ESSAYS ON AID ALLOCATION AND EFFECTIVENESS IN DEVELOPING COUNTRIES

By

ABRAMS MBU ENOW TAGEM

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1. INTRODUCTION

How foreign aid should be allocated and its effectiveness in delivering its desired outcomes has been a contentious issue for decades now. The central premise in giving aid is its ability to spur economic growth and development in developing countries, and the effectiveness of aid is usually judged on its ability to deliver said growth. Thus, a logical outcome of this premise is estimating, empirically, the effects of foreign aid on growth in developing countries: what is commonly referred to as 'aid effectiveness'. The literature on aid effectiveness is voluminous: some studies find aid to have a positive impact on recipient countries' economic growth (Hansen and Tarp, 2001; Arndt, Jones and Tarp, 2010); while other studies find that foreign aid is negatively related to growth in recipient countries (Rajan and Subramanian, 2008; Moyo, 2009). More significantly, there was the erstwhile influential study by Burnside and Dollar (1997; 2000, BD hereafter) where they concluded that aid was only effective in countries with better policies as captured in an index combining three policy indicators: the Sachs and Warner measure of trade openness, the budget surplus as a share of GDP and inflation. While these BD findings were subsequently challenged and found to be fragile (Hansen and Tarp, 2001; Dalgard and Hansen, 2001; Easterly, Levine and Roodman, 2004; Easterly, 2003), it bred a huge literature on conditional aid effectiveness (see Clist, 2010 pg. 9 for a list of such studies).

There are now too many papers focusing on the effects of aid on growth, and there is no consensus view on the impact of aid on growth. The results vary according to sample length and country coverage; data (different data sources, treatment of missing aid data, treatment of zeros in aid data); measuring aid in a way that adequately captures how it may affect growth (the timeline within which aid is expected to influence growth); empirical specification (particularly using the growth rate of output as the dependent variable while using levels as independent variables, including other robust explanatory variables that affect growth, how best to incorporate interaction terms, dealing with endogeneity of aid); and econometric methodology.

A prime reason for the inconclusiveness of cross-country growth regressions is cross-country heterogeneity in aid effects. Clist (2010) states that "*aid is not homogenous in goal, composition or effect*". Thus, the heterogeneous goals of aid, heterogeneity of donors, as well as recipients, mean heterogeneous effects of aid are to be expected. For example, if economic growth is not the primary objective of aid then aid's impact on growth, if any, will be limited. Aid for human capital, such as health, education and social protection services would generally have no effects on economic growth. To the extent that said aid influences the human development indicators in question, and these indicators are crucial for long-term growth, aid will have an indirect effect on growth. Understanding and incorporating such

heterogeneity in aid studies will improve expectations on aid effectiveness, and perhaps more importantly, broaden the criteria on which aid's effectiveness should be judged.

The **second chapter** engages with the heterogeneity in aid goals, within the context of aid allocation. Understanding aid allocation is important because it elaborates on the specific purpose for which aid is given, and informs expectations of its potential effects. Specifically, in this chapter focus is on analysing the determinants of health aid allocation in 44 Sub-Saharan African countries. The chapter examines health aid allocation practice for nine major donors (five bilateral donors, two multilateral donors and two Public-Private Partnerships) over a 22-year period using a double-hurdle estimator. An advantage of this estimator is allowing for differences in selection of recipients of health aid and actual allocation of health aid to said recipients. The historical aid allocation literature, which postulates a dichotomy between donors meeting recipients' needs in their allocation process or simply responding to their non-altruistic interests in recipient countries (non-altruistic donor interests may be motivated by colonial history, geographical proximity, as well as suitable markets for donors' exports). The literature has progressed through models including measures of recipients 'policy' (to indicate their ability to manage aid) to models including recipients' needs, measures for the policy environment, and measures capturing donors' non-altruistic interest in recipient countries (Dudley and Montmarquette, 1976; Trumbull and Wall, 1994; Alesina and Dollar, 2000; Berthélemy and Tichit, 2004; Berthélemy, 2006a; Clist, 2009; Younas, 2008).

Since interest is in modelling health aid allocation, health-related need variables are also included. Focus on health is due to its perceived impact in improving long-term growth (see Bermeo, 2006 for a formal theoretical model in which donors internalize the short-term growth potential of recipients); income trends in SSA (despite steady increases in GDP *per capita* worldwide many SSA countries are still relatively poor); and epidemiological trends in the region, emphasised by the Millennium Declaration, and the resulting surge in DAH (IHME, 2013). This chapter contributes to the literature in two ways. First, we estimate allocation patterns of specific donors, instead of pooling donors. This includes five bilateral and two multilateral donors (the largest providers of DAH as of 2011); and allows us to test competing hypotheses on determinants of aid allocation, underscoring the importance of donor heterogeneity. We find that donors respond to recipients' needs as well as the donors' own interests in health aid allocation. Second, we estimate allocation patterns of two of the biggest Public-Private Partnerships worldwide, tracing and emphasising their increased importance in the global health agenda. This constitutes a major deviation from what has previously been done in the scant health aid allocation literature.

Moving on from sector-specific aid, the thesis also engages with the broader literature on the fiscal effects of aid. Aid effectiveness studies typically look at the 'big picture' of aid influencing growth and/or economic development, ignoring the impact aid might have on government fiscal behaviour. Understanding the fiscal impact on aid can potentially enhance understanding of the broader impact of aid on growth. Franco-Rodriguez, McGillivray and Morrissey (1998), McGillivray and Morrissey (2001, 2004) and Morrissey (2012) state that since most aid is given to the government in sector and/or budget support, or finances services that would otherwise be a demand on the budget (through donor-operated projects), it should impact on government fiscal behaviour in recipient countries: i.e. on government spending, government revenue (especially taxes) and sometimes domestic borrowing. At least four strands of literature estimating these fiscal effects have emerged.

First, aid should have direct effects on the evolution and composition of government expenditure and there are studies looking at the link between aid and total spending (Remmer, 2004; Morrissey, Isopi and Clist, 2011) and some estimating the effects of aid on sector-specific growth-enhancing spending such as on health or education (Gomanee, Morrissey, Mosley and Verschoor, 2005). Second, and closely related to the first strand of literature are fungibility studies. These studies analyse the impact of aid on specific sectors stipulated by donors and usually test if spending in said sectors increases by the amount of aid. Some fungibility studies include Lu, Schneider, Gubbins, Leach-Kemmon, Jamison and Murray (2010) for health aid; Van de Sijpe (2013) for health and education aid; Marć (2017) for total aid. The latter two studies also distinguish between on-budget and off-budget aid.

Third, the tax effort literature focuses on the relationship between aid and taxes, conditional on other control variables (typically recipients' income levels and structural characteristics). The issue is whether aid crowds-out or supports domestic revenue mobilization (see Prichard, Brun and Morrissey, 2012; Morrissey, Prichard and Torrance, 2014 for the current state of research). In addition, aid can substitute for domestic borrowing. Another strand of research emanating from the fiscal effects literature is Fiscal Response Modelling (FRM hereafter), which allows estimation of the broader relationship between aid and fiscal aggregates. FRMs are typically based on the Heller (1975) framework in which governments raise revenue from varying sources (through taxation, aid and domestic borrowing) and allocate them to different expenditures, either recurrent or capital expenditures in an attempt to meet specific targets. These FRMs tend to be country-specific studies, hence they explicitly demonstrate recipient heterogeneity (with quantitative results differing across countries). Examples include Franco-Rodriguez *et al.,* (1998); McGillivray and Ouattara, 2006; Martins, 2010; Mascagni and Timmis, 2017; Bwire, Lloyd and Morrissey, 2017.

The third and fourth chapters of the thesis are based on the fiscal effects of aid: the third chapter looking at the impact of aid and taxes on government spending (within the context of an FRM) and the fourth chapter estimating the effects of foreign aid on domestic revenue mobilization. Donors' data on aid overstates the amount of aid that goes to recipient countries as substantial amounts of aid do not even leave the donor country (for example consultancy and technical services). Off-budget aid may include technical assistance given to recipients to enhance capacity building (this is particularly salient for tax revenue reform), food and humanitarian aid, as well as donor-undertaken projects. Hence, a key aspect of both chapters is distinguishing aid that goes through recipient's budgets from that which does not go through the budget. With the increasing availability of aid, taxation and spending data chapters 3 and 4 use novel methods in (panel) time-series econometrics to explore the unique characteristics of the data. We use the Common Correlated Effects Mean Group (CCEMG) estimator developed by Pesaran (2006) and extended by Chudik and Pesaran (2015) to include lagged dependent variables. The dynamic CCEMG estimator is fit for purpose for four main reasons.

First, it allows for cross-country recipient heterogeneity in the effects of aid on spending, and the effects of aid on taxes. Countries may have similar structural characteristics, relating to their economic and political development but the institutional setups responsible for translating those characteristics into economic performance differ across countries. Furthermore, there are multiple domestic political and economic, internal and external factors that mediate the fiscal impact of aid so heterogeneous impacts of aid should be expected. Second, the method allows the possibility to distinguish between long-run (equilibrium) effects and short-run (adjustment to equilibrium) effects of aid on government fiscal behaviour within an Error Correction Mechanism (ECM). This is particularly important given that expenditure and taxation policies and systems are statutory, and only change in the medium to long-term. Standard panel estimators must include an 'appropriate' number of lags to allow for the timeline within which aid can influence government spending and taxation. For example, Morrissey and Torrance (2015) use longer lags of aid to estimate the impact of aid on taxes, conditional on other structural characteristics. An advantage of the ECM is that in distinguishing between the long-run and the short-run, it is unnecessary to include the number of lags within which aid will affect government fiscal behaviour.

Third, the method explicitly tests for simultaneity and endogeneity between aid and government fiscal variables. Standard empirical approaches either use two-stage instrumental variables (IV) regressions which rely on the external validity of instruments or lagged values (GMM) to address endogeneity. However, external instruments tend to be weak and not-so-exogenous (usually correlated with the dependent variable of interest) while lagged values exhibit high persistence. The CCEMG instead relies

on the temporal dimension of the data to test for endogeneity. If the variables in question are non-stationary and cointegrated (and there is evidence to suggest aid and fiscal variables typically exhibit such properties), endogeneity can be tested for. Fourth, it controls for cross-country correlations arising from the use of panel data. Due to increased economic and financial integration countries cannot completely insulate themselves from events happening worldwide. For example, technical assistance from donors tends to reflect strong cross-country correlations since the purpose for disbursing it is broadly similar across countries, and such assistance is not given in response to specific recipient's characteristics. Furthermore, tax revenue data also tends to display cross-section correlation since tax systems are shaped by entrenched factors (including colonial heritage), and tax competition across countries could also induce cross-section correlation.

Global shocks (for example, the oil crises in the 1970s, the 1980s recession, the recent financial crisis, the Washington Consensus) affect countries differently, with the macroeconomic impact of the shocks depending on each country's ability to respond. These innate differences in responses to shocks, again, emphasize cross-country heterogeneity. More localized shocks, capturing spill-over effects (for example the devaluation of the CFA franc in 1994, the Arab Spring in 2011) affect just a subset of countries, with the impact still depending on the countries' abilities to respond. The CCEMG deals with these macroeconomic (business cycle) effects by augmenting the regression equation with cross-section averages of the dependent and independent variables. In addition, including cross-section averages allows for the fact that the impact of the shock differs across countries.

In **chapter 3** we contribute to the fiscal effects literature and build on the country-specific time-series models in considering cross-country heterogeneity, by analysing the effects of aid and taxes on spending for a panel of 69 low and middle-income countries covering the period 1980 to 2013. The following variables are included: aid, disaggregated into grants, loans and technical assistance (a proxy for off-budget aid); tax revenue, specifically the non-resource component although we also explore with total tax revenue (including indirect taxes) and total government revenue (the sum of tax and non-tax revenue); and government expenditure, disaggregated into capital and recurrent expenditures. For the primary model off-budget components are excluded from the main measure of aid; thus, giving a measure of net aid close to that which goes through recipients' budgets. This further motivates estimating the effects of aid heterogeneity on spending; with focus on ascertaining if off-budget aid generates fiscal responses from aid recipients. Following these models, two other models are estimated; one with total aid and disaggregated expenditures (capital and recurrent spending) and another with disaggregated aid (grants and loans) and disaggregated expenditures.

We find that aggregate spending is positively associated with aid and taxes in the long-run and short-run, although the effects are more profound for taxes. Aid is also found to be associated with capital expenditures, and not recurrent expenditures, implying that on average the aid-investment link is strong in these developing countries. Technical assistance has no effect on spending. Long-run causality runs mainly from aid and taxes to spending; with expenditure policies planned based on expected revenue targets. Two broad conclusions can be drawn from the results. (i) Recipient governments rely more on their domestic revenue to reduce the risk of fiscal vulnerability associated with aid due to the volatility of the latter. (ii) The small average effect of aid on spending points to the broader effects aid has on domestic revenue in developing countries.

Chapter 4 is a logical continuation of chapter 3, with focus on looking at the impact of aid on domestic revenue mobilization. This chapter departs from the tax effort literature in one key aspect: acknowledging that the impact of aid on taxes depends as much on technical assistance (such as in tax administration and improving the formulation of tax policy) and associated policy reforms (conditionality and the wider donor-recipient relationship), as the amount of aid. This motivates estimating different models in the chapter, drawing on the political calculus literature to interpret results. The basic argument is that collecting taxes is unpopular, and aid is a politically less costly source of revenue to cover government expenditure. Nonetheless, there are also political costs associated with aid (increased dependency on aid and bureaucratic costs of administration) and the choice between aid and taxes depends on these costs, evaluated according to accountability, autonomy and bureaucracy. We model the relationship between aid and taxes in 84 developing countries covering the period 1980 to 2013. We find that aid and taxes form a cointegrating relationship, with changes in taxes sustained by changes in aid in the long-run. The predominant finding is a positive long-run relationship between aid and taxes across different model specifications, and the results are robust to alternative (albeit smaller) datasets.

The **fifth chapter** provides a brief conclusion cohering the research chapters, the lessons learned (and avenues for further research) and limitations of the research.

2. ANALYSING THE DETERMINANTS OF HEALTH AID ALLOCATION IN SUB-SAHARAN AFRICA

Low-income countries (LICs) in Sub-Saharan Africa (SSA hereafter) typically have poor health outcomes, echoed in the Millennium Declaration (UN, 2000) which shone spotlight on the pressing health demands in developing regions. Three of the eight erstwhile Millennium Development Goals (MDGs hereafter) explicitly focus on health-related issues; reduction of child mortality, improvements in maternal health, and combatting HIV/AIDS, malaria and other diseases. Recipient countries have made huge strides in improving these health outcomes but still face constraints in financing their health expenditures domestically (some of the countries are characterized by low GDP *per capita*); hence their need for complementary foreign assistance. The volume of Development Assistance for Health (DAH hereafter)[1] from major donors to SSA has risen steadily, peaking at $8.8 billion in 2011; representing 28.6% of total DAH and 46.5% of total allocable aid (IHME, 2013). This surge in disbursements reflects income trends in the region (SSA comprises a raft of low-income countries); in addition to the menace of HIV/AIDS in the region. HIV/AIDS assistance amounted to $7.7 billion in 2011, a 1.2% increase from 2010 (IHME, 2013). Thus, this chapter contributes to the aid allocation literature by examining the extent to which health indicators are important determinants of selection and allocation decisions for DAH of nine major international donors to 44 SSA countries covering the period 1990 to 2011.

There has been extensive research on total aid allocation by bilateral and multilateral aid agencies (Alesina and Dollar, 2000; Berthélemy, 2006b; Berthélemy and Tichit, 2004; Isopi and Mavrotas, 2006; Clist 2009; Neumayer, 2003a; Younas, 2008 among others). These studies demonstrate a clear pattern of results: donor heterogeneity is pervasive and entrenched. Donors generally provide aid to serve varying, and even mutually exclusive motivations (early research on aid allocation postulates a dichotomy between donors' interests and recipients' needs). Nordic donors (Sweden, Finland, Denmark, Iceland and Norway) have historically disbursed aid in a more recipient-friendly way: more sensitivity to poverty and policy while giving less aid to more corrupt governments (see *inter alia* Alesina and Weber, 2002; Dollar and Levin, 2004). Nonetheless, there are still fundamental differences in how each of the countries respond to recipients' characteristics in giving aid. Research on sector-aid allocation has, however, been relatively scant. Some relatively recent studies include Lewis (2003) for energy aid; Farooq (2012) for education aid; Fielding (2010) for humanitarian aid; and Neumayer (2005)

[1] Health aid and Development Assistance for Health (DAH) mean the same thing so are used interchangeably.

for development food aid. Existing studies on health aid have modelled the effects of health aid in the context of MDGs (Thiele, Nunnenkamp and Dreher, 2007; Kasuga, 2007); the impact of health aid on health outcomes (Mishra and Newhouse, 2009; Williamson, 2008); the impact of governance on health aid allocation (Fielding, 2011) and the inclusion of bilateral donors' characteristics as variables influencing their allocation patterns (Stepping, 2015). In this chapter, we avail of the existing data on the health-related MDGs and explicitly test the hypothesis that donors placed more importance on the health-related MDGs post the Millennium Declaration.

A new type of donor has emerged, so-called Public-Private Partnerships (PPPs hereafter): for example, the GAVI Alliance (GAVI) and the Global Fund to Fight HIV, Tuberculosis and Malaria (GFATM). There is increasing evidence of their importance in DAH allocation (Ravishankar, Gubbins, Cooley, Leach-Kemon, Michaud, Jamison and Murray, 2009). Global health improvements (alongside improvements in education and other social sectors) have been a priority for donors, with the PPPs established to streamline efforts to tackle a few salient global health worries. Hence, since their inception PPPs have become a favourite channel through which traditional donors disburse their health aid. While these PPPs are funded by traditional donors, they are essentially apolitical: thus, their allocation patterns should more clearly match recipients' needs and merits. In this chapter, we test for differences between the allocation patterns PPPs and those of bilateral and multilateral donors.

This chapter allows the comparison of health aid allocation patterns of major donors based on a conceptual framework. The empirical section discusses the different estimation techniques and provides a testing strategy to discriminate between them. The main contribution of this chapter is to show that allocation patterns of health aid differ substantially across donors (even for the PPPs), and that donors placed more importance on the MDGs post the Millennium Declaration. The overarching tendency among donors, however, is them selecting and/or providing more health aid to countries with already high disease burdens and mortality rates. The PPPs, on their part, are found to be very expansive in their selection decisions, but more 'predictable' in their allocation decisions. Most countries in Sub-Saharan Africa are low-income countries with severe disease burdens hence they are automatically eligible for health aid from the PPPs. Nevertheless, better governed countries (from the selected countries) do receive more health aid from the PPPs.

The rest of the chapter is as follows: section 2.1 reviews the general empirical and health aid allocation literature. Section 2.2 provides a conceptual framework of health aid allocation. Section 2.3 discusses the data and presents some descriptive statistics while section 2.4 discusses the empirical specifications. Section 2.5 presents main results, as well as robustness checks. Section 2.6 concludes.

2.1 EMPIRICAL LITERATURE REVIEW

2.1.1 Aid flows across donors and recipients

Alesina and Dollar (2000) model the allocation patterns of 14 bilateral aid donors of the Development Assistance Committee (DAC) of the OECD. They use averaged data (in five-year averages) covering the period 1970 to 1994 and test for donor heterogeneity using panel regression methods. One of their main contributions is the inclusion of a measure of the colonial past of recipients. They find that bilateral aid allocation is influenced greatly by political and strategic interests,[2] as well as recipients' needs. Donors like Germany, Canada, UK, Netherlands and Scandinavian countries respond to recipients' needs while countries like the US and Japan have mixed results. Japan provides more aid to countries with better governance but not to poorer countries. The US, on the other hand, provides more aid to Israel and Egypt, emphasising the long-standing claim of strategic relationships between the US and these two countries. These findings are similar to those of Dollar and Levin (2004); who compare 'policy sensitivity' to 'poverty sensitivity' by donors over time. They find that the Netherlands and other Nordic countries respond highly to both policy (good institutions) and poverty (recipients' *per capita* incomes). They also find that other countries like Japan respond more to policy than poverty. This is evident from the huge sums of money the Japanese government disburses to other Asian countries that are relatively well governed but not poor; a finding confirmed by Kilby (2006).

Berthélemy (2006b) uses a panel dataset consisting of 22 OECD bilateral donors, the EU and multilateral donors (which are grouped into a representative multilateral donor). He employs Two-Part and Heckman sample selection techniques to data on 137 developing countries covering the period covered 1980 to 1999. One of the main findings is evidence of a positive 'bilateralism' effect among bilateral donors. This means on average, bilateral donors react positively to the geopolitical dummies and commercial interests, with the effect being larger for the latter. Berthélemy (2006b) clusters donors into different groups; altruistic donors with very low trade intensity coefficients and the less altruistic donors with much higher trade coefficients.[3] The intermediate group can be viewed as the moderately altruistic donors. Even within the different clusters, there is considerable heterogeneity between donors in the way they perceive their commercial interests. This is salient evidence of donor heterogeneity even at highly disaggregated levels.

Delving further into the 'bilateralism effect', Berthélemy (2006b) finds that some regions (MENA and Asia) will receive more bilateral aid in the presence of bilateralism while other regions (Africa) will lose

[2] Colonial heritage and FDI.
[3] Altruistic donors include Austria, Denmark, Ireland, Netherlands, New Zealand, Norway and Switzerland. Less altruistic donors include Australia, France and Italy.

from the presence of bilateralism. This is so because most African countries are smaller trading partners when compared to Asian and Middle Eastern countries; and they trade mainly in primary products. The main finding behind bilateralism is the dominance of trade (commercial interests) over geopolitical (colonial) interests. This result is at odds with previous findings that colonial history significantly influences bilateral donors' allocation patterns (Alesina and Dollar, 2000; Dollar and Levin, 2006).

Regarding the European Commission (EC hereafter) and other multilateral aid, Berthélemy (2006b) finds that the European Commission's allocation is not influenced by recipients' needs. The EC responds more to its geopolitical interests in allocating aid, which is reflected by its preferential treatment towards ACP (African, Caribbean and Pacific) countries with which it has free trade agreements. Other multilaterals, contrarily, respond significantly to recipients' needs in their allocation processes.

Younas (2008) compares motives of bilateral aid donors; altruism as opposed to commercial interests. He uses data for 22 OECD donors and 78 recipient countries over the period 1992 to 2003; first in annual observations, then in three-year averages and estimations are done using Pooled OLS (POLS) techniques[4]. His major contribution to the already existing literature is disentangling the trade variable (representing donors' commercial interests) to a highly disaggregated level. According to the theoretical model he postulates, donors will provide more assistance to the recipient countries with which they trade more in the goods for which the donors have a comparative advantage. European donors have a comparative advantage in the production of capital goods; and at a much-disaggregated level, Younas (2008) finds that donors provide more aid to countries that import more of their machinery and transport equipment. The results for the other 'usual' variables (like income *per capita*, population, political rights) are in accordance with what we find in the aid allocation literature (Neumayer, 2003b; Berthélemy and Tichit, 2004; Berthélemy, 2006a among others). When he uses three-year averages of aid flows, the most pertinent result is that bilateral donors do not respond to income *per capita* in recipient countries. However, the infant mortality rate, which measures physical hardship, is significant in both specifications (annual and averaged). This provides evidence that donors are partially responsive to recipients' needs. Nonetheless, this can be a crucial reason why most studies find development aid to be ineffective.

'Recipients needs' is often a blend of different variables (measures of economic, as well as, physical hardship) so being sensitive to one or some of its components while simultaneously being insensitive to the other(s) greatly reduces the effectiveness of aid in delivering its expected outcomes. This

[4] Younas (2008) uses Pooled OLS (POLS) techniques to incorporate recipient-specific and time-invariant variables. It should be noted that using fixed effects (which wipe out the long-run aspects of the model), instead of estimating POLS, does not qualitatively change the pattern of his findings.

ineffectiveness, as posited by Doucouliagos and Paldam (2008) can be attributed to poor governance mechanisms, corruption of the ruling elite, and aid fungibility issues in recipient countries. It could also be because donors attach greater priority to their commercial interests, while entirely (or partially) ignoring recipients' needs, as stated above.

