic	6.78	42.21	6.04	30.01	6.61	28.86
Obs.	1465	1465	1527	1465	1463	1463

Notes: The dependent variable is the share of government expenditures in GDP (%): denoted as SIPRI (when the SIPRI database is used) and WEO for the WEO database. *Total aid* is measured as the share of aid in GDP (%). Year and country fixed effects are included in all models, coefficients are not reported. Standard errors are clustered by country and are reported in parentheses. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$.

Table 13: The impact of off- and on-budget aid on government expenditures minus military expenditures

	(1) EXP	(2) EXP	(3) WO	(4) WEO	(5) SIPRI	(6) SIPRI
Off-budget aid	-0.342	-0.285**	-0.252	-0.210	-0.191	-0.145
	(0.24)	(0.13)	(0.24)	(0.15)	(0.22)	(0.14)
On-budget aid	0.192***	0.121***	0.188***	0.120***	0.183***	0.119***
	(0.04)	(0.02)	(0.04)	(0.02)	(0.04)	(0.02)
L.Gov. exp. in GDP		0.625***		0.566***		0.558***
		(0.05)		(0.05)		(0.05)
GDP growth	-0.031	0.002	-0.010	0.024	-0.011	0.021
	(0.05)	(0.04)	(0.04)	(0.03)	(0.04)	(0.03)
L.Inflation	-0.003	-0.000	-0.002	0.000	-0.002	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
L.Infant mortality	-0.017	-0.013	-0.022	-0.021	-0.032	-0.028
	(0.04)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)
L.Exp+imp in GDP	0.018	0.012	0.016	0.012	0.018	0.013
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
L.Agr. VA	-0.159**	-0.017	-0.186***	-0.042	-0.174***	-0.047*
	(0.07)	(0.03)	(0.06)	(0.03)	(0.06)	(0.03)
Constant	28.280***	10.223***	26.351***	9.165***	25.711***	9.584***
	(5.37)	(2.18)	(4.46)	(2.05)	(4.76)	(2.07)
R-sqr	0.21	0.53	0.24	0.54	0.25	0.54
F-statistic	11.89	41.00	10.74	27.40	12.73	27.86
Obs.	1465	1465	1527	1465	1463	1463

Notes: The dependent variable is the share of government expenditures in GDP (%): denoted as SIPRI (when the SIPRI database is used) and WEO for the WEO database. *Total aid* is measured as the share of aid in GDP (%). Year and country fixed effects are included in all models, coefficients are not reported. Standard errors are clustered by country and are reported in parentheses. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$.

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