Neumayer (2003b) explains aid allocation patterns by four regional banks (African Development Bank, Asian Development Bank, Caribbean Development Bank and Inter-American Development Bank) and three United Nations agencies (UNDP, UNICEF and UNTA). He applies POLS techniques to data from the OECD covering the period 1983 to 2007, in three-year averages. As is recurrent in the literature, the donors considered are heterogeneous in their aid allocation practises. Most donors provide more aid to less populous countries, consistent with other findings in the literature (Alesina and Dollar, 2000; Berthélemy, 2006a among others). For donors that give more aid to more populous countries (the Inter-American Development Bank), they cease to increase aid when the recipients' populations reach a certain threshold.[5] Neumayer (2003b) also finds that development banks are more sensitive to broader economic needs (proxied by recipients' incomes), than human development need (proxied by the infant mortality rate), as opposed to the UN agencies. This might be the case because the regional development banks are more focused on financing big infrastructure projects.[6] As expected, the multilateral agencies considered in this chapter are insensitive to higher military expenditures and arms imports. This finding chimes with Berthélemy (2006b), in which he states that one would expect multilateral donors to respond less to any political interests in giving aid.

Isopi and Mavrotas (2006) carry out aid allocation analysis using OECD-DAC data covering 20 aid donors and 176 recipients over the period 1980 to 2003. Their main contribution to the literature is the inclusion of an aid effectiveness variable, a measure of good policies which they term 'past outcomes'. Past World Bank projects, as well as other bilateral projects, are evaluated and given scores that vary from highly unsatisfactory (score of 1) to highly satisfactory (score of 6). For the 'usual' variables (income *per capita* and population) they find results consistent with what has been found in the aid allocation literature though the results vary in significance, from one country to the other. Regarding the new measure of policy, they find considerable heterogeneity among donors, as expected. While big donors like the US and the UK do not reward recipients based on their past performances,[7] other big donors like France are very keen on rewarding their recipients with more aid given they have had good

[5] Neumayer (2003b) finds this population threshold to be 96 million people.
[6] These big infrastructure projects may yield increases in income *per capita* as a by-product of development. It may be the case that the development banks focus on the projects knowing that they will eventually yield economic benefits to the citizens of the recipients.
[7] They find that the US responds more to political and humanitarian needs while the UK responds more to within-country inequality and growth.

progress in past projects. Germany, on the other hand, rewards recipients based on their needs and do not consider whether recipients did well in past projects. This is similar to the findings of Knack, Xu and Zou (2014) in which Germany provides aid to poorer (needier) countries and also to countries that have crossed a World Bank exogenously-determined income threshold.

Feeny and McGillivray (2008) model the aid allocation behaviours of bilateral donors to 10 developing countries covering the period 1968 to 1999, using Seemingly Unrelated Regression (SUR) techniques. Their results indicate that both recipients' needs and donors' interest variables determine aid allocation among donors. However, the magnitudes of these variables differ markedly among recipient countries. They find evidence of a middle-income bias[8] in countries like Tanzania, India, Kenya and Thailand, while countries like Egypt and Pakistan receive more aid when they experience drops in income *per capita*. The latter result is more palpable in the aid allocation literature (Berthélemy, 2006b; Neumayer, 2003b) though there has been increasing evidence of middle-income bias in the literature (Harrigan and Wang, 2011). Feeny and McGillivray (2008) also find evidence of the 'bandwagon effect' among donors for three countries (Egypt, Israel and Thailand). This is the term initially used by Dudley and Montmarquette (1976) to describe a situation in which bilateral donors provide more aid to recipients because those recipients receive more aid from multilateral donors. However, Feeny and McGillivray (2008) also find that for some other countries (Kenya, Morocco, Indonesia) bilateral donors view multilateral aid as substitutes for their own aid: so, they reduce their own aid to these recipients when the recipients receive more aid from multilateral organisations.

2.1.2 Sector-specific aid allocation

Most aid allocation research is based on general aid, with very few studies focusing on sector-specific aid. However, there have been some few attempts to fill this gap. Lewis (2003) discusses the allocation patterns of global environmental aid by bilateral and multilateral donors. He estimates allocation models using the Two-Part estimator and finds that donors' self-interests significantly outweigh recipients' needs in the allocation process. Donors favour nations with whom they have had pervious relations and those with unexploited natural resources.[9] Farooq (2012) explains donor allocation patterns for education aid to 146 recipient countries. He employs the Tobit estimator to averaged data (five-year averages) from the OECD's Credit Reporting System (CRS) database covering the period 1973 to 2007. He finds that on average, donors target aid to the recipients with the most need of the

[8] More aid is being given to these recipient countries as they experience increases in income *per capita*; with recipient incomes and foreign aid viewed as complements to each other. Middle-income bias can also be interpreted based on the coefficient of a squared GDP *per capita* term. If GDP *per capita* has a negative coefficient while its squared term has a positive coefficient then that will be evidence of a middle-income bias (Harrigan and Wang, 2011).

[9] The idea here is that the more aid a donor gives to recipient countries, the more the recipient countries will have the goodwill to let the donors exploit those natural resources.

education aid. Nonetheless, bilateral donors like France, UK, and Spain tend to favour their former colonies, as well as placing emphasis on factors other than recipients' needs. For the multilaterals, they target the recipient countries with the most need. This is a usual finding in the aid allocation literature; where bilateral donors place more emphasis on their self-interests and to some extent ignore recipients' needs; while multilateral donors respond more to the needs of the various recipients.

There is very scant research on the allocation patterns of donors (bilateral and multilateral) about health aid. Stepping (2015) examines the allocation of health aid by 22 bilateral donors to 160 recipient countries, covering the period 1990 to 2007. Stepping (2015) uses the Two-Part estimator for her analysis; stressing the inherent differences in selection of countries eligible for aid receipts, and the actual amounts of aid received by those countries. This is the first study to comprehensively disaggregate health-related aid into selection and allocation stages, while accounting for donor and recipient-heterogeneity.[10] Stepping (2015) finds that the health-related needs under consideration influence the selection of potential recipients of health aid. However, only the HIV prevalence rate determines the actual amount of funds going to recipient countries. As 'usual', poor countries are more likely to be selected and they are actual recipients of huge aid shares (Clist, 2011; Berthélemy, 2006a find similar results). Stepping (2015) also finds that increases in domestic health expenditures are associated with greater chances of being selected (even after controlling for population size) though health expenditures have no impact on actual allocation. She includes variables measuring donor's characteristics (population and income per capita) and finds that these characteristics are important for both selection and allocation decisions by donors.

Nevertheless Stepping (2015) does not model the selection and allocation decisions of multilateral donors. She also ignores the Public-Private Partnerships in health allocation and as stated by Basu, Stuckler and McKee (2014), these PPPs are increasingly gaining ground in the global health agenda. It would have been interesting to compare the allocation patterns of these PPPs and more traditional bilateral donors.

Fielding (2011) models the responsiveness of health aid to quality of governance in recipient countries. His analysis includes 22 bilateral donors and 109 recipients, covering the period 1995 to 2006. He estimates the allocation of health aid using varying measures of governance (while controlling for epidemiological and economic need, as well as sizes of past aid disbursements) in recipient countries using the system GMM estimator. He finds that donors allocate more aid to countries with higher neonatal mortality rates, even after controlling for other factors of need (like income and HIV prevalence rates) and governance measures. He finds no evidence to support the 'usual' result that

[10] In terms of population and *per capita* income.

donors give more aid to poorer countries. This stands in contrast to what is found in most of the aid literature; where more aid is given to poorer recipients. He also finds evidence in favour of a small-country bias though the magnitudes and significance levels are sensitive to model specification. As regards quality of governance, he finds that countries with better political rights are rewarded with higher aid flows. However, countries with high levels of corruption are also major recipients of aid flows.

The aid allocation literature provides evidence that donors (both bilateral and multilateral) give more aid to poorer and less populous countries. This is confirmed by Doucouliagos and Paldam (2007) in their meta-analysis of development aid allocation. They find that the poverty effect (that is donors giving more aid to poorer countries) and 'small-country bias' are robust to all kinds of model specifications, econometric techniques as well control variables. [11] As pointed out by Doucouliagos and Paldam (2007), no donor states that poverty in a less populous country is more important than poverty in a more populous country. Thus the 'small-country bias' on its own is a deviation from normal aid allocation patterns. This bias cannot be directly linked to other more noticeable biases like historical ties (relationships between colonies and their former colonisers) and strategic and economic relations (trade and political ideologies).

A general pattern found in most studies is multilateral donors being more sensitive to recipients' needs than bilateral donors. For bilateral donors, Germany and the Nordic donors are the most consistent with the humanitarian aid agenda.[12] Others like Japan and France place much emphasis on their economic and strategic interests, though Japan rewards better-governed countries more than France does. The USA, by far the largest donor of health aid and a huge donor of total aid (IHME, 2013 p. 10), has more astounding results. They do not respond to recipients' needs and merits, as well as ignoring their own personal interests. The only logically consistent finding about the USA's allocations is, while controlling for other factors, they give more aid to Israel and Egypt. This confirms the strategic relationship the USA has with these two countries.

Interestingly, there are similarities in findings in the literature even though different econometric techniques have been used. As has been pointed out in the later part of the aid allocation literature, all donors do not give aid to all recipients. Thus, the aid variable in most empirical analyses has limiting observations. Hence OLS techniques provide biased and inconsistent results. This led to the advent of

[11] All donors state their eligibility criteria for aid receipts and almost always include poverty reduction as one of their main targets. It is heartening, then, to find that donors allocate more aid to countries with lower incomes. Nevertheless, there is also evidence (albeit small) of a middle-income effect. No matter how small this effect may be, it constitutes a significant bias in aid allocation.

[12] They reward recipients whom they think can use the aid more effectively, countries that are most needy and they do not care much about their personal geopolitical or other interests.

techniques to circumvent this problem; The Tobit estimator, Two-Part estimator and Heckman estimator.[13]

2.2 CONCEPTUAL FRAMEWORK OF HEALTH AID ALLOCATION

Many studies on aid allocation have developed theoretical models which form the conceptual frameworks of their empirical analyses (Trumbull and Wall, 1994; Feeny and McGillivray, 2008 among others). Most of the theoretical models are variants of the original model developed by Dudley and Montmarquette (1976).[14] In their model, they assume aid decisions are motivated by donors subjectively measured developmental impact of its aid on recipient countries. In this section, we provide a conceptual framework of the allocation of development assistance for health (DAH hereafter) by the major donors in the international health scene.[15]

In the Dudley and Montmarquette (1976) model, they posit that all donors have the same objective; to maximize their utilities based on the subjectively measured impact of aid on the wellbeing of residents in recipient countries. Following Trumbull and Wall (1994), we postulate that donors have an overarching measure of the impact of their aid on recipient countries; for example, an indicator like the reduction in infant mortality rates will show how much donors' aid impacted on recipients' welfare.[16] This facilitates modelling the allocation behaviour of a representative donor. Each year the donor sets aside a fixed total pool of funds available to k recipient countries. Following Dudley and Montmarquette (1976) the representative utility function of the donor can then be written as:

$$M = \sum_{i=1}^{k} \theta_i M_i = \sum_{i=1}^{k} \theta_i M_i(a_i, n_i, RN_i, RM_i, DI_i) \quad (2.1)$$

[13] Researchers tend to choose arbitrarily among these methods although they are expected to be guided by data diagnostics in choosing the appropriate estimator. Farooq (2012) and Isopi and Mavrotas (2006) use the Tobit estimator while Stepping (2015) and Clist (2009) use the Double-Hurdle Estimator. Berthélemy (2006a) uses both the Two-Part and Heckman estimators. Younas (2008), Neumayer (2003b) and Harrigan and Wang (2011) use Pooled OLS (POLS) methods in cases where aid data are censored. The system GMM has also become a popular estimator of choice in cases where aid data are not censored; and when the studies seek to explain the influence of past aid disbursements/commitments on current disbursements/commitments

[14] The model with no administrative costs; in which foreign aid is treated as a private good by the donor. Dudley and Montmarquette (1976) extend their model to include administrative costs.

[15] This includes bilateral and multilateral donors, as well as Private-Public Partnerships (PPPs). Wiseman (2010) labels this last group, polylateral donors. The inclusion of multilateral aid in the model might raise questions as to whether multilaterals behave like bilaterals in aid allocation. However, Harrigan and Wang (2011) posit that if the overarching intention of all DAH donors is the same (for example, reductions in mortality rates and poverty), then all donors use the same subjective measure of the impact of their aid to a recipient and all recipients are viewed as equally important in the eyes of the donors.

[16] Most aid allocation models implicitly assume that recipients' needs and merits do not overlap with donors' interests. By merits we mean the recipients' ability to handle huge sums of development aid, typically proxied by their economic management and human rights governance. It is assumed that either the donor seeks to respond to recipients' needs and merits or to their own interests (which may not benefit the recipients as much). Bermeo (2007) states that in some cases donors' and recipients' intentions coincide, but the recipient may lack the necessary resources to implement the desired program. This is usually the case where donors care about their vested interests in the recipient countries, but also care about the development of the recipient.

$i = 1, \ldots, k$ recipient countries

where M is the weighted sum of the impacts of the donor's aid from allocating to k recipient countries, M_i is the subjectively measured impact of *per capita* health aid on recipient i, a_i is the amount of *per capita* DAH disbursements received by the recipient from each donor, RN_i is a vector of variables representing recipients' need for DAH, RM_i is a vector of recipients' merit variables, and DI_i is a vector of variables representing donors' interests in recipient i. n_i represents the population of recipient i. θ_i is a weight measuring the unobservable (or unquantifiable) importance of a recipient to a specific donor. These weights are not directly observable but they are what make donors prefer some recipients to others (see subsequent paragraphs). We make some postulations which can be mathematically expressed as follows:

$$\frac{\partial M_i}{\partial a_i} > 0, \frac{\partial M_i}{\partial n_i} > 0, \frac{\partial M_i}{\partial RN_i} \lesseqgtr 0, \frac{\partial M_i}{\partial RM_i} > 0, \frac{\partial M_i}{\partial DI_i} > 0 \tag{2.2}$$

Taking a specific functional form for the impact function;

$$M_i(a_i, n_i, RN_i, RM_i, DI_i) = a_i^{\alpha} RN_i^{\delta} RM_i^{\mu} DI_i^{\eta} n_i^{\tau} \tag{2.3}$$

$$0 < \alpha < 1, 0 < |\delta| < 1, 0 < \eta < 1, 0 < \mu < 1, 0 \leq \tau \leq 1$$

Note that DAH disbursements can be negative in cases where recipients' loan repayments are more than their aid receipts. However, as donor decision makers believe that the aid they provide is of benefit developmentally, IHME (2013, p. 23) provides evidence of increasing DAH receipts to SSA countries from 1990 to 2013. This implies the impact of *per capita* DAH in the recipient country invariably increases with the amount of DAH allocated to that recipient country.

$0 < \alpha < 1$ is interpreted, theoretically, as diminishing returns of the creation of impact of *per capita* DAH. As *per capita* DAH is increased, holding other factors constant, the incremental impact on each individual falls. Higher values of α mean it will take longer for such diminishing returns to set in.[17] α is the same for all recipients, implying the average coefficients attached to recipients' need, recipients' merit and donors' interest variables do not vary across recipient countries. Feeny and McGillivray (2008) postulate a theoretical model in which α varies by recipient country.

There is some ambiguity about recipients' needs. The impact of income *per capita* will depend on whether the donors view their aid as substitutes or complements to recipients' incomes (Younas, 2008).

[17] $\alpha = 1$ implies there are constant returns to per capita health aid and the donor is advised to give all its aid to that country (Dudley and Montmarquette, 1976).

For the former, more health aid will be given when *per capita* incomes fall: the impact the impact of health aid on each individual in recipient i will be a decreasing function of income *per capita*. For the latter (complements) health aid will increase with *per capita* incomes: the impact of health aid on each individual in recipient i will be an increasing function of income *per capita*. Increases in health-related need variables like the under-five mortality rate and the prevalence rates of HIV and tuberculosis are indicative of severe deprivation in terms of health. More health aid should then be given to countries that experience such acute deprivations in terms of health. The impact of health aid will thus be an increasing function of these health-related recipient needs.

$0 < |\delta| < 1$ indicates that some recipients' need variables are increasing functions of the impact of *per capita* health aid while others are decreasing functions of the impact of *per capita* health aid. The range just means different donors will place more emphasis on some need variables than others *vis-à-vis* health aid. However, more emphasis placed on a specific need variable does not necessarily result in less emphasis being placed on other need variables. This same argument can be made for recipients' merit and donors' self-interest variables.[18]

We include the population of the recipient country n_i as an independent variable. Ottersen, Kamath, Moon and Røttingen (2014) classify it as a cross-cutting criterion (which affects both recipients' needs and recipients' merits') and it will be interesting to test, and disentangle the effects of population and poverty. Moreover, since interest is in modelling the impact of these variables from a donor's perspective, separating population from income is akin to the World Bank's (and other donors') Performance Based Formulas (PBA) for aid allocation, where population is given a separate weighting.

$0 \leq \tau \leq 1$ is the range of 'biases' in the mind of the donors. By this we mean the elasticity τ is the measure of the donor's perception of the impact of its health aid in countries with different populations (Dudley and Montmarquette, 1976). One of the postulants of the model is that more populous countries experience diseconomies of scale to *per capita* DAH, resulting in lower marginal impacts of health aid. The range shows that for lower values of τ, there is more distortion in the impact donors expect their DAH to have on recipient countries; thus, *per capita* health aid will not have the expected impact on the recipients. Higher values of the elasticity mean the aid allocation process of that donor is better than that of others. Kasuga (2007) describes the aid which responds most to the needs of recipients, 'high-quality aid'.

Recipients' merit variables unambiguously increase donors' utility. These variables capture the perceptions of the donors on the recipients' obligations towards their citizens. Burnside and Dollar

[18] No monotonic transformation has been done to make the exponents in equation (2.3) sum up to 1.

(1997) hypothesize that when recipient governments employ better policy instruments, donors and recipients derive more benefits from an additional unit of aid disbursed. Policy instruments here will include economic globalization and human and political rights improvements among others. If a recipient country employs one or more of these instruments, it is perceived as putting a high weight on the welfare of its citizens. It is thus likely it will use the aid better so it is optimal for the donor to provide more health aid to such recipients.

The impact of *per capita* DAH also increases with donors' interests in that recipient country. As argued by Bermeo (2007), these self-interest variables are not mutually exclusive to need variables. For example, a donor may trade with a recipient because it wants a suitable market for its exports (Osei, Morrissey and Lloyd, 2004), but also because the donor is a consumer of the recipient's own major exports. These are likely goods in which the recipient country has some comparative advantage (for SSA countries these will most likely include raw materials and primary products). The donor seeks to allocate aid in an expedient manner; meeting recipients' needs while simultaneously enforcing their foreign policy.

The weights θ_i capture the idea of 'strategic development' by donors. Development in some countries is more valuable to the donor than development in other countries for some reasons; geographical proximity to the donor, former colony of the donor, belonging to a strategic region of interest to the donor, amongst other reasons. These weights are realized empirically in the form of unobserved heterogeneity and control variables.

The total impact of aid as the sum of the impact on identical residents of a recipient country can then be written as follows;

$$H = \sum_{i=1}^{k} \theta_i n_i \left(a_i^{\alpha} RN_i^{\delta} RM_i^{\mu} DI_i^{\eta} n_i^{\tau} \right) \tag{2.4}$$

Since the donor seeks to maximize the sum of the impacts of its DAH allocation to identical recipients of a country, we multiply the utility function by the population of the recipient country (n_i).

The representative donor is limited by a budget constraint of the form;

$$A = \sum_{i=1}^{k} a_i \, n_i \tag{2.5}$$

Where A is the fixed, total pool of funds available for distribution to all recipients. A is pre-determined *ex ante*. The maximisation problem of the representative donor can thus be written as;

$$\max_{a_i} M = \sum_{i=1}^{k} \theta_i n_i \left(a_i^{\alpha} RN_i^{\delta} RM_i^{\mu} DI_i^{\eta} n_i^{\tau}\right) subject\ to\ A = \sum_{i=1}^{k} a_i n_i$$

(2.6)

The corresponding Lagrangian will be as follows:

$$\mathcal{L} = \sum_{i=1}^{k} \theta_i n_i \left(a_i^{\alpha} RN_i^{\delta} RM_i^{\mu} DI_i^{\eta} n_i^{\tau}\right) + \lambda_i\left(A - \sum_{i=1}^{k} a_i n_i\right) \quad (2.7)$$

The first-order conditions will then be:

$$\frac{\partial \mathcal{L}}{\partial a_i} = \alpha\theta_i\left(a_i^{\alpha} RN_i^{\delta} RM_i^{\mu} DI_i^{\eta} n_i^{\tau+1}\right) - \lambda_i n_i = 0 \quad (2.8)$$

$$\frac{\partial \mathcal{L}}{\partial \lambda_i} = A - \sum_{i=1}^{k} a_i n_i = 0 \quad (2.9)$$

where λ_i is the marginal utility (to donors) from a unit of aid *per capita* spent in the recipient country. For donors to maximize impact from allocating DAH the marginal impact should be the same across countries ($\lambda = \lambda_i$), otherwise donors will increase their aid to countries where the marginal utility is higher. The marginal utility of aid will be captured by period effects in our empirical analysis: period effects account for aggregate shocks that are common to all countries at specific points in time, making the marginal utility of aid same for all countries at a time. Solving both first-order conditions and rearranging for the optimal allocation of *per capita* DAH, we get:

$$a_i^* = \left(\alpha\theta_i \frac{RN_i^{\delta} RM_i^{\mu} DI_i^{\eta} n_i^{\tau}}{\lambda_i}\right)^{\frac{1}{1-\alpha}} \quad (2.10)$$

Taking the logarithms of both sides of equation (2.10), including lags[19] and adding an error term yields the following equation:

$$lna_{ijt}^* = \beta_0 + \beta_i + \Phi_t + \beta_1 lnRN_{i_{t-1}} + \beta_2 lnRM_{i_{t-1}} + \beta_3 lnDI_{i_{t-1}} + \beta_4 lnn_{i_{t-1}} + \beta_5 lnB_{it-1} + \varepsilon_{it}$$

(2.11)

Where

$$\beta_0 = \frac{1}{1-\alpha} ln\alpha;\ \beta_i = \frac{1}{1-\alpha} ln\theta_i;\ \Phi_t = -\left(\frac{1}{1-\alpha}\right) ln\lambda_t;\ \ \beta_1 = \frac{\delta}{1-\alpha};\ \beta_2 = \frac{\mu}{1-\alpha};\ \beta_3 = \frac{\eta}{1-\alpha};\ \beta_4 = \left(\frac{\tau}{1-\alpha}\right);$$
$$\beta_5 = \left(\frac{1}{1-\alpha}\right)$$

Period effects, represented by a full set of time dummies, are included in the model for three reasons. First, they account for aggregate shocks which may be common to all countries; thus, potentially

[19] The intuition behind the inclusion of lags is discussed in section 2.4.

rendering the marginal impacts of a unit of aid *per capita* same for all recipients. Second, the inclusion of time dummies guards against spurious inference since some characteristics of the data may be common only to certain periods of the sample. Third, Sarafidis, Yagamata and Robertson (2009) posit that the inclusion of time dummies reduces (but does not wipe out entirely) cross-sectional dependence, which is palpable in macro panels like ours.

2.3 DATA AND DESCRIPTIVE STATISTICS

Guided by the aid allocation literature, explanatory variables are grouped into recipients' needs, recipients' merits, donors' interests and control variables. These variables will be used in the main estimations, as well as in sensitivity analyses.

2.3.1 Dependent Variable: Commitments or Disbursements?

Most studies in the aid allocation literature use aid commitments rather than disbursements, as dependent variable. The argument is that commitments more accurately portray the intentions of donors (Clist, 2009) and it is from the donors' perspective that most studies consider. However, in this chapter we use health aid disbursements. We seek to model the determinants of actual heath allocations, not promises made by donor agencies. This stand can be summed up by an extract from Kristof (2006) which says

"And whatever the impact on economic growth rates, aid definitely does something far more important: it saves lives. Let's not shy away from a conversation about the effectiveness of aid. The problems are real, but so are the millions of people alive today who wouldn't be if not for aid."

Promises to give funds do not save lives; disbursements of the funds do save lives. These disbursements are influenced by the recipients' ability to meet donors' conditionality (Clist, 2009); and the recipients' abilities to manage the aid effectively. This conditionality may be in the form of meeting certain pre-set thresholds in the provision of health services[20]; or also in the form of political conditionality (Carey, 2007): the latter common when donors convince recipients to implement governance policies in line with donors' thinking. Hence it would be more adequate to model aid allocation in the presence of such conditionality; and test if donors disburse more aid to faltering governments (based on the recipient government's effectiveness), or if they give more aid to needy governments. We also test if donors are more sensitive to their own interests. Thus annual *per capita* DAH disbursements will be used as the dependent variable. This variable is obtainable from the IHME-DAH (2014) database. DAH is defined as 'financial and in-kind contributions made by channels

[20] For instance, the GAVI Alliance state that besides acute poverty, countries will be eligible for funding if they cover at least 70% of the provision of the DTP3 vaccine (GAVI, 2013).

of development assistance to improve health in developing countries. It includes all disease-specific contributions as well as general health sector support, and excludes support for allied sectors' (IHME, 2009, p. 13).[21]

2.3.2 Explanatory Variables

2.3.2.1 Recipients' Needs

Recipients' needs are sub-divided into two groups; broader economic needs and health-related needs.

Broader Economic Needs

We use *per capita* income, GDP *per capita* (GDPpc hereafter) of the recipient country as the main measure of broader economic need. This is a widely used measure of recipients' needs in the existing aid allocation literature (Neumayer 2003a; Berthélemy, 2006b; Clist, 2009; Dollar and Levin, 2006; Isopi and Mavrotas, 2006). Roodman (2008) documents concerns about the endogeneity of *per capita* income: while recipients' income levels may determine how much health aid goes to recipients, health aid receipts may also increase recipients' incomes. This reverse causality is unlikely to significantly influence results for two reasons. First, health aid is small to shape economic outcomes and institutional conditions in recipient countries (Farooq, 2012). Second, Burnside and Dollar (2004) posit that large amounts of aid are unlikely to have short-term effects on economic and social outcomes, as well as institutional conditions.

Nevertheless, to control for potential endogeneity, we use lagged *per capita* income. A priori, *per capita* DAH is expected to increase as GDPpc decreases (empirically, this represents a negative relationship between *per capita* DAH and GDPpc). Decreasing GDPpc shows the limited ability of the recipient country to address their needs; and most donors' allocation statements (DFID, 2011 for instance) state poverty reduction as one of their main reasons for providing aid. Hence donors are expected to provide more aid to countries with lower incomes; as they view their aid as substitutes to domestic incomes. Nonetheless, some donors may view their health aid as complements to recipients' incomes, making them provide more aid to relatively richer countries (Feeny and McGillivray, 2008). Empirically, this translates to a positive relationship between *per capita* DAH and GDPpc. Data on GDP *per capita* is obtained from the World Bank's *World Development Indicators* (WDI) database.

Health-related recipients' needs

[21] Details on how the health aid data are obtained can be seen in the IHME (2013) Methods and Annex document.

The under-five mortality rate (U5MR hereafter), defined as the probability of children dying before the age of five, is a key indicator of severe deprivation in health. DAH is expected to increase as U5MR goes up. Like GDP *per capita*, the under-five mortality rate may also suffer from simultaneity bias: the under-five mortality rate influences the amount of health aid recipients receive but more health aid receipts may also help to reduce the under-five mortality rate. Thus, we use the lagged under-five mortality rate to control for potential endogeneity. We use the under-five mortality rate instead of life expectancy at birth for two reasons.

First, the distributional characteristics of the under-five mortality or infant mortality rates are more sensitive to the living standards of the poor (Younger, 2001), and are more sensitive to broader changes in economic conditions (Mishra and Newhouse, 2009). While incomes may increase almost indefinitely, mortality rates have a lower bound. Hence improvements in welfare are more likely to be associated with improvements in mortality if welfare is low (Younger, 2001). Moreover, reductions in the infant and child mortality rates reflect substantial improvements in life expectancy over the past decades in poor countries (Cutler, Deaton and Lleras-Muney, 2006). Second, Cutler *et al.,* (2006), Mishra and Newhouse (2009) and Boone (1996) state that the infant and under-five mortality rates in developing countries depends on variables like GDP *per capita* adult literacy rate, prevalence of child and maternal undernourishment, access to health facilities, medication and the number of physicians per hospital. Therefore, the under-five mortality rate is an adequate proxy for a wide set of human development outcomes with less time-variation. Data on the under-five mortality rate is obtained from the WDI database.

The prevalence of HIV in the population of those aged between 15 and 49 (HIV hereafter) is also a measure of acute health deprivation (Ottersen *et al.,* 2014). Increases in the percentage of people with HIV shows the burden of the disease on the population. As the percentage of the recipient population infected with HIV increases, donors are expected to increase the amount of health aid provided to the recipient. We get data on HIV prevalence rates from the WDI database.

Another measure of health–related need is the prevalence of tuberculosis (TB hereafter) in the recipient country's population. It is defined as the number of cases of tuberculosis at a given point in time, expressed as the rate per 100,000 populations. Empirical medical research has found that those suffering from tuberculosis are mostly (though not exclusively) those suffering from HIV as well. These two diseases show very high health burdens on the recipients and if their rates are increasing, donors would be expected to provide more health aid to ease the burden. Data on tuberculosis prevalence rates is obtained from the *African Development Indicators* (ADI) database of the World Bank.

There is some ambiguity regarding how these health-related need variables relate to *per capita* DAH. Normatively, increases in *per capita* health aid are expected to match increases in these health-related need variables. Nonetheless, the relationship between the variables and *per capita* health aid can be negative. This is a scenario in which donors allocate more health aid to countries with 'already high' under-five mortality, HIV prevalence and tuberculosis prevalence rates. Kasuga (2007) provides empirical evidence that the USA disburses more health aid to countries with 'already high' infant mortality rates.

2.3.2.2 Recipients' Merits

Recipients' merits are reflected in a country's 'governance' (Burnside and Dollar, 2000) as well as the quality of its institutions (Farooq, 2012). Carey (2007) suggests that bilateral and multilateral donors view and interpret good governance differently. Multilaterals like the World Bank proxy good governance by transparency and accountability, as well as broader economic measures like GDP *per capita* growth, trade openness and fiscal balance. Bilaterals, on the other hand, emphasize human governance; for example, respect of human rights. Burnside and Dollar (2000) suggest that development aid should be given to countries with good policies as they will be able to manage the aid better than countries with bad policies. It is worth mentioning that there is an ambiguous relationship between recipients' merits and recipients' needs. Feeny and McGillivray (2008) state that donors might give more aid to countries with low GDP growth and high trade openness to offset the implications of poor performance (which will be associated with high need). Otherwise, donors might prefer to give more health aid to middle income countries with high growth rates, rewarding them for better economic performance.

The growth rate of *per capita* GDP is an adequate proxy for recipient countries' governance. GDP *per capita* growth is calculated as the rate of change in GDP *per capita* so countries experiencing steady growth in their incomes are 'seen as' making efforts towards their development. They should then receive more aid. However, an alternative argument is that if a country is making huge strides in achieving development that country is not in dire need of aid.[22] Hence the recipient should not receive more aid in this case. On average, SSA countries have lower growth rates than other developing regions for two reasons. First, the difficulty in raising revenues domestically (Neumayer, 2005). These developing countries are constrained in their abilities to raise taxes and most have very weak and occasionally outdated tax systems in place (Osei, Morrissey and Lloyd, 2005). Second, there is also the problem of the Samaritan's dilemma. This is a situation whereby it is always optimal for donors to provide aid to recipients. Hence, the recipient exerts less effort *ex-ante* (interpreted here as generating

[22] See Feeny and McGillivray (2008) for a brief discussion.

less revenue for health expenditures), knowing that it will receive development assistance from donors. This causes a moral hazard problem which the donors can solve by enforcing *ex-post* conditionality on the recipients. However, White and Morrissey (1997) state that as it is always optimal for the donor to provide aid to the recipient, they provide the aid anyway. Thus, the relationship between *per capita* DAH and GDP growth may be negative or positive; the former when donors provide more health to cover for poor economic performance in the recipient countries, and the latter when donors reward recipients for good economic performance. Data on GDP *per capita* growth is obtained from the UNCTAD database.

A measure of democracy is also included since it reinforces what Carey (2007) postulates, that bilateral organisations focus more on human governance. Some donor agencies even state enforcing democracy; through political conditionality, as part of their objectives for providing aid. DFID (2011) state as part of their new results-based allocation policy; supporting the development of local democratic institutions, civil society groups, the media and enterprise. Hence implementing more democratic systems in their country will make some recipients favourites in being selected for, and receiving health aid. We get democracy data from the Polity IV dataset and it ranges from '-10' (least democratic) to '10' (most democratic).

We also include a measure of openness as a proxy for recipients' economic effectiveness. In computing the globalisation index, Dreher (2006) uses trade openness as one of the main components of economic globalization. Openness is the sum of exports and imports as a percentage of the recipient's GDP. The German agency for international development, GIZ, is guided by principles of reducing poverty and promoting equitable forms of globalization in their allocation patterns (GIZ, 2013). Nunnenkamp and Thiele (2006) postulate that aid can be used more wisely in economically stable countries that are more open to trade. Berthelemy (2006a) argues against the use of outcome variables like GDP growth and trade openness as measures for recipient merit. However, these outcomes are a result of genuine efforts made towards better economic management and prosperity so they can be used as good proxies for institutional quality. Data on trade openness if obtained from the WDI database.

The immunization rate of measles is also included in the analysis. This measures the percentage of children aged 12-23 months who received vaccines before they were 12 months old. Children are considered immunized if they have received at least one doze of the vaccine. Stepping (2012) states that the immunization rate in any given country can be seen as a proxy for the quality of health systems in said country. High coverage rates of immunization signal a developing country with relatively high health care quality, which itself shows signs of the country making efforts towards its human

development; so they will be more deserving of aid. Nonetheless, high immunization rates may be common in countries able to cater for their health needs. These countries, then, are not in dire need of aid so should not receive more aid. Thus, a positive relationship between *per capita* DAH and the immunization rate reflects donors rewarding countries with good health systems; while a negative relationship reflects donors provide less DAH to countries with good health systems (hence, less need for DAH). Data on the immunization of measles is obtained from the WDI database.

2.3.2.3 Donors' self-interest

Bilateral exports from the donor to the recipient are included as the main determinant of donors' interests. This variable has been extensively used as a measure of donors' interests in the aid allocation literature (Isopi and Mavrotas, 2006; Berthélemy, 2006b; Farooq, 2012 among others) since it depicts the strength of commercial links between the donor and the recipient country. Berthélemy (2006b) finds evidence that donors provide more aid to countries that have bilateral trade relationships with them. In this case, the effect of trade on *per capita* health aid allocation will be positive. Farooq (2012) states that donors give more aid to important trade partners, maybe because bilateral relationships are closer when trade is high or because donors tend to support, indirectly, their own exports to the recipients. Clist (2009) also finds some evidence that countries like Germany, Sweden and the Netherlands do not choose their trading partners as potential recipients of aid; while the USA provides less aid to its trading partners. In such cases the effect of trade on allocation is negative. There can also be reversed causality regarding DAH and trade; that is increased DAH may also lead to increased trade between the two countries so we lag it by one period. Data for exports comes from the OECD-DAC (2014) database.

2.3.2.4 Population

As stated earlier, population is included independently since there is no consensus on its perceived position in the model. Some studies include it as a recipient need variable (Clist, 2011; Feeny and McGillivray, 2008) while others include it as a control variable (Farooq, 2012). Most studies on aid allocation find a bias towards less populous countries (Alesina and Dollar, 2000; Trumbull and Wall, 1994) which can be termed a "small-country bias". Doucouliagos and Paldam (2007) posit that there is no reason to treat poverty in a less populous country as more important than poverty in a more populous country. Hence giving more aid to countries based on their size is indeed a bias. Younas (2008) provides some intuitive arguments as to why small-country bias is palpable in the literature. First, more populous countries experience diseconomies of scale of *per capita* aid which results in low

marginal impacts of aid. Second, more populous countries have limited absorptive capacity[23] and cannot handle additional amounts of aid. Third, it is relatively easier for donors to wield political influence in less populous countries than in more populous countries; i.e, as the population of the recipient country increases, the marginal political benefit to donors reduces. Nonetheless, some few studies find that donors give more aid to countries with increasing populations, until at least a certain threshold population (Neumayer, 2003b; Feeny and McGillivray, 2008). Thus, there can be a positive or negative relationship between *per capita* DAH and population. Population data is obtained from the WDI database.

2.3.2.5 Control Variables

Control variables capture the time-constant, recipient-specific effects derived from the conceptual framework. Neumayer (2005) posits that former colonial powers still maintain political, economic and cultural similarities with their former colonies. To capture these colonial and other similar geopolitical effects, we use dummy variables. We include bilateral dummy variables for former colonies of France and the United Kingdom. The dummy variables equal one if the recipient in question is the former colony of the observed donor. Otherwise, it is zero. Following Alesina and Dollar (2000), Clist (2009) and Farooq (2012), cultural similarity is also included, proxied by language similarities. Language is a dummy which takes the value of one if the recipient country uses the donor's language as an official language in their own country; and zero otherwise.

2.3.3 Descriptive Statistics

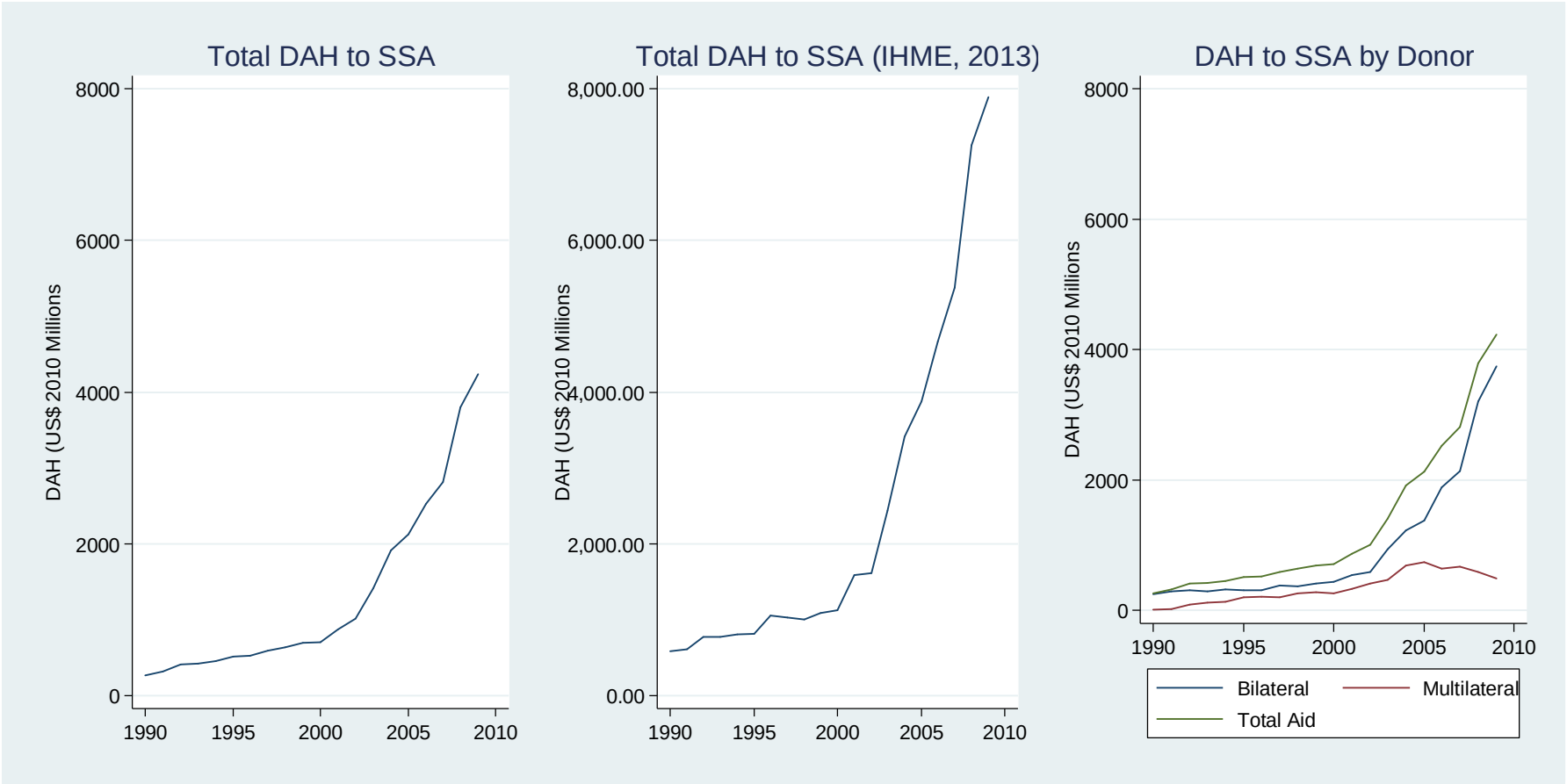
We aim to analyse the determinants of *per capita* health aid disbursements to 44 SSA countries over the period 1990 to 2011. For descriptive purposes, we aggregate all health aid flows into three categories and provide an overview of its composition and evolution; total health aid, total multilateral aid and total bilateral aid. All data are in millions of 2010 US dollars. Total multilateral aid is the sum of health aid disbursements from the European Commission (EC hereafter) and the International Development Association of the World Bank (IDA hereafter) while total bilateral aid is the sum of health aid disbursements from the UK, France, Germany, the USA and Sweden. Total health aid, is the sum of total bilateral and total multilateral aid. IHME (2012) states that the first four bilateral donors (UK, France, Germany and the USA) provided, in absolute dollar amounts, approximately 73% of the total development assistance in 2010. Sweden, on the other hand, was ranked one of the highest in terms of health aid disbursed, as a proportion of GDP (IHME, 2012). These five bilateral donors play a huge role in the international health scene: hence, modelling their allocation patterns is necessary.

[23] They lack the administrative expertise to absorb continuously large amounts of aid.

Panel A of figure 2.1 shows that total health aid (based on our sample of five bilateral and two multilateral donors) provided to the SSA region has been increasing throughout the sample period. IHME (2013, p. 23) states that health aid to SSA countries has been on the rise; with the region receiving $8.8 billion in 2011, a 6.1% increase from the value in 2010. This rise in disbursements has been to match the pressing health needs of the region (with the burden of disease increasing dramatically); and, because more low-income countries are found in the SSA region (IHME, 2013, p. 23). Panel B depicts this trend using data from the IHME (2013) report. Panel B includes all countries for which the IHME has health aid disbursement data. Panel C shows the evolution of bilateral and multilateral health aid disbursements to SSA countries over the sample period. It is clear from Panel C that health aid disbursements have been increasing steadily over the sample period; with a drastic increase in total and bilateral disbursements from 2003 to 2008. This was before the financial crisis and most bilateral donors were increasing their health aid disbursements to developing countries. Moreover, donors were just fresh from the Millennium Declaration so they were eager to meet up with the targets of the MDGs. There was also an increase in multilateral health aid disbursements between 2003 and 2008 but not as much as for the bilaterals. Irrespective of the small number of multilaterals included, this trend confirms IHME's (2013, p. 10) assertion that bilateral organisations provide more health aid than multilaterals.[24] Both multilaterals and bilaterals experienced drops in health aid disbursements after 2008, reflecting the effects of the 2008 financial crisis. Health aid disbursements from most donors were cut in the face of budgetary austerity.

[24] The increase in health aid disbursements over the period 2003 to 2008 is not as much for the multilaterals as it is for the bilaterals because we include just two multilateral organisations in our analysis. Other multilaterals like the African Development Bank, the International Bank of Reconstruction and Development and United Nations (UN) agencies were not included due to spotty data. Their exclusion, by no means, implies their non-importance.

Figure 2. 1: Distribution and Evolution of DAH over time (1990 – 2011)



Source: Panels A and C are based on the IHME DAH (2013) Database. Panel B is based on data obtained from the IHME (2013, p. 78) report.

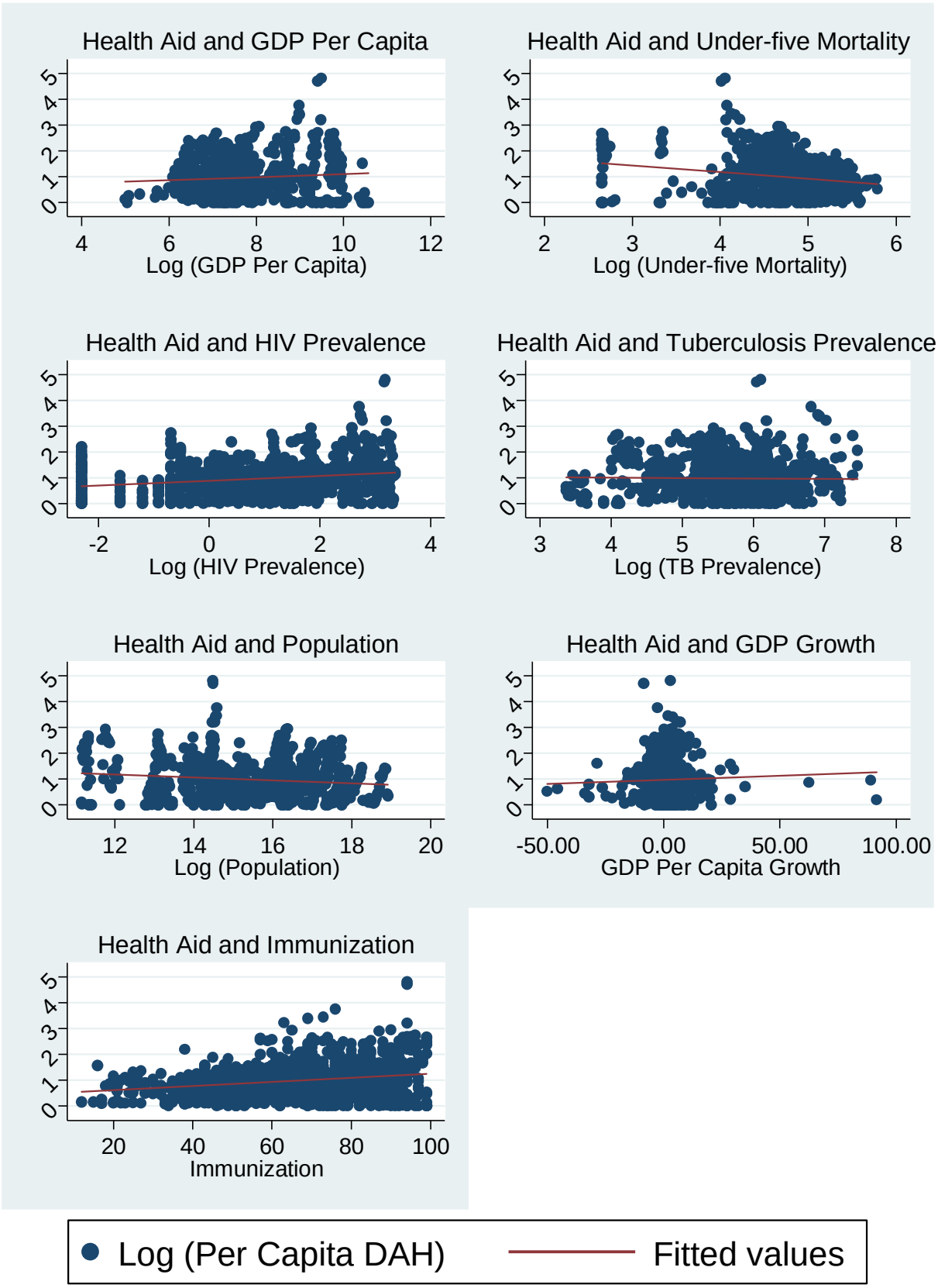
Table 2. 1: Main Recipients of Health Aid

Total Health Aid Flows (millions of $US 2010)				
	Most Received		Least Received	
Rank	Country	Amount	Country	Amount
1	Nigeria	2808.757	Seychelles	8.237
2	Kenya	2256.566	Equatorial Guinea	9.540
3	Uganda	2084.822	Sao Tome and Principe	20.085
4	Tanzania	1866.422	Cape Verde	31.161
5	South Africa	1835.736	Comoros	38.443
6	Mozambique	1466.119	Gabon	54.845
7	Ethiopia	1438.421	Swaziland	55.162
8	Zambia	1406.466	Gambia	58.558
9	Malawi	1110.169	Guinea Bissau	59.094
10	Ghana	936.223	Republic of Congo	73.986
Average *Per Capita* Health Aid flows ($US)				
	Most Received		Least Received	
Rank	Country	Amount	Country	Amount
1	Botswana	315.278	Togo	15.996
2	Namibia	191.601	D.R. Congo	16.966
3	Sao Tome	148.075	Cameroon	17.370
4	Zambia	124.846	Equatorial Guinea	18.089
5	Seychelles	105.286	Ethiopia	19.048
6	Malawi	91.667	Nigeria	19.762
7	Uganda	75.516	Republic of Congo	22.418
8	Mozambique	74.478	Central African Republic	24.309
9	Rwanda	73.771	Burundi	26.700
10	Comoros	71.588	Angola	27.073

Notes: All figures are in constant $US 2010.

Table 2.1 provides an overview of the 10 major/least recipients of health aid disbursements; in absolute $US2010 amounts and in *per capita* terms. The 2nd and 3rd columns of the table show that more populous countries receive more health aid in absolute dollar amounts; with Nigeria receiving most (approximately $US28.1 billion). Other populous countries like Tanzania also received huge sums of absolute health aid ($US18.7 billion). Less populous countries like Equatorial Guinea and Seychelles received smaller amounts of absolute health aid from donors. Health *aid per* capita, on the other hand, is highest in the least populous countries. Botswana, by far one of the least populous countries in Africa, receives the most health aid per capita ($US315.28 per person). A plausible argument for this is the fact that more populous countries lack the absorptive capacity to manage huge sums of aid. Hence donors prefer to give more *per capita* aid to small countries as they are assumed to be countries where the aid will be managed better. Nonetheless, less populous countries like Togo, Burundi, and Central African Republic receive less *per capita* health aid as they are badly governed countries.

Figure 2. 2: Scatter plots of Health Aid and recipients' needs and merits, 1990-2011



To get a broader view on how health aid is disbursed in response to recipients' needs and their ability to manage the aid, some bivariate analysis of health aid flows and indicators of need and merit is done. Figure 2.2 shows scatter plots of logged *per capita* health aid against some measures of need and merit.[25] We also include a linear OLS fitted line to get a richer picture of the relationship between *per capita* health aid and the explanatory variables. The most surprising pattern is that health aid shows a positive relationship with *per capita* incomes. The Performance Based Allocation formula of the IDA, as well as most bilateral donors' policy statements (for example, DFID, 2011), state that more aid should be provided to countries that otherwise cannot cater for their needs (needs proxied by *GDP per capita*). Hence, we would expect more health aid to countries with lower incomes. However, Feeny and McGillivray (2008) state that it is perfectly normal for donors to give more aid to relatively richer countries, as their aid is disbursed to complement recipients' incomes. Moreover, there might be higher labour costs in countries with higher *per capita* incomes so these countries tend to receive more *per capita* health aid from donors.

There is a negative relationship between *per capita* health aid and recipients' population. This means smaller countries receive more health aid *per capita*, as seen in Table 2.1. This negative relationship is consistent with the aid allocation literature (Younas, 2008; Neumayer, 2003b; Harrigan and Wang, 2011 amongst others). Younas (2008) provides some intuitive explanations for this negative relationship, one of which is the fact that marginal impact of aid decreases as population increases. This will be discussed in more detail in the next section.

Ottersen *et al.,* (2014) posit that more health aid should be disbursed to countries with increasing under-five mortality rates. Nevertheless, from the graphical analysis we can see that is not the case; a positive relationship between *per capita* health and the under-five mortality rate is observed. On average, donors provide more health to countries only when their under-five mortality rates have risen to very high levels; not when they are relatively low and just increasing.

Ottersen *et al.,* (2014) also posit that more health aid should be given to countries with higher HIV prevalence and tuberculosis prevalence rates. From our graphical analysis, we can see that the relationship between HIV prevalence and TB prevalence rates and *per capita* DAH is positive. Regarding health aid and recipients' merits, we can see that on average donors provide more aid to countries with better economic policies and to countries investing more in the health of their citizens; proxied by real GDP *per capita* growth and immunization rates respectively.

[25] See Appendix tables A1 and A2 respectively for variable definitions and descriptive statistics.

Correlation coefficients between *per capita* health aid disbursements from the various donors are considered. To gauge if there are any "herding" practises in health aid allocation, we aim to decipher if donors provide more health just because their "peers" do so as well. Going by table 2.2 we conjecture that most countries follow the UK's health aid allocation patterns. The correlation coefficients between the UK's *per capita* disbursements and that of other donors are significant for Germany, Sweden and the EC. This is tacit evidence that the UK wields considerable influence in the international health agenda. As regards correlation between need and merit variables, table 2.3 shows that the correlation coefficients are generally small albeit significant. Including the variables together in the subsequent multivariate analysis should not lead to problems of multicollinearity. One caveat remains, however. The rate of immunization of measles is negatively and significantly correlated with the under-five mortality rate $(r = -0.5418, p < 0.05)$ but we include both variables in our multivariate analysis because the rate of immunization of measles is an adequate proxy for effort expended domestically in trying to improve economic conditions. In some way, it is treated as an 'instrument' for government health expenditures; which itself proxies the weight domestic governments place on the welfare of their citizens.

Table 2. 2: Correlation coefficients between *per capita* DAH disbursements across donors

	UK	France	Germany	USA	Sweden	EC	USA
UK	1						
France	-0.0347	1					
Germany	0.0802*	-0.0484	1				
USA	0.0404	-0.0437	0.1533*	1			
Sweden	0.1577*	-0.0574	0.0442	0.1346*	1		
EC	0.1035*	0.0252	0.0728*	0.0534	0.0248	1	
IDA	-0.0518	0.1014*	-0.0132	0.0045	-0.0509	0.0610	1

Notes: * indicates significance at the 5 per cent level.

Table 2. 3: Correlation coefficients between main explanatory variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1)	1								
(2)	-0.3714*	1							
(3)	-0.5855*	0.4480*	1						
(4)	0.0931*	0.2348*	-0.1175*	1					
(5)	0.0043	0.1588*	0.2487*	0.1724*	1				
(6)	0.1235*	-0.0381	-0.0739*	-0.0212	-0.0007	1			
(7)	0.5311*	-0.4599*	-0.3328*	-0.0014	-0.0196	0.2124*	1		
(8)	0.2272*	0.2955*	-0.5418*	0.2145*	-0.1797*	0.1107*	0.2341*	1	
(9)	-0.0108	0.1456*	-0.1560*	0.1244*	0.0940*	0.0135	-0.0671*	0.0725*	1

Notes: (1) is GDP per capita, (2) is population, (3) is the under-five mortality rate, (4) is the HIV prevalence rate, (5) is the tuberculosis prevalence rate, (6) is GDP per capita growth, (7) is trade openness, (8) is the immunization rate, (9) is democracy. All variables except GDP growth, immunization and democracy are logged. * indicates significance at the 5 per cent level.

The descriptive analysis in this section is strictly preliminary. A proper multivariate analysis of the determinants of *per capita* health aid disbursements should be carried out, where we would be testing relationships between the key variables and *per capita* DAH.

2.4 EMPIRICAL MODEL SPECIFICATION

We estimate a health aid allocation model using one of two techniques. The choice of the appropriate technique is motivated by the characteristics of the data and data diagnostics. Theoretically, the Tobit estimator is applicable if the underlying dependent variable contains negative values that have been censored to zero in the empirical realization of the variable (Sigelman and Zang, 1999). Since the dependent variable in this chapter is health aid disbursements it is normal that there be some negative disbursements; in cases where loan repayments are larger than receipts from international donors. Such instances are relatively few and can be censored at zero, easing applicability of the Tobit estimator. Thus, the zero health aid disbursements will now represent actual zero disbursements (no aid) or loan repayments (negative disbursements).

It is also normal that all donors do not give health aid to all recipients every year (Clist, 2009); such that some recipients receive occasionally receive $0 in the form of health aid or total Overall Development Assistance from specific donors (McGillivray, 2003). If the decision-making processes of donors *can be* modelled accurately then the appropriate estimator will be used (Sigelman and Zang, 1999). For instance, if the donor decides on how much health aid it *"wishes"* to contribute to a specific country then, again, the Tobit estimator will be an appropriate choice. If the donor decides whether to contribute, and then if the first decision is affirmative, decides how much to give; a Tobit estimator will be inappropriate. The $0 observations would not be a result of censoring but of a binary choice. In this case, the Double-Hurdle estimator is more appealing.

The Tobit Estimator

The first estimator we consider is the Pooled Tobit estimator, which is a special type of double hurdle estimator where ($x_1 = x_2$). The underlying reason for using the Tobit estimator is that the decision on whether to provide aid, and the amount of aid provided are determined by the exact same factors. More generally, consider the following model;

$$y_i^* = \alpha + x_i'\beta + \varepsilon_i \tag{2.15}$$

Where $y_i = y_i^*$ if $y_i^* > 0$

$$y_i = 0 \text{ if } y_i^* \leq 0$$

And $\varepsilon_i \sim N(0, \sigma^2)$

where y_i^* is the latent (true) variable which is only observed for values greater than zero, is a function of the regressors (x_i) and a normally distributed error term. The Tobit estimator then estimates the chance of censoring (for the limited observations) at the same time as estimating the value of y, if uncensored. The Tobit is estimated by maximum likelihood and has been used extensively in the aid allocation literature (Alesina and Dollar, 2000; Isopi and Mavrotas, 2006; Alesina and Weder, 2002) The model for health aid allocation will be given by:

$$Aid_{ijt}^* = Max(0,\ \beta x_{ij,t} + u_{it}) \tag{2.16}$$

Where $Aid_{ijt} = Aid_{ijt}^* \ if \ Aid_{ijt}^* > 0$ (2.17)

$$Aid_{ijt} = 0 \ if \ Aid_{ijt}^* < 0$$

where i represents the recipient country, j represents the donor country, and t refers to time. Aid_{it}^* is the quantity of DAH *per capita* disbursements (the latent variable), $x_{ij,t}$ is the set of explanatory variables which vary with the recipient, the donor and with time. β is the vector of parameters associated with the explanatory variables and u_{it} is the random error term. A key assumption for consistency of estimates is that the idiosyncratic error in the Tobit estimator should be normally distributed and homoscedastic. Monte Carlo studies have shown the Tobit estimator to result in inconsistency when errors are non-normal and heteroskedastic (Pagan and Vella, 1989). Nonetheless, lognormal extensions of the Tobit are readily available, and Deaton (1997, p. 89) also discusses a non-parametric alternative to the fully parametric Tobit estimator. In this chapter, we are interested in getting the partial effects of independent variables on the unconditional expected value of health aid. The partial effect of any independent variable x_i will be;

$$\frac{\partial E[DAH_{ijt}|x_i]}{\partial x_i} = \Phi\left(\frac{x_i'}{\sigma}\right)\beta \tag{2.18}$$

The Two-Part Estimator

The Two-Part or Double Hurdle estimator was popularized by Cragg (1971). In the first part, a Probit model can be estimated in which donors decide whether to provide health aid to recipients, or not. This decision is a function of recipients' needs, recipients' merits, donors' interest and attendant control variables. The basic equation of the Probit takes the following form:

$$\Pr\left[DAH_{ijt} = 1 \middle| x_i\right] = F(X) = \Phi\left(\alpha_i + \rho_t + \beta x_{ijt-1} + \mu_{it}\right) \quad (2.19)$$

where i refers to the recipient, j represents the donor and t is time. The dependent variable DAH_{ijt} equals 1 if the country receives health aid (if the latent variable DAH^*_{ijt} is greater than zero), and zero otherwise. Φ is the cumulative standard normal distribution from which the errors of the Probit draw, α_i represents unobserved heterogeneity, ρ_t represent period effects and x_{ijt-1} is a vector of lagged explanatory variables that vary by recipient, donor and time. μ_{it} is the error term.

Based on equation (2.19), we can estimate a pooled Probit in the 1st stage. Given the non-linearity of the conditional mean, the parameter estimates cannot be treated as partial effects so they are not very informative. Interest will then be on partial effects; with interest in obtaining the partial effects of independent variables on the probability of being chosen to receive *per capita* health aid. The partial effect, which shows the change in the probability of selection to receive health aid, resulting from a change in any independent variable will be;

$$\frac{\partial \Pr[DAH_{ijt}=1|x_i]}{\partial X_i} = \beta_i \phi(x_{it}\beta) \quad (2.20)$$

The second stage of the double-hurdle estimator is an OLS model in which the donors decide how much health aid to provide only to the selected countries from the first stage. The allocation equation will be of the form:

$$\ln\left(DAH_{ijt} | DAH_{ijt} > 0\right) = \left[\alpha_i + \rho_t + \beta x_{ijt-1} + \varepsilon_{it}\right] \quad (2.21)$$

where i refers to the recipient, j represents the donor and t is time. The dependent variable is the logarithm of *per capita* DAH disbursements from donor j to recipient i in year t. α_i represents unobserved heterogeneity, ρ_t represent period effects and x_{ijt-1} is a vector of lagged explanatory variables that vary by recipient, donor and time. ε_{it} is the error term. An appealing feature of the double hurdle estimator is that the variables influencing selection of recipients can (and possibly should) be different from those influencing the amount of health aid recipients get. One crucial assumption here is that the choice of the recipient(s) and the amount of DAH allocated be completely independent of each other. In other words, the error terms in the two equations should be completely independent; that is $Cov\left[\mu_{it}\varepsilon_{it}\right] = 0$.[26] Nunnekamp and Ohler (2011) state that if the assumption of independence is not met; which is almost always the case, the regression in the second step suffers from selection bias. Results from the 1st stage are, however, not affected. Another key assumption for

[26] This independence assumption is directly testable using a Heckman estimator. Since there is no sample selection in our model the Heckman estimator cannot be used to test for independence.

consistency of the double-hurdle estimator, besides independence in the errors, is that E (lnDAH|DAH=1, x) is linear in x (Cameron and Trivedi 2009, p. 556). This assumption can be tested by using regular model specification tests.

The choice of the appropriate estimator for the model is an issue that most researchers tend to ignore and choose their estimators arbitrarily. Isopi and Mavrotas (2006), Farooq (2012), Berthélemy and Tichit (2004) use the Tobit estimator while Berthélemy (2006a), Clist (2009) use the Double-Hurdle estimator. There are tests for model choice and the analyst should be guided by data diagnostics in choosing the appropriate estimator. A Wald test with a $x^2(N)$ distribution can be used to discriminate between competing estimators. Furthermore, when the model is correctly specified the *Likelihood Ratio* (LR) test can also be used. Drukker (2002) also provides a conditional moments test for normality and homoscedasticity of the residuals from the Tobit estimator.

Recipients' need factors are specific to recipients and they vary over time. Donors' self-interest variables are those observable variables that make recipients special to certain donors. Hence, they are known to donors and recipients, and they vary over time. Recipients' merit variables are treated analogously.[27]The control variables are time-invariant. Our baseline regression will be of the form;

$$\begin{aligned} lnDAH_{ijt} = {} & \alpha_0 + \pi_1 ln(U5MR)_{it-1} + \pi_2 ln(HIV)_{it-1} + \pi_3 ln(GDP\ per\ capita)_{it-1} \\ & + \pi_4 ln(TB)_{it-1} + \theta_1 ln(Exports)_{it-1} + \gamma_1 (GDP\ growth)_{it-1} \\ & + \gamma_2 ln(Openness)_{it-1} + \gamma_3 (Democracy)_{it-1} + \gamma_4 (\text{Immunization})_{it-1} \\ & + \delta_1 (Colony)_i + \delta_2 (Language)_i + \phi_1 ln(Population)_{it-1} + \rho_t \\ & + \varepsilon_{it} \end{aligned} \tag{2.22}$$

where ρ_t represents period effects (time dummies), α_0 is the constant term, and ε_{it} represents the error term. Some comments on the specification are noteworthy. All explanatory variables are lagged for two reasons. First, the disbursement of aid is subject to time lags. Feeny and McGillivray (2008) and Farooq (2012) state that allocations for any given year are made towards the end of the preceding year. Hence decision-makers in the funding agencies base their allocation decisions on the available information on recipient countries, which is almost always for the penultimate year (Feeny and McGillivray, 2008). Alternatively, donors use the available information from the recipients to form expectations for the year for which the aid will be given (Feeny and McGillivray, 2004).[28] Second, recipients' need, donors' interest and recipients' merit variables are either endogenously or exogenously related to health aid *per*

[27] It should be noted here that we use the word factors instead of variables; with various variables making up a factor. For instance, the recipient need factor will comprise variables like income *per capita*, and the under-five mortality rate among others. Factors can be viewed as vectors of variables.

[28] These information and time lags do not apply to time-invariant factors like colonial history, geographical distance, or geographical location of the recipient country.

capita. Roodman (2008) states that this might be the case for income *per capita* (as well as under-five mortality, infant mortality rates and bilateral exports), though it is not severe. However, to pre-empt potential endogeneity from influencing our analysis, we choose to lag all the time-varying explanatory variables by one period.

2.5 EMPIRICAL RESULTS

2.5.1 Diagnostic Tests

Based on the assumptions mentioned above, tests will decide between the double-hurdle and Tobit estimators. It should be remembered that the smallest amount of heath aid is $0 and natural logs are not defined for such observations. To be able to use these observations for our diagnostic tests, we set all censored observations of lnDAH to an amount slightly smaller than the minimum uncensored value of lnDAH (Cameron and Trivedi, 2009, p. 546). The diagnostics will be based on normality and heteroscedasticity tests, as well as specification of the linear conditional mean in the 2nd stage of the Two-Part estimator. For the double-hurdle estimator normality and heteroscedasticity tests are done only on the second stage, and can be used for any OLS regression (Clist, 2009). Normality and heteroscedasticity tests for the pooled Tobit are due to Cameron and Trivedi (2009, p. 549-553) and Drukker (2002). Actual data on *per capita* health disbursements from the UK are used for the testing strategy.

Table 2. 4: Diagnostic Tests for Model Selection

Estimator	Tobit		Double-Hurdle	
Test for	Normality	Heteroskedasticity	Normality	Heteroskedasticity
Test Stat	62.63	280.544	21.90	3.51
Probability	0.00000	0.00000	0.0000	0.0611

Notes: The Tobit tests for normality and homoscedasticity are conditional moment tests from Cameron and Trivedi (2009, p. 550-553), and both have a large sample chi-squared distribution. The test for normality of the Two-Part estimator has a Chi-squared distribution, with two degrees of freedom. The test for heteroscedasticity is the Breusch-Pagan/Cook-Weisberg test, with the null hypothesis of constant variance of the error term. The test has a Chi-squared distribution, with one degree of freedom.

The results (table 2.4) lead to a strong rejection of normality and homoscedasticity in the Tobit estimator. Non-normality is still evident though the dependent variable has been transformed to logarithms. Normality is rejected in the double-hurdle estimator but homoscedasticity is accepted. Nonetheless, Cameron and Trivedi (2009, p. 556) state that neither homoscedasticity nor normality are extremely necessary conditions for consistency of the two-part estimator. The key assumption for consistency of the double-hurdle estimator, besides independence in the errors from the two stages, is

that E (lnDAH|DAH=1, x) is linear in x (Cameron and Trivedi, 2009, p. 556). This assumption can be tested by regressing the dependent variable on predicted values of Y $(\widehat{Y})$ and Y^2 $(\widehat{Y^2})$ and testing that the coefficient of $\widehat{Y^2}$ is not significantly different from zero. The null hypothesis of insignificance of $\widehat{Y^2}$ cannot be rejected. Indeed, the conditional mean of the double-hurdle estimator is correctly specified. This then gives the double-hurdle estimator an advantage over its Tobit counterpart. As two assumptions from the possible three are in favour of the double-hurdle estimator, these results point towards the double hurdle estimator as the appropriate estimator for our analysis.

2.5.2 Disbursements by Major Donors

2.5.2.1 Decision Stage

Here, a pooled Probit estimates the probability of receiving health aid from individual donors; results from which can be found in Table 2.5. For the health-related need variables, the under-five mortality rate influences selection of recipients for three of the seven donors; Germany, USA and the IDA. For Germany, the relationship is negative while for the other two donors it is positive. A 1% increase in the U5MR will lead to a 0.08 percentage points (pp hereafter) increase in the probability of selection for the USA's health aid and a 0.14pp increase in the probability of selection to receive the IDA's health aid.

The HIV prevalence rate influences selection decisions for all but one of the donors; France. Increases in the HIV prevalence rate lead to higher probabilities of selection to receive health aid from the UK, Germany, USA, Sweden and the European Commission. Contrarily, the IDA chooses countries where HIV prevalence rates are already very high, as argued in section 2.3. Based on our results, Sweden is most sensitive to this health indicator. A 1% in the HIV prevalence rate leads to a 0.09pp increase in the probability of selection to receive Swedish health aid. A 1% increase in the HIV prevalence rate leads to a 0.03pp increase in the probability of selection to receive health aid from the UK, a 0.03pp increase in probability of selection to receive from Germany, a 0.02pp increase in the selection probability by the USA and a 0.03pp increase in selection probability by the EC.

Table 2. 5: Determinants of Health Aid – Selection Stage

	UK	France	Germany	USA	Sweden	EC	IDA
Recipients' Needs							
Under-five Mortality Rate	-0.032 (0.047)	-0.031 (0.040)	-0.087* (0.048)	0.079* (0.047)	0.085 (0.052)	-0.025 (0.047)	0.140*** (0.039)
HIV Prevalence Rate	0.028*** (0.011)	0.005 (0.015)	0.033*** (0.010)	0.023** (0.010)	0.090*** (0.011)	0.034*** (0.010)	-0.073*** (0.008)
Tuberculosis Prevalence Rate	0.016 (0.017)	0.124*** (0.026)	-0.042** (0.018)	0.028* (0.016)	0.031* (0.019)	-0.056*** (0.018)	-0.060*** (0.019)
GDP *Per Capita*	-0.219*** (0.021)	-0.007 (0.026)	-0.071*** (0.020)	-0.019 (0.023)	-0.053** (0.023)	-0.054** (0.025)	-0.102*** (0.018)
Population	0.101*** (0.017)	-0.021 (0.024)	0.110*** (0.020)	0.154*** (0.015)	0.009 (0.020)	0.039*** (0.014)	0.099*** (0.010)
Recipients' Merits							
GDP *Per Capita* Growth	0.004** (0.002)	0.003 (0.002)	0.0003 (0.002)	0.003 (0.002)	-0.001 (0.002)	0.001 (0.002)	-0.0004 (0.002)
Openness	0.169*** (0.032)	-0.034 (0.032)	0.051 (0.032)	0.014 (0.031)	-0.065* (0.038)	0.102*** (0.037)	0.0001 (0.031)
Democracy	0.003 (0.002)	-0.007*** (0.003)	-0.003 (0.003)	-0.001 (0.002)	0.004* (0.002)	0.003 (0.003)	0.002 (0.002)
Immunization	0.0004 (0.001)	-0.002** (0.001)	0.001 (0.001)	0.002** (0.001)	0.004*** (0.001)	-0.005*** (0.001)	0.006*** (0.001)
Donors' self-interest							
Exports	0.049*** (0.011)	0.043** (0.018)	-0.005 (0.015)	0.005 (0.007)	0.071*** (0.010)		
Control Variables							
Colony	0.236*** (0.046)	0.108* (0.063)					
Language	0.140*** (0.038)	0.359*** (0.053)		0.084*** (0.031)			
Diagnostics							
Observations	773	773	773	773	773	773	857
Log-likelihood	-283.76	-293.25	-327.18	-252.69	-306.92	-336.82	-321.81
x^2	486.26	217.98	359.68	223.97	273.84	94.18	355.99

Notes:

(i) We estimate the selection probability (1 = receives health aid; 0 = does not receive health aid) based on a pooled Probit maximum likelihood. All time-varying regressors except democracy, immunization and GDP per capita growth are logged. Heteroscedasticity and correlation-robust standard errors are reported in brackets. All equations include a constant term and a full set of time dummies (none of which are reported).

(ii) All time-varying explanatory variables are lagged one period.

(iii) ***, ** and * denote significance at 1, 5 and 10 per cent respectively.

(iv) The chi-squared statistic is for the test of joint significance of all regressors in the model. The p-values of the test have not been reported but for all donors, the test statistic is significant at 1 per cent.

The tuberculosis prevalence rate is also an important determinant of selection of potential recipients of health aid. All donors, except the UK, are influenced by the tuberculosis prevalence rate in their selection of recipients. France, USA and Sweden choose countries with high tuberculosis rates as potential recipients, with the impact being largest for France. A 1% increase in the tuberculosis

prevalence rate leads to a 0.1pp increase in the selection probability of receiving French health aid. A 1% increase in the tuberculosis rate leads to a 0.03pp increase in the selection probability of receiving health aid from the USA and a 0.03pp increase in the selection probability from Sweden. The relationship, however, is negative for Germany, the EC and the IDA. They choose countries with already high tuberculosis prevalence rates as potential recipients of their health aid, as argued in section 2.3.

GDP *per capita* in the recipient countries is an adequate measure of broader development needs. Five of the seven donors in our analysis choose poorer countries as potential recipients of their health aid; UK, Germany, Sweden, the European Commission and the IDA. The UK responds most to broader development needs as a 1% increase in *per capita* income leads to a 0.22pp reduction in the selection probability of receiving health aid. The IDA reduces its selection probability by 0.10pp after a 1% increase in recipients' *per capita* incomes. With a 1% increase in incomes Germany, Sweden and the European Commission reduce their selection probabilities by 0.07pp, 0.05pp and 0.05pp respectively. This negative relationship is consistent with most of the aid allocation literature (Berthélemy, 2006a; Carey, 2007; Clist, 2009; Angeles *et al.,* 2008 among others).

Five of the seven donors in the analysis choose more populous countries as potential recipients of their health aid; UK, Germany, USA, the European Commission and the IDA. Of all the donors that are influenced by population in their selection decisions, the USA shows the most profound effect. A 1% increase in population is matched by a 0.15pp increase in the selection probability of receiving health aid from the USA. The UK and the IDA increase their selection probabilities by 0.10pp each respectively, while Germany increases its selection probability by 0.11pp after a 1% increase in recipient's population.

Looking at recipients' merit variables, *per capita* GDP growth rate is not an important determinant of health aid allocation. The only donor in this chapter to reward countries with better economic performance is the UK. From a normative point of view, they see high GDP growth rates as a characteristic of countries working towards self-development. A 1-unit increase in the GDP growth rate leads to a 0.4pp increase in the selection probability of receiving health aid from the UK. Democracy, likewise, is not an important determinant of selection for donors. Only France and Sweden respond to recipients' levels of democracy in their selection decisions. The results are very different for France as it seems like they tend to punish countries that are more democratic. This may be the case for some plausible reasons.

First, if the French consider other forms of human governance (like media freedom) are more important than the recipient's administrative style then they will indeed choose countries with low levels of democracy. Second, countries with low levels of democracy may be former colonies of the French (with which they share a language), or strategic trading partners. Hence the French government will have an interest in such countries, irrespective of their governance.[29] Ottersen *et al.,* (2014) state that the French development agency chooses potential recipients of its aid based on their linguistic ties and the income level of the recipient. It is not totally surprising, then, that they choose countries with low levels of democracy as potential recipients of their health aid. Sweden, on the other hand, rewards more democratic governments by choosing them as potential recipients of their health aid.

Regarding trade openness, the UK and the EC choose countries that are more open to trade. A 1% increase in a recipient's level of openness leads to a 0.17pp increase in the selection probability of receiving health aid from the UK while it leads to a 0.10pp increase in the selection probability of receiving health aid from the EC. For the EC, this increase in selection probabilities will most likely be in favour of the countries in EU-ACP trade agreements. Berthélemy (2006b) finds that the EC provides more aid to such countries. However, countries with increasing trade openness are potentially countries with the ability to raise development finance through international trade (exporting and FDI in the recipient countries) so they should not receive more health aid. Sweden, then, does not choose recipients with increasing levels of trade openness. A 1% increase in the level of trade openness leads to a 0.06pp reduction in the selection probability of receiving health aid from Sweden.

The USA, Sweden and the IDA choose countries with high immunization rates as potential recipients of their health aid, with the effect being largest for the IDA. A 1-unit increase in the rate of immunization of measles leads to a 0.6pp increase in the selection probability of receiving health aid from the IDA. [30]Nevertheless, high immunization rates can also be evidence of countries with quite good health systems and with a good record of investing in their people; hence they should not receive health aid as they are not in dire need of it. Empirically, we find that the relationship is negative for France and the EC. A 1-unit increase in the rate of immunization of measles leads to 0.2pp and 0.6pp reductions in the probability of selection to receive aid from France and the EC respectively.

[29] Colonial heritage, bilateral relationships and language similarities are all controlled for in the analysis. Hence, this negative relationship between French selection and democracy may be attributable to unobservable strategic development motives of the French government.

[30] The result is in line with the USA through one of its independent foreign aid agencies, the Millennium Challenge Corporation (MCC). The MCC rewards countries committed to principles of good governance, economic freedom and investment in their citizens (Ottersen *et al.,* 2014 pg. 24). The progress towards attainment of these eligibility criteria is gauged by different policy indicators (with immunization rates being one of the main indicators of investment in citizens).

As regards donors' self-interests, only the bilateral donors are considered as bilateral exports are used. Three of the five bilateral donors in this chapter choose their trading partners as potential recipients of their health aid; UK, France and Sweden. This contrasts with the findings of Clist (2009) and Carey (2007) who state that bilateral trade plays no role in the UK's choice of recipients of total ODA. This reinforces the motivation of this chapter, which is that the allocation of health aid is different from the allocation of total ODA. Bermeo (2007) posits that the shift in focus from total ODA to sector-specific aid is most likely to increase the effectiveness of aid as donors now disburse funds to sectors whose performances can easily be tracked.

Moreover, Carey (2007) and Clist (2009) use different period of data in their analyses; as well as different samples from the one in this chapter. A 1% increase in exports from the donor to recipients leads to a 0.05pp increase in the selection probability for the UK, 0.04pp increase for France and a 0.07pp increase for Sweden.

Time-constant variables are also included in the analysis in the form of dummies; for colonial heritage and language similarities. They are included based on the 'strategic development' argument of Bermeo (2007), as argued in section 2.2. The only donors in this analysis with former colonies in the SSA region are the UK and France, and they both choose former colonies as potential recipients of their aid. The UK also chooses countries that speak English as their official language as potential recipients of health aid.[31]

2.5.2.2 Allocation Stage

The results for the allocation stage can be found in Table 2.6. Here, an OLS model is estimated in which the donors decide how much *per capita* health aid to provide only to the selected countries from the decision stage. In terms of the amount of health aid allocated, only three donors are responsive to recipients' under-five mortality rates; Germany, Sweden and the IDA. A 1% increase in the under-five mortality rate leads to a 0.22% increase in health aid disbursements from Sweden. Contrarily, the relationship between under-five mortality and *per capita* health aid disbursements is negative for Germany and the IDA. They provide more health aid to countries only when under-five mortality is significantly higher, as discussed in section 2.3.

[31] The Fixed Effects estimator has been ignored in all estimations. This is because controlling for colonial ties and common language captures most of the unobservable characteristics that make some recipients more 'attractive' than other recipients, to donors. For example, if the geographical location of a recipient makes it more appealing to a donor, it may also be because that recipient speaks the same language as the donor or because the recipient is a former colony of the donor. Hence, controlling for common colonial heritage and language captures much of the unobservable, time-invariability of recipients' characteristics. In addition, time dummies are included. While these dummies help purge the impact of commo shocks, they also capture unobservables that are specific to a country each year. Estimating a fixed effects logit in the first stage and a linear fixed effects model in the second stage changes the signs and significance of my main results, hence they are not reported. The results, however, are available upon request.

Table 2. 6: Determinants of Health Aid- Allocation Stage

	UK	France	Germany	USA	Sweden	EC	IDA
Recipients' Needs							
Under-five Mortality Rate	-0.127 (0.095)	-0.042 (0.063)	-0.105** (0.048)	-0.130 (0.205)	0.217* (0.113)	0.008 (0.067)	-0.275*** (0.102)
HIV Prevalence Rate	0.043** (0.019)	-0.043** (0.017)	0.038** (0.016)	0.188** (0.048)	0.035* (0.020)	0.037** (0.014)	-0.038 (0.023)
Tuberculosis Prevalence Rate	0.041 (0.032)	-0.007 (0.030)	0.012 (0.020)	0.039 (0.065)	-0.006 (0.036)	0.047** (0.023)	-0.008 (0.039)
GDP *Per Capita*	-0.268*** (0.048)	0.030 (0.053)	-0.006 (0.040)	-0.029 (0.076)	0.049 (0.029)	0.052 (0.036)	0.028 (0.054)
Population	-0.073** (0.030)	-0.119*** (0.034)	-0.062** (0.027)	-0.076 (0.063)	-0.046 (0.034)	-0.072*** (0.015)	-0.134*** (0.025)
Recipients' Merits							
GDP *Per Capita* Growth	-0.006 (0.005)	0.0004 (0.002)	0.003 (0.002)	0.010*** (0.003)	-0.0001 (0.003)	-0.002 (0.002)	0.004 (0.004)
Openness	0.146** (0.063)	-0.066 (0.057)	-0.038 (0.048)	0.035 (0.149)	-0.032 (0.044)	-0.007 (0.040)	-0.092 (0.082)
Democracy	0.009 (0.007)	0.001 (0.004)	0.001 (0.004)	0.021** (0.009)	-0.001 (0.003)	0.0003 (0.004)	-0.002 (0.005)
Immunization	0.002 (0.002)	-0.001 (0.001)	-0.001 (0.001)	0.003 (0.003)	0.002 (0.002)	-0.002** (0.001)	0.002 (0.002)
Donors' self-interest							
Exports	0.074** (0.030)	0.041 (0.031)	-0.009 (0.019)	0.045* (0.023)	0.008 (0.021)		
Control Variables							
Colony	0.236** (0.046)	0.095 (0.071)					
Language	-0.022 (0.069)	0.009 (0.054)		-0.083 (0.123)			
Diagnostics							
Observations	381	551	442	565	327	616	561
R-Squared	0.529	0.459	0.253	0.399	0.265	0.290	0.450

Notes:
(i) The dependent variable here is logged per capita health aid. The OLS estimator is conditional on receiving per capita health aid. Standard errors are reported in parentheses. All time-varying regressors except democracy, immunization, and GDP per capita growth are logged. All time-varying regressors are lagged one period.
(ii) Clustering is done at the country-year level to purge the regressions of heteroscedasticity and serial correlation. All equations include a constant term and a full set of time dummies.
(iii) ***, ** and * denote significance at 1, 5 and 10 per cent respectively.

The HIV prevalence rate is a very important variable in the allocation decisions of all donors except the IDA. The partial effect is highest for the USA, indicative of the importance the USA places on the HIV pandemic. A 1% increase in the HIV prevalence rate leads to a 0.19% increase in *per capita* health aid disbursements from the USA. IHME (2013, p. 42) states that over the last decade, the USA and the Global Fund to fight HIV, Tuberculosis and Malaria (GFATM) have consistently been the largest providers of health aid to combat HIV. US bilateral agencies contributed a total of $3.9 billion to the fight of HIV; the United States President's Emergency Plan for Aid Relief (PEPFAR) contributing

most. The UK, Germany, Sweden and the European Commission all have a 0.04% increase in actual *per capita* health aid disbursements following a 1% increase in the HIV prevalence rate. France, on the other hand, provides more *per capita* health aid to countries only when their HIV prevalence rates are extremely high.

The tuberculosis prevalence rate is not a significant determinant of health aid disbursements for most donors. Only the EC responds to changes in the tuberculosis prevalence rate in deciding whether to provide more health aid; with increases in the rate matched by increases in health aid disbursements from the EC. In the selection stage the EC chose countries with extremely high tuberculosis prevalence rates as potential recipients. Of those countries, those whose tuberculosis rates are still increasing receive more health aid from the EC. A 1% increase in the tuberculosis prevalence rate leads to a 0.05% increase in health aid disbursements from the EC.

Per capita income was an important determinant of donors' selection decisions but is not a primary determinant of allocation decisions for all donors; except the UK. The UK provides more aid to poorer countries as a 1% increase in *per capita* income leads to a 0.27% reduction in health aid disbursements from the UK. This negative and significant relationship between *per capita* income and aid disbursements has been found in previous studies (Carey, 2007; Clist, 2009; Berthélemy, 2006a; Angeles *et al.,* 2008; Younas, 2008; Harrigan and Wang, 2011 among others).

Though most donors chose more populous countries as potential recipients of their health aid, they disburse less *per capita* health aid to more populous countries. From the more populous countries selected to receive aid, those with increasing populations receive less health aid from the UK, France, Germany, the EC and the IDA.[32] A 1% increase in population results in a 0.19% reduction in health aid disbursements from France, a 0.13% reduction in disbursements from the EC, a 0.07% reduction in disbursements from the UK and the EC, and a 0.06% reduction in health aid disbursements from Germany.

In terms of recipients' merits, only the USA rewards countries with better economic performance (proxied by the GDP growth rate) with more health aid flows. A 1-unit increase in the real *per capita* GDP growth rate leads to a 1% increase in *per capita* health aid disbursements from the USA. Hence the USA is avoiding a moral hazard problem by not being seen as providing more health aid to countries with bad economic performance. More economic globalization, measured by the amount of trade openness in the recipient country leads to more health aid receipts from the UK. A 1% increase in the level of trade openness in the recipient country leads to a 0.15% increase in *per capita* health aid receipts

[32] Younas (2008) provides some intuitive explanations as to why there is a negative relationship between recipient population and aid. These reasons have been discussed in the data section of the chapter.

from the UK. The USA provides more health aid to more democratic governments as, normatively, more democratic governments are more transparent and accountable.

As is evident from the selection stage, high immunization rates are characteristic of countries with high quality health services and with the ability and willingness to invest in the development of their people. Hence such countries are not in dire need of health aid so the donor will be better off giving its aid to countries that need it more. A 1-unit increase in the rate of immunization of measles results in a 0.2% reduction in health aid disbursements from the EC.

As regards bilateral trade and strategic interests of donors, the UK responds most to the variables. The UK and the USA provide more health aid to their trading partners. Increases in the amount of exports from the UK to the recipients lead to increases in the amount of health aid provided by the UK and the USA. A 1% increase in the amount of exports from these donors leads to 0.07% and 0.05% increases in the UK's and the USA's health aid disbursements respectively. Colonial ties also influence allocation decisions in the UK as they tend to choose, and then provide more health aid to their former colonies.

2.5.2.3 What about the erstwhile Millennium Development Goals?

Motivating the thesis focus on health aid is the Millennium Declaration (UN, 2000) which shone spotlight on the pressing health demands in developing regions. Two of the eight previous MDGs explicitly focus on health-related needs considered in this chapter; reducing the under-five mortality and HIV prevalence rates. Data on these variables (as well as the tuberculosis prevalence rate) has been available before the Millennium Declaration so it will be tested if the advent of the Millennium Declaration; and the MDGs made donors to give more importance to these three variables conditional on other measures of need, merits and donors' interests. Hence, we will consider only the post-MDG era of health aid allocation.

To test if donors' allocation patterns have indeed been influenced by the Millennium Declaration, Chow tests will be conducted on the sample. Chow tests test whether new variables (the interaction terms in this case) have any explanatory power in the new model. First, we create a dummy variable called MD, taking a value of 1 for the years 2000[33] to the end of the sample, and zero otherwise. This dummy variable is interacted with the MDG health-related need variables in our analysis to test for any changes in the importance of these MDG variables over time (precisely after the Millennium Declaration). We report results of the joint tests of significance of the interaction terms, as well as the coefficient estimates of the interaction terms.

[33] We choose the year 2000 as the starting point since it is the year of the Millennium Declaration.

Table 2. 7: Chow Tests for MD Interactions

		UK	France	Germany	USA	Sweden	EC	IDA
1st stage	**Post-MD**	17.15	30.86	5.09	33.13	0.68	3.97	24.93
		0.0007	0.0000	0.1652	0.0000	0.8768	0.2649	0.0000
2nd stage	**Post-MD**	2.49	2.86	0.13	13.06	1.28	1.85	0.67
		0.0793	0.0491	0.9436	0.0000	0.2939	0.1530	0.5742

Notes: Wald statistics are reported above, with their corresponding p-values below. For the first stage, the Chow tests have a $x^2(h)$ distribution; with h being the number of regressors jointly tested. In the second stage, the Chow tests follow an F-distribution. These statistics are for the period 2000 to 2011.

The tests of joint significance are done by stage, donor and period; results from which are reported in Table 2.7. All donors, except Sweden and Germany, show changes in the importance of the MDGs (put together) post the Millennium Declaration. The Swedish government are possibly indifferent to the advent of the Millennium Declaration; not because they do not care about recipients' health-related needs, but probably because they have always viewed these recipients' needs as important to their selection and allocation decisions.[34] In most aid allocation studies, Sweden has always been found to be a need-oriented and 'altruistic' donor (for example, Clist, 2009). The UK, France and the USA are the only donors for whom the MD interaction term is significant at both the selection and allocation stages. We can further gauge these differences, for countries that experience significant changes, using the estimates of the interaction terms (and compare with the base estimates).

Results for countries with changes in importance are reported in Table 2.8. For the under-five mortality rate, the UK, France and the USA changed the importance of the variable post the Millennium Declaration at the selection stage. Prior to the Millennium Declaration the UK selected countries only when their under-five mortality rates were extremely high. After the Millennium Declaration, however, the UK increased its probability of selection of countries with relatively low but increasing under-five mortality rates. The USA, contrarily, had higher probabilities of choosing countries with increasing under-five mortality rates as potential recipients. Post the Millennium Declaration, they choose countries only when the rates get very high. At the allocation stage, only the USA shows a significant change in the importance of the under-five mortality rate post the Millennium Declaration. While the USA did not consider the under-five mortality rates in its allocation decisions before the Millennium Declaration, it does consider it in the post-MDG era. The relationship between US *per capita* health aid disbursements and the under-five mortality rate is negative in the post Millennium Declaration era. Just

[34] From tables 2.5 and 2.6 we can see that the under-five mortality and HIV prevalence rates play important roles in the selection and allocation decisions of Swedish *per capita* DAH.

like the US chose countries with already high mortality rates, it gives more aid to countries with very high rates. This is similar to the findings of Kasuga (2007).

The UK, France, the USA, and the IDA give more importance to the HIV prevalence rate in their selection decisions. While the UK and France did not consider the HIV prevalence rate before the Millennium Declaration, the indicator became more significant post the MDG era. Increases in the HIV prevalence rate (reflecting increases in the burden of the disease) lead to increases in the probability of selection to receive *per capita* health aid from the UK and France. Prior to the Millennium Declaration the USA chose recipients with low, but increasing HIV prevalence rates as potential recipients of its aid. However, after the Millennium Declaration it chooses countries with already high HIV prevalence rates. The IDA selects, and disburses more health to countries with already high HIV prevalence rates. Four of the seven donors placed more emphasis on the HIV prevalence rate in the allocation stage; the UK, the USA, Sweden and the EC. Post the MDG era, they all provided more health aid to countries with relatively low, but increasing HIV prevalence rates.

The last variable under consideration is the tuberculosis prevalence rate. Five donors; France, Germany, the USA, the EC and the IDA show significant changes in the importance of tuberculosis prevalence rates in their respective selection decisions. Germany, the USA and the IDA now select countries with relatively low, but increasing tuberculosis prevalence rates as potential recipients of their respective health aid disbursements. France and the EC on the other hand, select countries with already high tuberculosis prevalence rates as potential recipients of their respective health aid. In the allocation stage just France placed increased importance on the tuberculosis prevalence rate after the Millennium Declaration. Analogous to the selection stage, countries with very high tuberculosis prevalence rates receive lower health aid disbursements from France for reasons mentioned above.

Table 2. 8: Tests for Changed Relationships

Step	1	2	1	2	1	1	2	2	1	2	1
	UK	**UK**	**France**	**France**	**Germany**	**USA**	**USA**	**Sweden**	**EC**	**EC**	**IDA**
U5MR	-0.813***	-0.175	0.213	-0.053	-0.339	1.483***	0.141	0.228*	-0.176	-0.053	0.887***
	(0.268)	(0.107)	(0.238)	(0.089)	(0.282)	(0.501)	(0.165)	(0.115)	(0.247)	(0.097)	(0.267)
MD*U5MR	1.156***	0.150	-0.756***	0.012	-0.121	-1.623***	-0.705***	-0.060	0.137	0.095	-0.205
	(0.385)	(0.125)	(0.283)	(0.068)	(0.308)	(0.452)	(0.231)	(0.080)	(0.271)	(0.115)	(0.285)
HIV	0.020	0.001	-0.092	-0.044**	0.122*	0.433***	0.011	-0.014	0.131**	0.012	-0.171**
	(0.058)	(0.018)	(0.081)	(0.018)	(0.069)	(0.132)	(0.031)	(0.033)	(0.056)	(0.018)	(0.060)
MD*HIV	0.264***	0.109*	0.335***	0.003	0.012	-0.491***	0.281***	0.067*	0.032	0.042**	-0.399***
	(0.099)	(0.041)	(0.082)	(0.032)	(0.086)	(0.157)	(0.053)	(0.038)	(0.072)	(0.021)	(0.081)
TB	-0.031	0.064	1.010***	0.029	-0.327***	-0.176	0.043	-0.025	-0.100	0.039	-0.455***
	(0.115)	(0.040)	(0.178)	(0.032)	(0.109)	(0.116)	(0.038)	(0.076)	(0.103)	(0.040)	(0.128)
MD*TB	0.240	-0.060	-0.779***	-0.063**	0.316**	0.570***	-0.047	0.019	-0.273*	0.015	0.370*
	(0.168)	(0.065)	(0.201)	(0.027)	(0.148)	(0.156)	(0.085)	(0.067)	(0.143)	(0.048)	(0.190)

Notes:

(i) U5MR, HIV and TB are the under-five mortality, HIV prevalence and TB prevalence rates respectively. These statistics are only for donors that experienced significant changes in the importance of the under-five mortality, HIV prevalence and tuberculosis prevalence rates after the Millennium Declaration (MD). The tests are done by stage, donor and period (post Millennium Declaration period). The coefficients on the interaction terms (not marginal effects) are reported. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 1, 5 and 10 per cent respectively.

(ii) The number at the top of each column corresponds to the stage of the Double-Hurdle estimator. For example, 1 at the top of the first column corresponds to the 1st stage of the Double-Hurdle estimator (Probit) for the UK.

2.5.2.4 Anything new from Polylaterals?

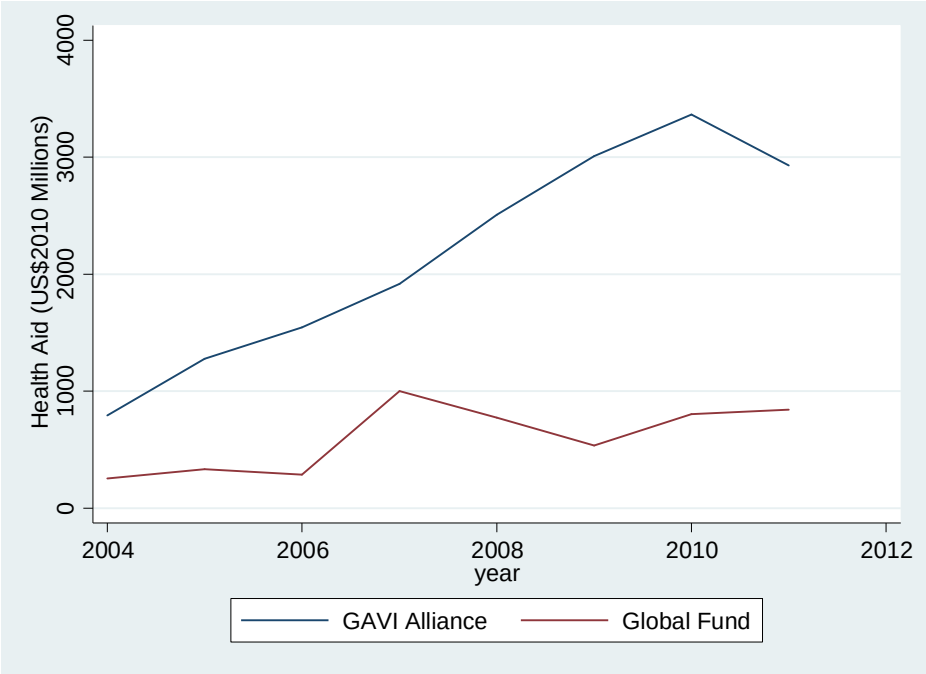
Another novelty of this chapter will be to chart the rise of a new type of donor, so called Public-Private Partnerships (PPPs) and investigate the key differences between these and the more traditional bilateral and multilateral donors. The two biggest PPPs in the world are the GAVI Alliance (GAVI hereafter) and the Global Fund to fight HIV/AIDS, Tuberculosis and Malaria (the Global Fund hereafter) and we model the allocation patterns of these two PPPs.[35]The GAVI Alliance has as primary objective, increasing immunization coverage in developing countries (Ottersen *et al.,* 2014). GAVI (2013) states that from its inception in 2000 through 2012, it has committed approximately $7.5 billion in support of immunization of children in developing countries. The Global Fund on the other hand, was created in 2002 to provide grants and services to governments in low-income and middle-income countries in the fight against HIV, tuberculosis and malaria (Blanchet, Thomas, Atun, Jamison, Knaul and Hecht, 2014). IHME (2012) states that a total of $3.3 billion in DAH was channelled through the Global Fund in 2010. Both the GAVI Alliance and the Global Fund have revised their eligibility criteria, with the new funding models set to come into effect by 2015. However, as the sample in this chapter covers the period 1990 to 2011, our analysis will be based on the old funding models.

For the GAVI Alliance, countries with Gross National Income *per capita* (GNIpc hereafter) equal to or below $1550 are eligible for funding (GAVI, 2013). However, an additional eligibility criterion is that the 3rd doze of the diphtheria-tetanus-pertussis (DTP3) vaccine be equal to or above 70% in recipient countries; or that the recipient governments make efforts to cover the measles vaccine (GAVI, 2013). For the Global Fund, the income threshold for eligibility is adopted from the World Bank's classification (GFATM, 2012). Regardless of the income classification, countries with severe disease burdens are naturally eligible for funding from the Global Fund (Ottersen *et al.,* 2014).[36] The basic eligibility criteria for the GAVI Alliance and the Global Fund are primarily concerned with recipients' needs (in terms of economic development). Nonetheless, additional eligibility criteria relate to commitment by the recipient countries, demonstrated performance and expected effectiveness (particularly for the GAVI Alliance), and increasing health needs in terms of burdens of diseases (predominantly for the Global Fund).

[35] The Bill and Melinda Gates Foundation (BMGF) is also a very influential PPP but we do not include it in our analysis for one major reason; they do not provide development assistance directly to the Sub-Saharan African region (Sridhar and Batniji, 2008). Nonetheless, they provide development assistance by their contributions made through the GAVI Alliance and the Global Fund. Moreover, their funds are disbursed for research, not service delivery (as opposed to GAVI and the Global Fund whose major contributions to improving health are through service delivery).

[36] "Severe" means countries with extremely high HIV prevalence, TB prevalence and mortality rates. Empirically, this translates to a negative relationship between the respective variables and *per capita* health aid disbursements; meaning donors will be selecting and/or providing more *per capita* health aid to countries with very high rates.

Figure 2.3: Aid disbursements by the two largest PPPs



Source: IHME DAH Database 2013

Ravishankar *et al.,* (2009) and Sridhar and Batniji (2008) posit that huge sums of health aid are now being disbursed through these PPPs, as opposed to the more traditional donors. IHME (2013, p. 10) states that disbursements by PPPs grew substantially in 2013; with the GAVI Alliance providing $1.5 billion in 2013 and the GFATM providing $4 billion. Figure 2.3 shows that health aid provided by these two PPPs has been increasing since their respective inceptions. Hence, an econometric analysis of their allocation patterns is necessary. We analyse the allocation patterns of the PPPs using the Double Hurdle estimator and compare to those of traditional donors.

PPPs' Allocation Patterns

To analyse the allocation patterns of the PPPs, we will take advantage of some of the more sophisticated variables available. To measure recipients' merits, we use the IDA Resource Allocation Index (IRAI). This variable is based on the Country Policy and Institutional Assessment (CPIA), which itself evaluates performance in terms of quality of a country's policy and institutional framework. It ranges from 0 (low effectiveness) to 6 (high effectiveness). Health aid is thus expected to increase as the IRAI increases. CPIA data is publicly available only from 2005 onwards which makes it suitable for the analysis of PPPs. Data for the IRAI variable is obtained from the World Bank's CPIA database.

Instead of GDP *per capita* in purchasing power parity terms as a measure of broader economic need, Gross National Income (GNI) *per capita* atlas method is used. This is what the PPPs use as a measure of

recipients' abilities to pay for their health bills (GAVI, 2009; GFATM, 2012); i.e. the measure of recipients' need. We intend to model, as closely as the possible, the decision making and actual disbursement patterns of the PPPs. All other variables (the under-five mortality rate, the HIV prevalence rate, the tuberculosis prevalence rate and the recipient's population) are similar to those used in the main analysis.

Results for the selection and allocation decisions of PPPs, bilaterals and multilaterals are reported in Table 2.9. The under-five mortality rate is a significant determinant of selection decisions by the two PPPs and bilateral donors; while multilateral donors are not influenced by it. A 1% increase in the under-five mortality rate leads to 0.12pp and 0.15pp increases in the selection probabilities of receiving health aid from the GAVI Alliance and the Global Fund respectively. The result is relevant for the GAVI Alliance as their main aim, from inception, is to provide vaccination and immunization services to children in developing countries (Ottersen *et al.,* 2014). On average, bilateral donors choose countries with very high under-five mortality rates as potential recipients of their aid. Nonetheless, in the allocation stage only the Global Fund is influenced by under-five mortality rates in their decisions and the relationship between the variables is negative. The Global Fund provides more *per capita* health aid to countries with already high under-five mortality rates.

The HIV prevalence rate is a significant determinant of selection for the average multilateral donor only. The relationship between the HIV prevalence rate and the probability of selection is negative, meaning they choose countries with extremely high HIV prevalence rates as potential recipients of their health aid. However, multilaterals do not consider the HIV prevalence rate as an important determinant of their actual disbursements of *per capita* health aid. Bilaterals and the Global Fund do provide more health aid to countries with relatively low, but increasing HIV prevalence rates. A 1% increase in the HIV prevalence rate leads to a 0.19% increase in *per capita* health aid disbursements from the Global Fund and a 0.51% increase in *per capita* health aid disbursements from bilaterals. This finding is plausible since the Global Fund focuses on providing services in the fight of HIV, tuberculosis and malaria.

Table 2. 9: Selection and Disbursement Patterns of PPPs, Bilateral and Multilateral Organizations

	GAVI		GFATM		Bilaterals		Multilaterals	
	Probit	**OLS**	**Probit**	**OLS**	**Probit**	**OLS**	**Probit**	**OLS**
Recipients' Needs								
Under-five Mortality Rate	0.121*** (0.033)	0.102 (0.062)	0.148*** (0.047)	-0.334** (0.164)	-0.099* (0.051)	-0.276 (0.451)	0.318 (0.602)	-0.315 (0.296)
HIV Prevalence Rate	0.019 (0.012)	0.003 (0.019)	-0.009 (0.010)	0.191*** (0.029)	0.008 (0.005)	0.512*** (0.131)	-0.040** (0.017)	-0.052 (0.081)
Tuberculosis Prevalence Rate	-0.039* (0.023)	-0.012 (0.024)	-0.063** (0.027)	0.014 (0.056)	-0.003 (0.029)	-0.248 (0.192)	-0.075* (0.042)	-0.006 (0.138)
GNI *Per Capita* Atlas	0.003 (0.015)	-0.056 (0.035)	-0.010 (0.017)	-0.124 (0.092)	-0.052** (0.025)	0.262 (0.223)	-0.038 (0.038)	0.040 (0.246)
Population	0.004 (0.012)	-0.015 (0.019)	0.002 (0.004)	-0.220*** (0.037)	0.071*** (0.025)	1.458*** (0.147)	0.080*** (0.025)	0.758*** (0.113)
Recipients' Merits								
IRAI	0.002 (0.024)	0.080** (0.035)	0.004 (0.021)	0.234*** (0.082)	-0.123 (0.033)	0.734* (0.411)	0.180*** (0.057)	0.554 (0.348)
Diagnostics								
Observations	179	169	179	170	144	170	253	242
R-Squared		0.249		0.465		0.795		0.451
Log-likelihood	-24.72		-17.34		-11.05		-21.45	
x^2	59.43		59.99		37.40		6.12	
F**-stat**		10.11		11.44		50.06		18.55
$E(DAH)$	0.599	0.162	0.676	0.678	0.707	11.500	0.861	0.949

Notes:

(i) We estimate the selection probability (1 = receives health aid; 0 = does not receive health aid) based on a pooled Probit maximum likelihood. All time-varying regressors except democracy, immunization and GDP per capita growth are logged. Heteroscedasticity and correlation-robust standard errors are reported in brackets. All equations include a constant term and a full set of time dummies (none of which are reported).

i) In the allocation stage, the dependent variable is logged per capita health aid. The OLS estimator is conditional on receiving per capita health aid. Standard errors are reported in parentheses. All time-varying regressors except democracy, immunization, and GDP per capita growth are logged. All time-varying regressors are lagged one period.

(iii) ***, **, * denote significance at 1, 5 and 10 per cent respectively.

(iv) The last row represents the expected value (mean) of the dependent variable in each stage.

The tuberculosis prevalence rate influences selection decisions of multilaterals, the GAVI Alliance and the Global Fund. The relationship, however, is negative in all cases. This implies that all these donors choose countries with already high rates as potential recipients of their respective *per capita* health aid disbursements. The tuberculosis prevalence rate does not have any significant impact on donors' actual allocation decisions. This empirical finding confirms the growing literature on the bias in GFATM disbursements in favour of HIV (as opposed to tuberculosis and malaria). IHME (2013, p. 10) states that the HIV sector has been an increasing beneficiary of health aid, with other health sectors like tuberculosis, malaria and maternal health receiving less attention. This sustained focus is driven mainly by the Global Fund and the US government; and this has been confirmed in our empirical analysis.

Regarding broader economic need, only bilaterals choose poorer countries as potential recipients of their health aid. On average, a 1% increase in recipients' *per capita* incomes leads to a 0.05pp reduction in the probability of being selected to receive *per capita* health aid from bilaterals. In the allocation stage, *per capita* incomes do not influence any of the donor's decisions on how much aid to allocate. The result is plausible for the PPPs as they have more expansive eligibility criteria; countries below a certain income threshold are naturally eligible for funding by the GAVI Alliance and the Global Fund. As most SSA countries in our analysis are low-income countries, all of them are naturally eligible for aid from GAVI and the Global Fund regardless of the income threshold (Ottersen *et al.,* 2014). Hence the insignificant effect of *per capita* income in determining allocation decisions may reflect a situation where all the countries in the sample are eligible, and receive some health aid, no matter how small.

Both bilaterals and multilaterals choose more populous countries as potential recipients of their health aid. A 1% increase in recipients' population leads to a 0.07pp increase in the probability of selection to receive total bilateral health aid and a 0.08pp increase in the selection probability to receive total multilateral health aid. In the allocation stage, bilateral and multilateral organisations still provide more health aid to more populous countries. On average, a 1% increase in recipients' population leads to a 1.46% increase in *per capita* health aid disbursements from all bilaterals and a 0.76% increase in *per capita* health aid disbursements from multilaterals. While the

multilaterals show signs of a small-country bias in allocation[37], bilaterals compensate for increases in population by more than proportionately providing more health aid. The Global Fund, on the other hand, provides more health aid to less populous countries. Increases in population result in lower *per capita* health aid disbursements from the Global Fund. A 1% increase in population leads to a 0.22% reduction in health aid disbursements from the Global Fund. This shows that the Global Fund seeks to provide more aid to countries where they will maximize the impact of their health aid disbursements.

As regards the recipient countries' perceived effectiveness in managing aid, proxied by the IDA Resource Allocation Index (IRAI), only multilaterals choose countries with better policies and institutions as potential recipients of their health aid. On average, a 1-unit increase in a recipient's level of effectiveness leads to an 18pp increase in the selection probability of receiving health aid from multilaterals. This effect is quite large, indicative of the emphasis multilateral donors place on recipients' ability to manage huge sums of aid. Normatively, while bilateral donors may provide health aid partially for non-need or non-merit reasons, it is not the case with multilateral organisations. The latter set the benchmark for appropriate allocation behaviour by choosing better governed countries as potential recipients. At the allocation stage, bilaterals are influenced by recipients' policy and institutional frameworks while multilaterals are not. A 1-unit increase in a recipient's effectiveness score results in a 73% increase in health aid disbursements from all bilaterals. The PPPs also provide more aid to countries where their aid will be better managed. Part of their eligibility criteria states that countries should make considerable efforts in contributing to the improvement of domestic health conditions (GFATM, 2011; GAVI, 2009). Such domestic efforts are proxied by the indices used to build the resource allocation index so it is only normal that as they choose very many countries as potential recipients; they provide more health aid to the most deserving ones. A 1-unit increase in the resource allocation score leads to an 8% increase in health aid disbursements from the GAVI alliance and a 23% increase in health aid disbursements from the Global Fund.

[37] As the marginal effect of population has an elasticity interpretation, it shows how much the selection probability of receiving health aid increases if population increases by 1% (Neumayer, 2005). If the estimated partial effect is less than one then it means increases in population are matched with less than proportionate increases in the selection probability of receiving health aid. This, then, is evidence of a small-country bias.

2.5.2.5 Robustness Checks

Sensitivity analyses are carried out to test the robustness of our results. First, we check the robustness of the results to the possible endogeneity of the under-five mortality rate. Selection and allocation decisions are estimated using Instrumental Variable Probit (we used internal instruments, with up to two lags of the U5MR as instruments) and Two-Stage Least Squares (2SLS) respectively. Appendix tables A3 and A4 show similarities to tables 2.5 and 2.6; with few exceptions. At the selection stage, GDP growth becomes a significant determinant of French health decisions as countries with better economic performance become potential recipients of French health aid. From table 2.5 the under-five mortality rate and the level of trade openness influenced German and Swedish selections respectively. However, allowing for the endogeneity of the under-five mortality rate makes this significance disappear. At the allocation stage, Germany now rewards countries with better economic performance by disbursing more health aid to them. *Per capita* incomes now influence Swedish allocation decisions but the relationship is a positive one. As Sweden is a relatively small donor, they probably concentrate their health aid to smaller and richer countries. The HIV prevalence rate becomes a significant determinant of allocation decisions by the IDA as they disburse more *per capita* health aid to countries where these rates are very high.

Second, the under-five mortality rate is replaced with the infant mortality rate. (Appendix tables A5 and A6) The main results are also robust to the use of the infant mortality rate (in place of the under-five mortality rate) but for a few exceptions. At the selection stage, the infant mortality rate is negative and significant for the UK which means the UK chooses countries with already high mortality rates as potential recipients. While the under-five mortality was a significant determinant of selection by the USA, the infant mortality rate does not influence their selection decisions. GDP growth, however, becomes a significant determinant of selection by the USA. Germany now chooses countries that are more liberal to trade as they are seen as countries with the potential to manage, efficiently, huge sums of aid. The tuberculosis prevalence rate loses its importance in Swedish selection decisions. At the allocation stage, the infant mortality and tuberculosis prevalence rates become significant determinants of actual disbursements from the UK. The HIV prevalence rate loses its importance in Swedish allocation decisions while the

infant mortality rate is not an important determinant either. The HIV prevalence rate becomes a significant determinant of actual health aid disbursements from the IDA.

Third, we include another measure of broad economic need; donors' non-health aid provided to recipients (appendix tables A7 and A8).[38]The results are not as robust to the inclusion of non-health aid as they are to the inclusion of the infant mortality rate; or to the use of instrumental variables. This is probably because different sectors in any economy are dynamically inter-connected (Osei *et al.,* 2005) so the determinants of health aid allocation will be very similar to the determinants of non-health aid; which now results in an endogeneity problem. Nonetheless, at the selection stage non-health aid is a positive and significant determinant of health aid for all donors except the USA. This is perfectly reasonable as countries chosen as potential recipients of non-health aid will most likely be chosen as potential recipients of health aid. At the selection stage, non-health aid still portrays a complementary relationship with health aid for three donors; the USA, Sweden and the IDA.[39]

Fourth, instead of using *per capita* income in Purchasing Power Parity (PPP) terms, GNI *per capita* atlas method is used (appendix tables A9 and A10). The difference between the two measures of income is that exchange rate fluctuations are smoothed by the latter by using a three-year average, price-adjusted conversion factor. Moreover, the atlas *per capita* income is the income measure used by the GAVI Alliance and the Global Fund in determining eligibility for their health aid. Thus, we are testing if other donors follow the guidelines of these PPPs in their respective selection and allocation decisions. Data for GDP *per capita* atlas is obtained from the WDI database. At the selection stage, democracy becomes a significant determinant of selection by the UK and the IDA. *Per capita* income loses its significance in selection decisions by the EC while the under-five mortality rate also becomes insignificant in determining selection of

[38] It is possible that this amount might increase regardless of the amount of health aid provided. Alternatively, donors might view non-health aid as a substitute to health aid so any increases in this component of development aid will lead to less health aid being received. We include non-health aid as a measure of recipient need because it captures aid to all other sectors. Most donors state multidimensional objective functions in their aid allocation patterns but they tend to place more emphasis on development needs; so non-health aid will be meeting the development needs of other sectors like education, climate change, and infrastructure among others.

[39] Ottersen *et al.,* (2014) state that donor agencies have been urged to provide at least 0.7% of their Gross National Incomes (GNI) in the form of development aid. While not all donors have attained this target; in fact, most have not even come close, the amounts of development aid they have been providing has been increasing. The 0.7% of GNI is then partitioned to different sectors (like the health sector, education and production sectors among others). Our results then prove that as the GNIs of donor countries are increasing, so are their total aid budgets. Hence the amount of aid available to all sectors increases simultaneously.

countries to receive German *per capita* health aid. At the allocation stage, the inclusion of the atlas measure of income causes some major changes for the UK only. The under-five mortality rate, tuberculosis prevalence rate, democracy and the language dummy all become significant determinants of health aid allocation by the UK. Openness, on the other hand, loses its significance. These major changes for the UK may imply that the UK is very influential in the international donors' agenda. Most donors seem to follow the guidelines set by the UK in choosing and allocating their own health aid. Bilateral trade relationships become important for French allocation decisions while population becomes important for the Swedish. The HIV prevalence rate becomes an important determinant of allocation decisions by the IDA.

2.6 CONCLUSION

In this chapter, we examined selection and allocation decisions of development assistance for health (DAH) of nine major donors (five bilateral, two multilateral and two polylateral donors) for 44 Sub-Saharan African countries covering the period 1990 to 2011. We use annual data on health aid disbursements (instead of commitments) to analyse determinants of the actual resource transfers: and include a multitude of factors to capture recipients' need, merits and donors' interests.

We find, as is almost always the case in the aid allocation literature, substantial heterogeneity in donors' behaviour; which underscores the use of the two-part estimator. First, the UK is consistently (in selecting recipients, and disbursing health aid) poverty-sensitive while Germany, Sweden, the EC and the IDA are poverty-sensitive only when choosing potential recipients of their health aid. Second, all donors, except France, choose more populous countries as potential recipients of their health aid while they all (but for the USA and Sweden) provide more health aid to less populous countries. Third, recipients' merits are more important in selection than in actual disbursement decisions. In addition, some donors like the UK choose and provide more aid to better governed recipients while others may view better governed countries as ones not in dire need of health aid; hence they are neither chosen nor given more health aid by donors like France and the EC.

There is also deep-rooted donor heterogeneity regarding the health-related indicators; but two broad generalizations can be made. First, overall, the health indicators are salient for selection of

potential recipients, and disbursements. For both selection and allocation decisions; we find evidence of more health aid for countries with low, but increasing health burdens (reflected by the positive relationship between *per capita* DAH and the health-related measure of need); while we also find that some donors choose and disburse more health aid to countries with very high under-five mortality rates and disease burden (a negative relationship between the health indicator and *per capita* DAH). Second, the HIV and tuberculosis prevalence rates are more important determinants of selection than the under-five mortality rate: six of the seven donors are influenced by the HIV (except France) and tuberculosis (except the UK) prevalence rates in their selection decisions. Once selected, the HIV prevalence rate matters most for actual disbursements (for six of the seven donors considered). The USA is most sensitive to the HIV prevalence rate, reflecting their long-standing commitment to alleviate the disease burden across the globe (IHME, 2013). These results imply that health-related variables are salient for donor disbursement behaviour; reflecting the importance donors place on health improvements in developing countries.

Few studies examine the determinants of aid allocation in the context of the MDGs (Thiele *et al.,* 2007; Kasuga, 2007); while other studies model the effects of health aid on health outcomes, then provide estimates on the amounts of aid that will have to be provided for the MDGs to be attained (Mishra and Newhouse, 2009 among others). In this chapter, we explicitly model the impact of the Millennium Declaration (hence the attainment of the hitherto MDGs) on donors' allocation behaviour using interaction terms. We find significant, but modest changes over time. Regarding the under-five mortality rate, France and the USA select countries with very high rates as potential recipients while only the USA provides more health aid to countries with extremely high rates; a similar finding to Kasuga (2007). The UK, on its part, chooses countries with low, but increasing mortality rates. All donors excluding the USA and the IDA, choose and provide more health aid to countries with increasing HIV prevalence rates. The IDA choose countries with extremely high HIV burdens as potential recipients of health aid. The EC and France choose countries with already high tuberculosis rates as potential recipients while Germany, the USA and the IDA choose countries with increasing tuberculosis rates as potential recipients.

The emergence of the Public-Private Partnerships (PPPs) in international health scenes has been well documented (Ravishankar *et al.,* 2009; Sridhar and Batniji, 2008; IHME, 2014 among

others). With a relatively short period of their existence it is difficult to adequately analyse the evolution of their allocation patterns. However, we make a modest attempt to fill this gap in the allocation literature by analysing the selection and disbursement patterns of the PPPs and compare to the 'average' bilateral and multilateral organisations. There is more homogeneity in the behaviour of PPPs and they are expansive in their selection patterns. This is gleaned from the insignificance of *per capita* income and population; implying that they select countries that meet the basic eligibility criteria and more. They, however, provide more health aid to better governed countries.

Donor heterogeneity is palpable in our analysis, but it does not preclude the possibility that donors share preferences; with health aid allocation being interdependent across donors. Donors have begun to avail of the benefits (the most important of which is a reduction in administrative fragmentation and transaction costs of aid in recipient countries) of coordinating their efforts (for example, the GAVI Alliance, the Global Fund and the Nordic Development Fund are all efforts to streamline foreign assistance for specific purposes). Research into the allocation patterns of major donors, allowing interdependencies between them, is a fruitful area for future research. In addition, considering the sample period of this chapter (22 years of data), the time-series properties of the data may be salient. Most of the variables included in the analysis are macroeconomic aggregates which typically display non-stationarity in the long-run. Given the research question we sought to tackle in this chapter, stationarity and cointegration properties of the data could not be explored. Furthermore, we accounted for the impact of common shocks by using a complete set of time dummies. However, this approach implicitly assumes that the effects of the shocks are identical across countries; which may be inaccurate given that the dynamic environments into which aid is injected differ substantially (not least due to the different institutional setups across countries). More advanced time-series econometric methods; for example, the recently developed discrete choice Common Correlated Effects Mean Group Estimator (Eberhardt, 2017) will be fit for purpose.

3. AID, TAXES AND GOVERNMENT SPENDING: A HETEROGENEOUS, COINTEGRATED PANEL ANALYSIS

Aid still represents a vital source of revenue in many developing countries as the poorest of these countries do not have sufficient resources to finance their development needs (Herzer and Morrissey, 2013). The central premise in giving more aid is that it should spur economic growth and development in recipient countries, and that is usually the basis from which the effectiveness of aid is judged. Morrissey (2012) states that as most aid given to a country goes to the government, or finances services that would otherwise be a demand on the budget, it should impact on government spending. Substantial amounts of aid do not actually go through the budget: aid may be in the form of donor-funded projects or technical assistance (Morrissey, 2012; Van de Sijpe, 2013) which does not even leave the donor country. Nonetheless, the amount of aid going through recipients' budgets is large, which should have a direct effect on the level and composition (allocation to different expenditure headings) of government spending (Morrissey, 2015a). This proposes a prior hypothesis to investigate: is there empirical evidence that aid is related to total spending (and its components) over time on average?

That is the fundamental question addressed in this chapter, building on insights from multi-factor models in nonstationary panels (Kapetanios, Pesaran and Yamagata, 2011; Pesaran, 2006). We employ common factor models by Pesaran (2006) to estimate the average long-run effect of aid and taxes on spending in a sample of 69 countries using annual data covering the period 1980 to 2013. The common factor approach allows for cross-section correlations in the data, *created* by global shocks that affect countries to varying degrees, and *represented* by unobserved common factors. Our focus in the empirical part of this chapter is on obtaining average estimates of the impact of aid and taxes on spending using these common factor models that allow for heterogeneous fiscal impact across countries and variable dynamics. They are also robust to endogeneity created by unobserved common factors, as well as omitted variable bias.

Barring Martins (2011), most studies on the effects of aid on spending (Remmer, 2004; Morrissey, Isopi and Clist, 2011; Aworinde and Onakoya, 2016; Marć, 2017) and a few early fiscal response models (Heller, 1975; Mosley, Hudson and Horrell, 1987) have been cross-country models in which the dynamics between aid and fiscal aggregates (tax/GDP and spending/GDP ratios) is assumed to be the same across countries. The general pattern of findings in these studies is that over time, aid increases total spending in recipient countries, albeit spending not increasing by the full amount of aid (i.e. aid is not fully additional). Additionality is difficult to establish (Morrissey, 2015a), not least because recipient governments are not aware of all aid available to finance their public spending.

While donors can implement stringent measures to ensure their aid is fully spent on intended sectors, recipients may respond by reducing their own domestic revenue allocated to spending in those sectors, resulting in aid not being fully additional (spending may not increase at all if the increase in aid is completely offset by a reduction in domestic funds allocated to the specific sector). It is also possible that spending in a sector increases by more than the amount of aid, especially in pro-poor social sectors (for example health and education) where aid-funded investments create claims on future government spending. As our focus is on average effects across countries, we do not delve further into the contentious issue that is aid additionality. Nevertheless, we argue that the studies are restrictive in modelling the impact of aid on spending, and base our arguments on three key aspects.[40]

First, these studies do not explore the time-series properties of the data, thus ignoring potential long-run (levels) relationships between aid and fiscal variables. Söderbom, Teal, Eberhardt, Quinn and Zeitlin (2014, p. 394) state that 'erroneously' assuming variable stationarity has more severe implications for empirical inference than assuming variable non-stationarity. Fiscal variables are usually trending (nonstationary) in the long-run, hence in a levels specification a mixture of stationary and nonstationary variables, or a mixture of nonstationary variables of

[40] Fungibility studies typically fill the gap on aid additionality. Most recently, Van de Sijpe (2013) and Marć (2017) estimated fungibility models considering both aid that goes through the budget (on-budget aid) and that which comes in the form of technical assistance and donor-funded projects (off-budget aid). Van de Sijpe (2013) estimates aid additionality for health and education spending while Marć (2017) estimates additionality for total government spending. The main limitation of the latter is that it does not disaggregate government spending into capital and recurrent spending. It will also be important to deduct growth-enhancing recurrent spending (for example, wages for teachers and doctors, maintenance costs for roads and buildings) from total government spending.

different order may lead to unreliable results (Herzer and Morrissey, 2013). Our approach considers the time series properties and dynamics of the data, permitting us to make credible claims about long-run (equilibrium) and short-run relationships between aid and fiscal aggregates. Specifically, we test for the existence of a long-run equilibrium (cointegrating) relationship between aid, taxes and spending in the panel of 64 developing countries; and provide estimates for the long-run and short-run parameters.

Second, as Roger (2015) emphasises, these cross-country estimates are based on the stringent *homogeneity* assumption, that the effects of aid on government spending are the same for all countries in the respective samples. *Homogeneity* imposes the coefficients determining how aid impacts on government spending, the data generating process (DGP hereafter), to be the same across countries. Countries may be in the same region, and even be at the same stage of economic development but have fundamental institutional differences that influence the fiscal impact aid would have. Incorporating such heterogeneity is fundamental in estimating any potential effects aid might have on government spending. Barring the few cross-country studies mentioned above, all fiscal response models (FRMs hereafter) are country-specific (Franco-Rodriguez *et al.,* 1998; Osei *et al.,* 2005; Mascagni and Timmis, 2017; Bwire *et al.,* 2017). In this chapter, we build on this country-specific, time series analysis by estimating the effect of aid and taxes on spending (and its components), over time on average, in a panel of 69 developing countries, allowing for those effects to differ across countries.

Third, cross-country approaches suffer from the potential endogeneity of aid. Conditional on the level of spending that can be domestically financed (which itself can be influenced by external or internal shocks), aid tends to go to those countries with *ex ante* lower expenditure (hence greater need for aid). This creates an endogeneity problem which standard instrumental variable methods can address. Nonetheless, Temple (1999) documents the difficulty in finding variables that qualify as instruments, alongside the spuriousness of estimates when the instruments are weak or invalid.

Closely related to the issue of endogeneity is cross-section dependence. Internal and external factors that influence recipients' spending and taxation capacities, and potentially the amount of aid they receive, create interdependencies across countries. This means in standard panel data approaches the country variable series, as well as residuals from cross-country regressions, will be

correlated; resulting in inconsistent and biased econometric estimates (Chudik and Pesaran, 2015). Thus, in this chapter we employ nonstationary panel methods that allow for cross-section correlation and test for the existence of a long-run (equilibrium) relationship between aid, taxes and spending. We proceed to test for exogeneity in domestic fiscal variables and aid, providing evidence on how recipients and donors react to deviations from the budgetary equilibrium.

Specifically, our findings are three-fold. First, the results provide evidence of a long-run equilibrium (cointegrating) relationship between aid, taxes and spending, akin to a domestic budget equilibrium. The average long-run effect of aid on spending is positive, and robust to variable and residual correlation, outliers, and omitted variables. This long-run impact is quite small, considerably smaller than the average long-run impact of taxes. This suggests that in the long-run expenditure patterns are driven mainly by taxes, consistent with results in the broader fiscal effects literature (Mascagni and Timmis, 2017). Second, aid has a significant long-run and short-run impact on spending in least developed countries (particularly Sub-Saharan African countries). These are the most aid-dependent countries where the political costs of tax and aid are still relatively similar. Third, aid is weakly exogenous, meaning there is no donor 'disbursement rule' that considers recipients' budget situations. The level of aid to recipients is independent of their fiscal situation.

The rest of the chapter is organised as follows: Section 3.1 provides a review of the literature on aid and spending, and fiscal response modelling in general. Section 3.2 provides a conceptual framework from which hypotheses will be tested; emphasising theoretical and econometric issues faced in the empirical analysis, as well as the impact of cross-section dependence in econometric modelling and the importance of cross-country heterogeneity. Section 3.3 presents a brief discussion on the data used for this analysis, and some charts. Section 3.4 sets out the empirical model specifications. Section 3.5 presents results for tests for cross-section dependence and unit roots, estimates for the impact of aid and taxes on spending, as well as results from exploratory analysis and the analysis of weak exogeneity. Section 3.6 concludes.

3.1 LITERATURE REVIEW[41]

Aid and Government Expenditure

Remmer (2004) models the impact of foreign aid on government size (measured by changes in expenditure/GDP rates) using cross-country data over 1970-1999. She estimates the long-run and short-run effects of aid on changes in expenditure/GDP ratio in a homogenous error correction modelling (ECM) framework. The analysis suggests there exists a long-run equilibrium relationship between aid and government spending, with no significant short-run impact. Total government revenues (as well as taxes) have both a long-run and a short-run impact in increasing government expenditures. The focus of her study is the estimation of the long-run impact of aid on changes in expenditure; which she accomplishes. Nonetheless, there is a basic limitation to her study. Aid may affect some of the control variables (tax/GDP and import/GDP ratios) included in her analysis and such inter-related effects are not accounted for in her analysis.[42] In a time series context this is countered by finding cointegration, implying no relevant variable has been omitted. Notwithstanding the aforementioned limitation, the analysis establishes the effect of aid on total government spending over time.

Morrissey *et al.,* (2011) analyse the effect of aid on spending for a panel of 58 countries over 1990-2008. As the data they collect are very limited (in terms of coverage of countries and years) they estimate a parsimonious model in which spending is influenced by aid and total government revenue (as well as tax revenue). They find that domestic revenue is a significant driver of government spending; with a significant coefficient close to unity and high explanatory power. Aid is also a significant determinant of government spending, with the effect being smaller for middle income countries in the sample.

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[41] This review does not include fungibility studies in the mould of Marć (2017) and Van de Sijpe (2013) since our interest is in establishing the cointegration properties of aid, taxes and spending in a budgetary framework. As part of the Martins (2011) analysis, the effects of aid on public investment are estimated. However, the main hypothesis of the Martins (2011) paper is establishing if macroeconomic and fiscal management of aid surges are coordinated. While subtle comparisons are made to the Marć (2017) and Martins (2011) papers, aid additionality and macroeconomic responses to aid surges are not explicitly considered in this chapter (see section 3.1).

[42] Morrissey *et al.,* (2014) counter this problem by using generated regressors to purge imports and taxes of the influence of aid; hence estimating a tax effort equation with the proportion of taxes and imports not explained by aid. These generated regressors are, however, insignificant in all estimations; indicating that the inter-related effects between aid and taxes and aid and imports is not much of a problem.

Fiscal Response Models (FRMs)

These are studies that address the components of the budget by considering the dynamic relationship between aid, tax revenue, government spending and domestic borrowing over time. As stated earlier, pristine FRMs have their shortcomings. In a bid to subdue these difficulties, the Vector Autoregressive (VAR) method; re-parameterized as a Vector Error Correction Model (VECM) is being used to estimate fiscal effects of aid. It is a time series econometric approach that has two advantages in its application to fiscal effects studies. First, it postulates that there is a long-run equilibrium (cointegrating) relationship between domestic fiscal aggregates (cointegration is tested for) and aid is a part of this relationship; then it lets the data reveal the variables that drive the relationship and how they respond to each other. That is, no structural relationship between aid and variables is imposed. Second, the time series dimension of the data is fully explored, permitting a distinction between short-run (adjustments to equilibrium) and long-run (equilibrium) relationships between macroeconomic aggregates (Roger, 2015). While FRMs consider the broader relationship between domestic fiscal variables and aid they do not, however, estimate the magnitude of aid on government spending.

Osei *et al.,* (2005) was the first study to adopt the VAR in a fiscal response framework for Ghana. They estimate the fiscal effects of aid in separate models with aggregated and disaggregated government expenditure; using annual data covering 1966-1998. They provide evidence of weak exogeneity of aid; that is donors do not respond to fiscal imbalances in determining their aid allocation, but aid influences other fiscal variables. They also find that aid to Ghana was associated with reduced domestic borrowing (imposed by the IMF as a prerequisite for more aid) and increased tax revenue. It is not the amount of aid, *per se*, that directly affects tax revenue or domestic borrowing but specific policies (donor conditionality) associated with aid. Like most other VAR-related FRMs they do not provide estimates of the magnitude of the effect of aid on government spending; nor do they formulate and test any fiscal hypotheses of interest. The econometric analysis shows that increases in aid, alongside policies associated with increased taxes, are what lead to increased spending. There is no direct impact of aid on spending.

Morrissey *et al.,* (2007) use official Kenyan aid data over 1964-2004 to distinguish fiscal effects of aid grants and loans. They include GDP within the fiscal framework and estimate two separate

models; the fiscal effects of loans and grants, and the impact of aid on growth. Aid grants are associated with increased spending and spending has a positive impact on growth (with grants also having a positive association with growth). Loans, on the other hand, were sought to finance unexpected deficits when expenditures exceeded revenues (and in periods of surplus the loans were repaid). Deficits, hence loans, negatively impact growth. Tax revenue was found to be weakly exogenous; that is the government was unable to adjust tax revenue in the face of fiscal imbalance. Like Osei *et al.,* (2005) they do not provide estimates of the magnitude of the effect of aid on government spending.

Lloyd *et al.,* (2009) apply the Vector Autoregressive (VAR) method to a sample of 19 developing countries, using data from the early 1970s to early 2000s for most countries. The analysis shows that aid influences budgetary behaviour (cointegration) for a variety of recipient countries (even middle-income countries for which aid is a comparatively small share of spending). Aid is also found to be positively associated with the different components of government spending; and it is weakly exogenous for most of the countries. Nonetheless, like most other VAR-related studies on the fiscal effects of aid, they do not provide estimates of the magnitude of the effects of aid on spending. Their normalization is on tax revenues, with no discussion of the effects aid might have on spending.

Martins (2010) uses a quarterly dataset covering 1993-2008 to analyse the fiscal effects of aid in Ethiopia; disaggregating aid and domestic expenditures but using total government revenue (as opposed to tax revenue used in other FRMs). There is evidence of a long-run positive relationship between aid (as well as grants) and development expenditures, but not between aid and recurrent spending; thus, no evidence of fungibility. Domestic borrowing increases in response to shortfalls in revenue (grants and taxes) and there is no evidence suggesting that aid displaces tax effort. Nonetheless, contrary to Osei *et al.,* (2005) and Morrissey *et al.,* (2007) donors to Ethiopia provide more grants as the level of development spending increases (i.e. grants adjust to the level of development spending). The magnitude of the effect of aid on government spending, however, is not estimated.

Bwire *et al.,* (2013) assess the dynamic relationship between aid and domestic fiscal aggregates in Uganda over 1972-2008. They estimate two models, with aggregated and disaggregated expenditures respectively. Results indicate that in the long-run, the budget is influenced more by

tax revenue than aid; with aid and tax being negatively associated with domestic borrowing while spending is positively associated with domestic borrowing. In the disaggregated model, increases in capital spending lead to increases in deficits. Like Osei *et al.,* (2005) policies associated with aid disbursement improve the efficiency of tax collection (not aid disbursements leading to increased taxes); and domestic borrowing is the main source of government deficits. They also find aid to be endogenous; meaning donors adjust to fiscal imbalances in allocating aid to Uganda.

Empirical evidence regarding the way fiscal aggregates respond to aid flows varies by country, meaning the relationship between aid and fiscal aggregates should essentially be country-specific. Thus, in this chapter we extend the country-specific time series models, in considering cross-country heterogeneity, by analysing the effects of aid and taxes on spending for a panel of 69 low and middle-income countries. We also incorporate cross-section dependence which we argue is palpable in macro datasets like ours. Using annual data covering 1980-2013, this chapter contributes to the literature on the fiscal effects of aid (focusing on the effect of aid on government expenditure), explicitly considering panel unit roots and cointegration, accounting for the distorting impact of cross-sectional dependence in estimation, and incorporating recipient heterogeneity. To the best of our knowledge, no studies on aid and public expenditure have explicitly accounted for these three key concepts.

3.2 CONCEPTUAL FRAMEWORK: DYNAMICS AND HYPOTHESES

3.2.1 Theoretical Issues

There has been growing interest in modelling the dynamic relationship between aid and domestic fiscal aggregates; studies referred to as fiscal response models (FRMs), which draw heavily on the work of Heller (1975). Governments raise revenue from different sources (for example, taxes, aid and sometimes domestic borrowing) and allocate them to different expenditures (for example investment or recurrent expenditures) in a bid to meet some revenue and expenditure targets (Lloyd, McGillivray, Morrissey and Opoku-Afari, 2009). Governments have targets for expenditures and revenue (including aid) and their fiscal behaviour is an attempt to meet these targets, subject to a budget constraint. Thus, the decision makers are assumed to act in a rational, utility-maximising manner (McGillivray and Morrissey, 2001). While FRMs have been

fundamental in providing the basic motivation and intuition on the interplay between aid and domestic fiscal variables, they are fraught with theoretical and empirical limitations.

First, on theoretical grounds, there is no consensus on the precise form the public-sector decision maker's utility function should take (Lloyd *et al.,* 2009). As a result, FRMs assume that government's utility function takes the form of a perfectly symmetric loss function. Adopting a perfectly symmetric loss function implies undershooting and overshooting revenue and expenditure targets equally lead to a reduction in utility. This is counterintuitive because decision makers' preferences are potentially asymmetric. One would expect the government to suffer utility losses only when they are unable to attain their pre-set targets; but instead maximise utility in situations where they surpass their expected targets. This is an inherent symmetry problem which FRMs cannot address.[43]

Second, FRMs are estimated using three-stage least squares (3SLS) and so are difficult to estimate, interpret and are highly sensitive to the data used (McGillivray and Morrissey, 2001). Third, for FRMs to be estimated it is necessary to estimate budgetary targets (revenue and expenditure targets) but there is no accepted theory regarding how governments form revenue and expenditure targets (Morrissey, 2012). Fourth, the FRM is inherently static and thus empirical applications make no attempt to distinguish long-run and short-run relationships involving aid and domestic fiscal variables. They ignore the intertemporal changes in macroeconomic characteristics of recipient countries which are unlikely to be stable over time (Lloyd *et al.,* 2009); such characteristics influencing the impact aid might have on other fiscal aggregates.

Although the theoretical FRM is the underlying motivation for looking at spending, taxes and aid together, we just provide a conceptual framework for the dynamics between foreign aid, taxes and spending based on a government budget identity; which could form the basis for testing hypotheses. In the simple underlying budget identity, all revenues and borrowing must equal all expenditures:

[43] Feeny (2006) proposes a utility function that allows for asymmetries: overshooting equally as bad as undershooting all targets, overshooting some targets being preferable to undershooting others, and undershooting some being preferable to overshooting. The resulting estimates show that incorporating asymmetries has no major implications for empirical inferences as the reduced form and structural equations are similar to those derived from perfectly symmetric loss functions.

$$Revenue + Aid + Borrowing = Expenditures \quad (3.1)$$

where revenue includes tax and non-tax revenues (for example, receipts from central banks), borrowing includes domestic and foreign non-concessional borrowing (i.e. from international private markets), aid includes grants and loans while expenditures consist of government capital and recurrent expenditures.[44] Equation (3.1) is based on the underlying accounting identity, which *is not* predictive of the effects aid might have on domestic fiscal variables (particularly expenditures). Aid is posited to affect domestic fiscal variables, in a manner that can only be determined empirically (Lloyd *et al.,* 2009). At the risk of stating the obvious, equation (3.1) is not a theory that states how expenditures are determined; just that all revenues and borrowing must equal all expenditures.[45]

To generate any testable hypotheses about the direction of the effects of aid and taxes on spending we impose a structural relationship, which can be interpreted as a behavioural representation.[46] Hence we adopt a structural relationship of the form:

$$exp_{it} = \alpha_i + \beta_{i1} aid_{it} + \beta_{i2} tax_{it} + u_{it} \quad (3.2)$$

Based on equation (3.2) we can explicitly test the hypotheses of aid leading to an *increase* or a *reduction* in spending; as well as the impact of tax revenue on spending. The β coefficients in equation (3.2) represent the cross-country average effects of aid and taxes on spending respectively and they vary by country; a point we will emphasize in section 3.4. We consider equation (3.2) to be the long-run (equilibrium) relationship, the relationship of primary interest in

[44] We abstract from seigniorage in this analysis. While printing money generates finance for domestic expenditures, some countries in the sample (for example, CFA Franc countries) have their exchange rates pegged to more developed countries, making them unable to print more money at will.

[45] While the budget identity is a useful backdrop for estimating fiscal effects of aid, theory on accounting identities is not the focus of this chapter. Different testable hypotheses emanate from equation (3.1), breeding different strands of literature (Mascagni and Timmis, 2017). For example, the tax effort literature focuses on the aid-tax relationship, whether aid crowds-out or enhances tax revenue collection (see Prichard *et al.,* 2012 for the current state of research); fungibility studies focus on the additionality of foreign aid to domestic public expenditures (see McGillivray and Morrissey, 2004 and Morrissey, 2012 for a review of fungibility studies); and studies looking at the link between aid and government spending (see *inter alia* Remmer, 2004; Mascagni and Timmis, 2017). The main hypothesis of this chapter is in the spirit of time-series studies on the aid-expenditure relationship.

[46] In estimating any structural relationship of the effects of aid and taxes on spending we omit non-tax revenue and borrowing. This is so we do not end up estimating an accounting identity. The Ugo Panizza datasets have data on domestic and foreign borrowing (and their net present values) but for most of the countries in the sample the data are available only from the 1990s and after. This makes borrowing unsuitable for the type of panel time-series estimation pursued in this chapter.

most empirical studies. This equation can be made to include dynamics (the inclusion of a lagged dependent variable as well as lags of explanatory variables), and factor structures (created by common shocks which cause cross-section dependence) but with implications for estimation.

As aid is still a considerable share of GDP and accounts for large portions of government spending in most developing countries, it should have a direct financing impact on the level and composition of government spending (Morrissey, 2012). Aid can also have an indirect impact on spending through donors' policy conditions (for instance in the 1980s structural adjustment loans were promised to countries that reduced their government expenditures). Taxes have a direct effect on spending, determined by changes in tax rates and the tax base (Lloyd *et al.,* 2009).

While we expect a positive relationship, it is conceivable that there might be a negative relationship between aid and spending for two reasons. First, it may be a result of reverse causality (as described in the introduction). Second, donors' conditionality may result in reductions in spending. Most developing countries had very large public sectors in the late 1980s and early 1990s so the Structural Adjustment Program (SAPs hereafter) of the World Bank and IMF emphasised the retrenchment of public sectors as one of the prerequisites for increased aid (Williams, 1994). Structural Adjustment Aid (SAPs Aid) was promised to countries that cut (or at least made attempts to cut) their public sector, with no consensus on the expected size of the retrenched public sector in recipient countries. In this way donor conditionality may lead to reductions in expenditure in the short-run. This intuition, however, applies only to countries that were stagnating and struggling to adjust; and maintained large and inefficient public sectors (for example, Kenya and Cote D'Ivoire). Contrarily, countries like Uganda that suffered economic collapse and were then recovering from disaster were expected to increase their expenditures after receiving more aid; with a view to rebuilding the economy.

Of equal importance is incorporating off-budget aid (proxied here by technical assistance) into the analysis. Van de Sijpe (2013) finds that technical assistance takes up a big share of education and health aid to developing countries (and is also a huge share of total aid). Significant amounts of aid are in the form of donor-funded projects or technical assistance (Morrissey, 2012; Van de Sijpe, 2013; Marć, 2017) which does not even leave the donor country. Such aid does not go through recipients' budgets but can still generate fiscal responses from recipients. Insofar as

public-sector decision-makers implement the policies stipulated by technical assistance consultants, technical assistance can generate a fiscal response from recipients.

3.2.2 Econometric Issues

In some countries, fiscal variables like government expenditures and tax revenue show high degrees of persistence, albeit with positive and/or negative trends, meaning in the long-run they are nonstationary processes (Lloyd *et al.,* 2009; Eberhardt and Teal, 2011). The concept of nonstationarity is closely linked to the order of integration of variable series, which determines the number of times the variable series needs to be differenced to achieve stationarity. If after first differencing a variable series becomes stationary that variable series is said to be integrated of order one, i.e. I(1). This means the first differenced series, will itself, be I(0). While variable nonstationarity is a property characterising macroeconomic data for most countries the precise order of integration of the variable series should be a feature of the sample; not a global property (Pedroni, 2007). This means variable (non)stationarity should be investigated for each specific sample; and not assumed to always exist in every dataset.

In the fiscal response context, the order of integration of variables is particularly salient. Aid, for instance, performs two distinct, but not mutually exclusive, fiscal roles in developing countries. First aid may form part of recipients' domestic budget planning processes, in which case it will be nonstationary, and enter the long-run I(1) relationship (cointegrating relationship like equation (3.2)). Second, it may be used to just relax the budget constraint, in which case it will enter the I(0) short-run relationship (Lloyd *et al.,* 2009). In this case, aid substitutes for borrowing from private markets. This distinction, then, corresponds to the econometric notions of long-run equilibrium (representing the budgetary planning process of which aid plays an important role) and the short-run dynamic adjustments (represented by aid simply relaxing the budget constraint).

In statistical terminology, a cointegrating relationship (long-run equilibrium) between fiscal variables (expenditures and taxes) and aid exists when a linear combination of such I(1) variables have errors that are stationary, I(0). That is, regressing nonstationary fiscal variables like aid and taxes on nonstationary expenditures is valid if and only if the resulting error terms are stationary (i.e. u_{it} should be stationary). Nonstationary errors from equation (3.2) result in spurious

regressions (Granger and Newbold, 1974).[47] Occasionally, the observed long-run evolution deviates from its path but short-run 'error corrections' in the system ensure that it returns to its long-run equilibrium path (Hendry, 1995). Eberhardt and Teal (2011) state that this long-run relationship can be the *same* for all countries in the sample (i.e. homogenous cointegration); or alternatively, each country may follow its own long-run trajectory (i.e. heterogeneous cointegration). Furthermore, for countries with stationary variable series the problem of non-cointegration and spurious regression does not arise (Eberhardt and Teal, 2011).

Discussion of nonstationarity in fiscal variables, as well as accommodating dynamics in the relationship between fiscal variables, relates to the notion of exogeneity. Once dynamics are incorporated into equation (3.2), the strict exogeneity assumption no longer holds. This allows for the possibility of feedback between variables in the fiscal equilibrium; meaning past fiscal imbalances determine the amount of aid recipients receive and the amount of tax revenue they raise. In statistical terminology, such reverse causality translates to the concept of weak exogeneity, which is of great importance in the fiscal response literature. In a time-series context, if the variables are nonstationary and form an equilibrium relationship (i.e. they are cointegrated) then exogeneity of aid and other variables can be tested.

When weak exogeneity tests are applied to domestic fiscal variables, the tests indicate which of the fiscal variables adjust following fiscal disequilibria (deficit/surplus) to restore equilibrium. When such tests are applied to the level of aid, they offer insights into the disbursement behaviour of donors. If donors respond to domestic fiscal imbalances when allocating aid, this will imply aid is endogenously determined. If on the other hand, donors do not respond to fiscal imbalances in their allocation decisions but aid influences other aggregates in the system, aid is said to be weakly exogenous or 'long-run forcing' (Lloyd *et al.,* 2009).

Likewise, (non)stationarity of tax revenue indicates its potential effects on expenditures. Despite the important fiscal roles aid plays in developing countries, government spending is driven mainly by domestic revenues in most of those countries (with tax revenue being the most important). Indeed, there is country-specific evidence that tax revenue is more important for

[47] Nonstationarity of the error term leads to inconsistency in estimation. The covariance between the nonstationary error term and the nonstationary regressor(s) does not converge to zero even as $T \to \infty$ (Coackley, Fuertes and Smith, 2006). Thus, the estimator does not converge to the true parameter value but to a random number (Coakley *et al.,* 2006).

government spending in developing countries (Mascagni and Timmis, 2017 for Ethiopia; Bwire *et al.,* 2017 for Uganda). As domestic revenues (represented solely by tax revenue in this chapter) are typically trending, they are expected to impact positively on (and sustain) domestic expenditures in the long-run. This implies a cointegrating relationship between taxes and spending. While nonstationarity is a necessary condition for tax revenue to have a long-term impact on spending, it is however, not a sufficient condition. Tax revenues are dependent on several recipient-specific factors[48] that might make it highly unpredictable; with such variations making it approximate a stationary series. In such instances, revenues will merely have a short-run impact on spending.

Though aid impacts on government spending in recipient countries, it also has an impact on tax revenue (and domestic revenue mobilisation in general); which, as emphasized, impacts on spending (see chapter 4). Some aid is given for tax administration and public-sector management while some is given for physical capital and human capital development. Data on aid given for specific 'observable or quantifiable' purposes like human capital and physical capital development, public finance management and public-sector policy (obtainable from the OECD's Creditor Reporting System database) are now available; but unsuitable for time series analysis as they are available only for the recent past. Notwithstanding the novelty of aid disaggregation, there is a huge body of research on the impact of aid on tax revenue which uncovers many channels through which aid can influence taxes. However, there is no consensus and results are sensitive to empirical strategy.

Nonetheless, interrelations between aid and taxes should be accounted for in any empirical estimation of the effects of aid and taxes on spending. Omitting tax revenue from equation (3.2) will attribute all the effects on spending to aid, ignoring the effects of taxes and biasing the coefficient on aid upwards. This justifies a parsimonious approach of including both aid and taxes. Besides taxes can act as a proxy for any observed or unobserved time-varying omitted variables that influence spending (for instance exports, imports and recipient policy) and if

[48] This is essentially what tax effort models aim to uncover; the factors determining the tax/GDP ratio in developing countries. Typical variables included in such regressions are the share of agriculture in recipients' GDP and exports (proportion of GDP). These two variables are particularly susceptible to volatility in developing countries, resulting in tax revenue volatility as well.

cointegration is found in equation (3.2), it will justify the inclusion of both aid and taxes in the model (implying no important nonstationary variables have been omitted).

3.2.3 Cross-Section Dependence in the Data

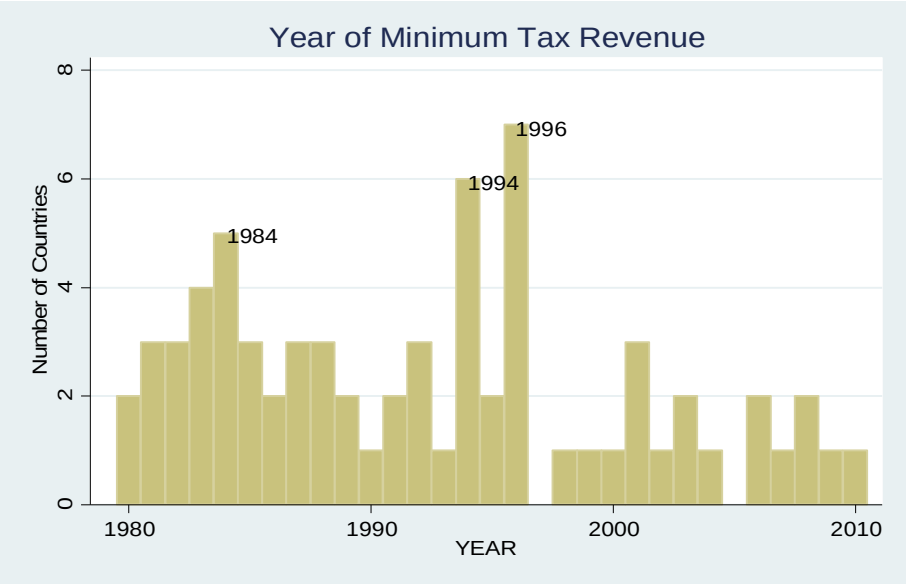
Global events like the oil price shocks of the 1970s and the recent financial crisis potentially affect all countries, albeit to varying degrees (Coakley *et al.,* 2006). These common shocks induce unobserved time-varying heterogeneity across countries; which in turn introduces cross-section dependence between regression error terms and variable series. Such time-varying heterogeneity can lead to inconsistency in standard panel estimators (Eberhardt and Teal, 2011; Pesaran, 2006). 'Common' here refers to the fact that the shocks potentially affect all countries but in varying degrees. The common factors giving rise to these shocks can be *strong* factors with more widespread effects; like the oil shocks of the 1970s or the more recent financial crisis. Alternatively, the source of the shock can be *weak* factors like devaluation of the CFA Franc in 1994 and the Arab Spring in 2011; which simply represent local spillover effects. Cross-section dependence may be error cross-section dependence (in which case the error terms of different units of data are correlated) and/or variable cross-section dependence (in which case the shocks affect variable series of different countries).

Over the years, there has been an increase in economic and financial integration of countries; resulting in strong interdependencies across such countries. It is not a far-fetched idea, then, to assume cross-section dependence across countries; as *common* shocks affect variable series across these countries differently. The economic mechanisms creating such time-varying unobserved heterogeneity are important as they are indicative of the kind of cross-section dependence in the data (strong vs. weak cross-section dependence; error vs. variable cross-section dependence).

Strong shocks like the global recession of the 1980s or the more recent financial crisis had adverse effects on the amounts of aid donors could disburse. Jones (2011) states that in the wake of the financial crisis of 2008 donors faced severe economic slowdowns, with *small* donors (like Norway and Sweden) suffering most, hence reducing the amount of aid they disbursed. Nevertheless, *large* donors like the US and the UK still recorded increased disbursements during, and after the financial crisis. Aid funds still represent a huge source of income in developing countries, especially in Sub-Saharan Africa; and almost all these countries receive aid funds from

both *small* and *large* donors. Hence shocks affecting the disbursement capacity of these donors will invariably affect the amount of aid developing countries receive.

Figure 3. 1: Minimum tax/GDP distribution (1980-2013)



Notes: The histogram indicates the number of the countries that recorded their lowest tax/GDP rates in each year. Approximately one-quarter of the countries in the sample had the lowest tax/GDP rates in three years; 1984, 1994 and 1996. **Source:** ICTD GRD (2014).

Weaker shocks like the devaluation of the CFA franc in 1994 affected mainly the countries of the CFA Franc zone and their neighbouring countries (through geographic proximity and interactions between economic agents); so, they are merely representative of local spill-over effects. One of the consequences of the devaluation was the retrenchment of the public sector in CFA countries, resulting in a reduction in their tax bases (as the formal sector became smaller in these countries); hence a reduction in tax revenues. Such reductions in tax revenues lead to reductions in total government revenues, hence government spending.

Figure 3.1 highlights cross-section dependence in tax/GDP *troughs* across the 69 countries in the sample. The histogram shows the years in which each country recorded its lowest tax/GDP rate. More than one-quarter of the countries in the sample reached their minimum tax revenues in three years; 1984, 1994 and 1996. Closer inspection of the data revealed that the fall in tax revenues in the aforementioned years was as a result of currency devaluations (for the CFA

Franc zone countries), economic (trade) liberalisation and political instability (internal and external conflict).

Guillaumont, Guillaumont-Jeanney and Brun (1999) state that SSA has a higher level of *primary* instability (political and economic) than other developing regions. Such instabilities can easily spillover to other countries in the region, depending on the proximity of these neighbouring countries to the country of primary instability. Proximity here refers, but is not strictly restricted, to the actual distance between the two countries. It can also be a common colonial heritage, cultural affinity (language and religion), as well as bilateral trade volumes. Murdoch and Sandler (2002) discuss spatial war spillovers, whereby civil wars in a country may lead to the destruction of infrastructure and capital in neighbouring countries, as well as creating disincentives for foreign direct investment (FDI) in those neighbouring countries. Gyimah-Brempong and Traynor (1999) find that political instability negatively affects growth; particularly through its effect in discouraging investment in such unstable countries (and potentially in neighbouring countries as well). Moreover, resources which can be spent on development and infrastructure projects are instead spent on national security and defence, resulting in stagnant growth in the fighting countries (and possibly their neighbours too). These all result in cross-section dependence in the data.

In addition to the economic mechanisms creating the cross-section dependence, the econometric implications of cross-section dependence are of equal importance. Plausibly, shocks creating cross-section dependence may create factors that need differencing to achieve stationarity (i.e. the unobserved shocks create common factors that may be nonstationary). Such I(1) common factors cause the variables not to cointegrate, creating *spurious regressions* (Coakley *et al.,* 2006). If the factors are stationary (i.e. they are time-specific or relatively stable over time), then unbiased estimates can be obtained simply by augmenting the OLS regressions with a full set of time dummies or with a linear time trend. This, however, implicitly assumes that the shocks have identical effects on each country (Eberhardt and Teal, 2011; Coakley *et al.,* 2006), an assumption this chapter aims to further investigate. If the factors are nonstationary then they become part of the cointegrating relationship (Banerjee and Carrion-i-Silvestre, 2011), and a full set of time dummies and a linear trend can capture parameter heterogeneity but may mis-specify the true

nature of the evolution of the common factors (Eberhardt and Teal, 2011). Therefore, methods that allow for the possibility of nonstationary common factors should be used.

3.2.4 Allowing for Heterogeneity in the Fiscal Impact of Aid

Lloyd *et al.,* (2009) state that there is a high degree of heterogeneity in government fiscal behaviour among developing countries, with fiscal effects of aid differing from one country to another (Franco-Rodriguez *et al.,* 1998). While countries in a region (for example, SSA) may have similar structural characteristics (relating primarily to their level of political and economic development); they have fundamental institutional differences that influence the impact aid will have on spending in those countries. Moreover, they are also heterogeneous in terms of their resource endowments, country size and population. Hence it becomes misleading to pool together all countries in a regression equation, assuming common dynamics. Such institutional differences and country-specific characteristics will ensure that each country has its own long-run equilibrium trajectory (hence country-specific fiscal equilibrium) and its own short-run dynamics.

Eberhardt and Teal (2011) argue that neglecting parameter heterogeneity in econometric analysis has more severe implications if observable variables (in our case, aid, taxes and spending) and unobservable (time variant and/or time-invariant) variables are nonstationary, resulting in the breakdown of the cointegrating relationship between aid, taxes and spending. Generally, a pooled regression equation (with common parameters for all countries) in levels will have nonstationary errors if the actual DGP differs by country (i.e. the *true* coefficients determining how aid and tax revenue influence spending differs across countries); and also, if observable variables are nonstationary (Eberhardt and Teal, 2011). With reference to equation (3.2) a pooled regression equation will have error terms that contain one or more of:[49]

$$(\beta_{i1} - \mu_1)aid_{it} \qquad (\beta_{i2} - \mu_2)tax_{it} \tag{3.3}$$

where μ_1 and μ_2 are the common (the same for all units of data) regression coefficients for aid and taxes respectively, while β_{i1} and β_{i2} are the *true* country-specific parameters. Evidently, each of the terms in equation (3.3) is a linear combination of nonstationary processes; hence the nonstationary errors themselves. Eberhardt and Teal (2011, p. 140) state that even in cases where

[49] This exposition draws heavily on Eberhardt and Teal (2011).

there is heterogeneous cointegration (i.e. aid, taxes and spending cointegrating in each country regression), the pooled equation does not cointegrate. Hence pooled estimation will not yield the mean of the cointegrating parameters across countries.

Heterogeneity in the time-varying unobservables (i.e. the *true* nature of evolution of the unobservables) should also be incorporated in analysis. Analogous to the aforementioned point, a pooled regression equation, even after augmenting with a full set of $T-1$ dummies, imposes common evolution of unobservables in all countries. If the DGP of unobservables is indeed heterogeneous and nonstationary, the errors again become nonstationary as well; resulting in the breakdown of the cointegrating relationship (Eberhardt and Teal, 2011). If the true DGP process of unobservables is nonstationary, country regressions with linear trends or time dummies capture heterogeneity but lead to misspecification of the true evolution of unobservables; resulting in nonstationarity in errors (Bai, Kao and Ng, 2009). We will formally introduce the concepts of stationarity, parameter heterogeneity and cross-section dependence into our econometric model in section 3.4.

3.3 DATA[50]

Annual data on 69 developing countries covering the period 1980 to 2013 are used in this analysis. All variables are in logarithms. Data on gross ODA disbursements, net ODA disbursements, gross ODA loans, gross ODA grants and technical cooperation (off-budget aid) are obtained from the OECD's Development Assistance Committee (2015) database. The main independent variable of interest is net ODA disbursements, which is the sum of ODA grants, capital subscriptions and net loans. As the OECD DAC database comprises aid data provided by donors it tends to overstate the amount of aid that goes through recipients' budgets. Hence to get a measure of net ODA 'close' to that which goes through recipients' budgets, we deduct technical assistance from grants. This gives us a new measure of grants which we then add to net loans to get net ODA figures for the econometric analysis. We also estimate variants of the main

[50] For descriptive purposes, all data except technical cooperation will be expressed as a percentage of GDP. Technical cooperation is expressed as a proportion of recipients' gross ODA received. We do not provide descriptive statistics for total tax revenue and total government revenue because they are only included to test the robustness of our main results.

model with, grants, loans and technical assistance (the proxy for off-budget aid) as regressors of primary interest.

Total government spending data are obtained from the *World Development Indicators*. As total government spending is the sum of government consumption (recurrent) expenditure and domestic public investment (capital expenditure), we also collect data for these two expenditure headings (both from the *World Development Indicators* as well).

Data on total revenue, total tax and non-resource tax revenues, all excluding grants and social contributions, are obtained from the novel Government Revenue Dataset (GRD) of the International Centre for Tax and Development (ICTD) and the United Nations University – World Institute for Development Economics Research (UNU-WIDER). Non-resource tax revenue excludes royalties and natural resource taxes (Prichard, Cobham and Goodall, 2014). Total tax revenue comprises all direct and indirect tax revenues while total government revenue is a composite of all tax and non-tax revenues (for instance, central bank receipts). The ICTD GRD data are compiled by combining data from the major international databases, individual country IMF Article IV reports and national budgets, as well as private tax datasets (for example, Keen and Mansour, 2009). The data distinguish between resource and non-resource components of each tax type, with the non-resource components of interest in econometric research. The tax data, in local currency units, are scaled by recipients' GDP series (sourced from *World Economic Outlook*), also in local currency units. This ensures consistency across countries and data sources. By combining datasets and still ensuring consistency across sources, the ICTD dataset achieves improved data coverage (Prichard *et al.,* 2014).

Figure 3.2 shows the distribution and evolution of net aid/GDP, spending/GDP and tax/GDP rates for all 69 countries in the sample covering the period 1980 to 2013. The lower and upper ends of each box plot show the 25th and 75th percentiles respectively, with the horizontal line in the middle of the box indicating the median. The interquartile range and median of net aid/GDP rates increase consistently until 1988; then drop slightly in 1992 and continue falling until 2000. They pick up after 2000 until 2008 then drop again in 2013. Despite these fluctuations, aid still represents a large part of recipients' GDP over time on average (28% in Guinea-Bissau, 20% in Mozambique, 17% in Burundi and Malawi, and 14% in Rwanda). Spending/GDP rates increase in 1984, but reduce gradually thereafter; with a noticeable reduction 1992 and 2000. The rates

pick up gradually after 2000. Tax/GDP rates show a consistent pattern of evolution over time, with the interquartile range, as well as the median increasing steadily over time (tax/GDP rates are consistently between 9% and 20%) albeit with some minor fluctuations.

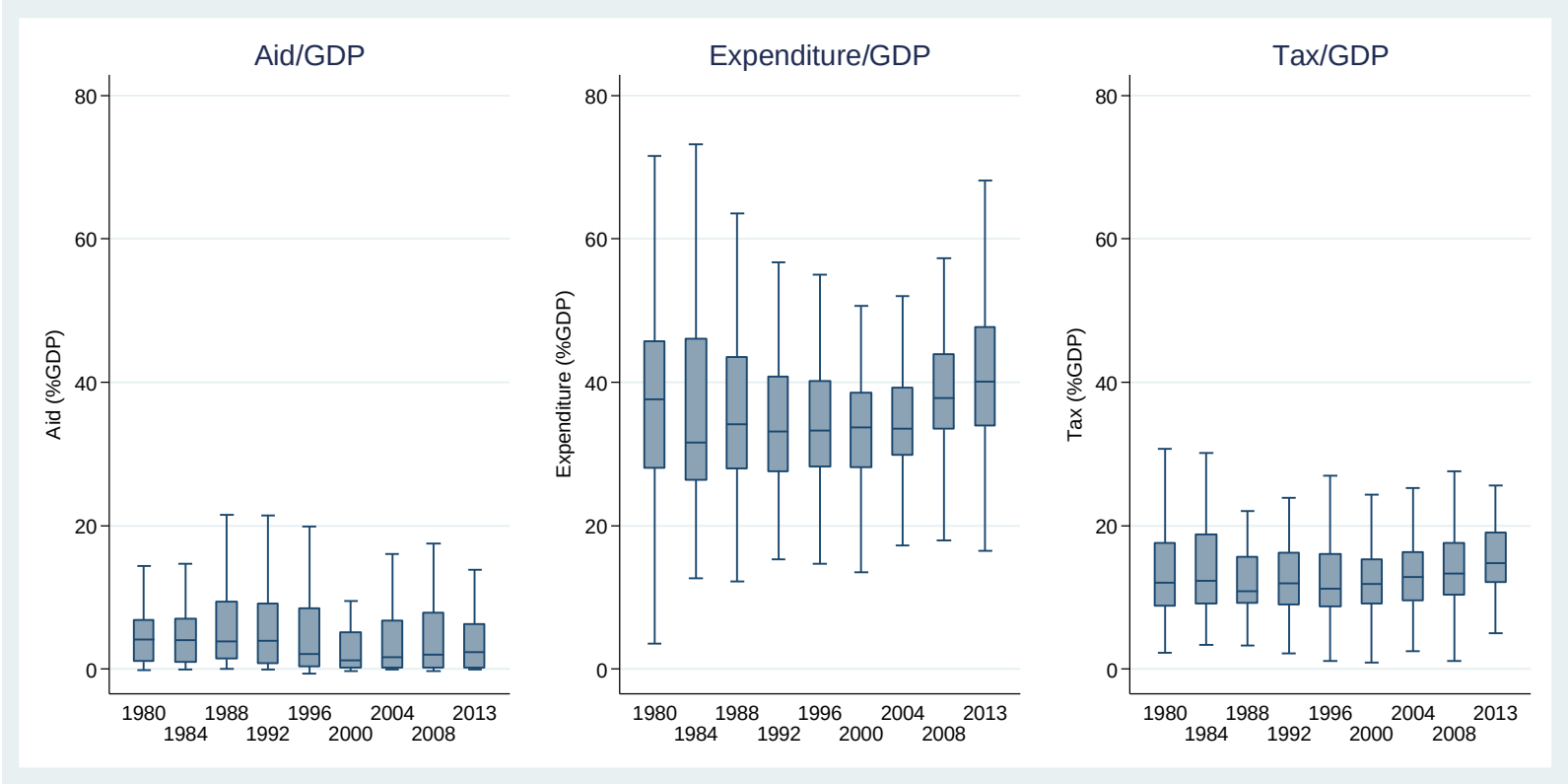
Figure 3.3 shows the composition of aid (grants vs. loans) to countries at different stages of their economic development, based on the World Bank's income classification (see appendix table B2 for details). Least developed countries received more aid in grants, than loans, over time. This is quite intuitive as grants are not expected to be repaid. It is possible that these countries receive more grants simply because their tax/GDP rates are low. Lloyd *et al.,* (2009) state that the fiscal impact of aid *may be* conditional on the level of development (income) of the country. A growing economy produces a larger tax base and more efficient tax collection mechanisms so that the tax/GDP ratio increases while the aid/GDP ratio declines (with aid representing a lower share of government spending). Least developed countries are those with slow (sometimes stagnant) growth, low tax/GDP rates and for whom aid still represents a huge share of government spending. It follows then, that they would receive more aid in the form of grants; as their tax collection capacities are constrained and they are not able to tax as much as may be necessary for development. As countries become more developed, they tend to receive less aid (proportionately). Aid to upper middle-income countries, regardless of its composition has reduced over time; with grants and loans representing not up to 3% of recipients' GDP in 2013 (for the UMICs in the sample). Some countries currently in the 'upper middle income' bracket were probably 'less developed' in the late 1970s and early 1980s, which is why the amount and composition of their aid is higher in the 1980s than it is now.

Figure 3.4 shows that least developed countries have the lowest tax/GDP ratios in the sample. While this may indicate fiscal nonchalance on the part of governments in LDCs, it may also reflect the fact that least developed countries are constrained in their ability to raise taxes. Indeed, Keen and Simone (2004) find that the poorest countries face greatest difficulty in raising tax revenue. Given the tax base, they may be taxing as much as they can but it still is insufficient to generate economic and political gains (Osei *et al.,* 2005; Morrissey, 2015b). Even in LDCs with more efficient tax collection mechanisms than their peers at the same stage of economic development, the tax base is still small; as the informal sector is very large in such countries (Morrissey, 2012). All these effects translate into lower tax/GDP ratios, slow (or even non-

existent) growth and high dependence on foreign aid flows. As alluded to earlier such countries are the ones that receive more aid in the form of grants.

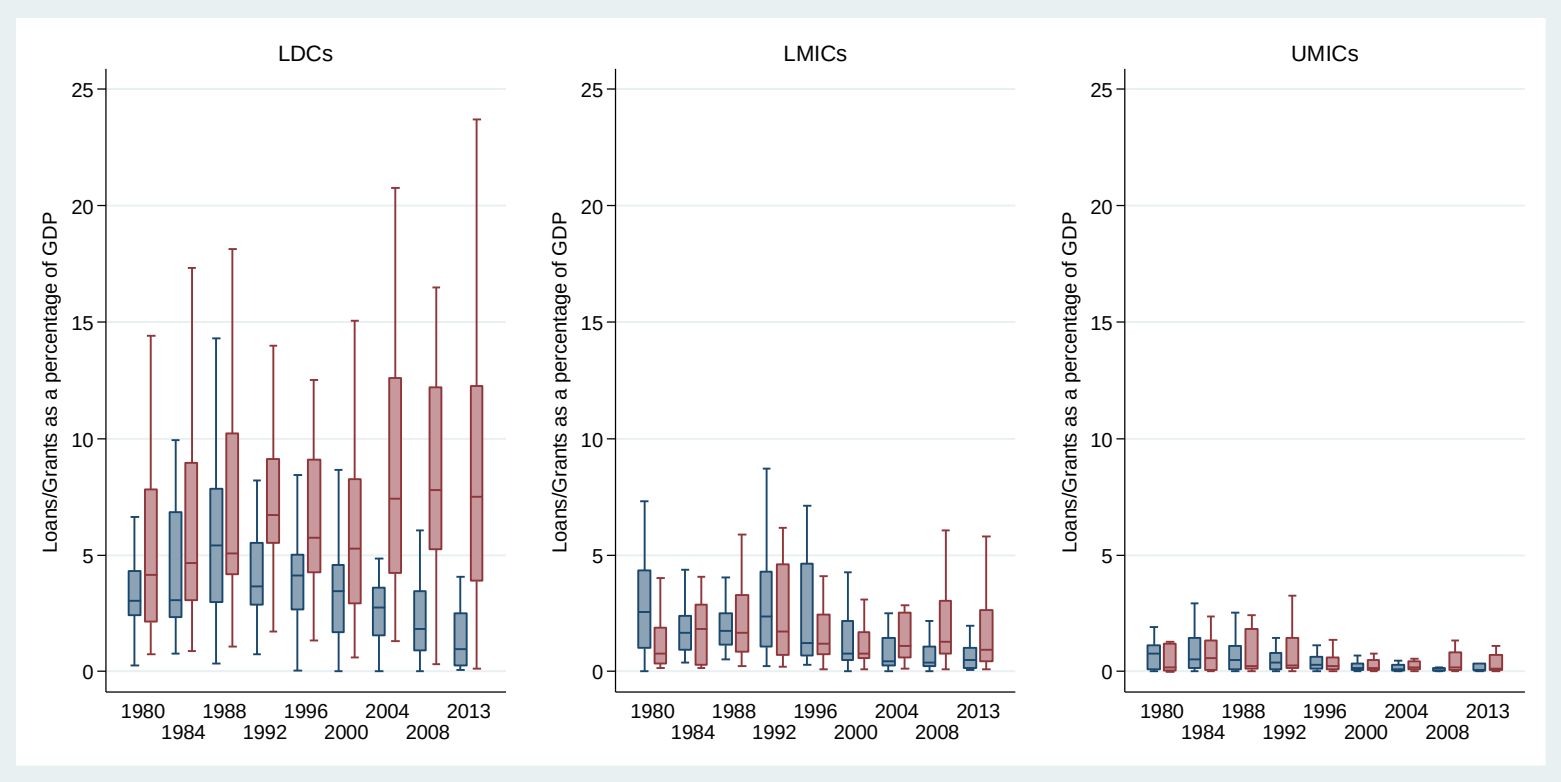
As mentioned in section 3.2.1, Van de Sijpe (2013) finds that technical assistance takes up a big share of education and health aid to developing countries (and is also a huge share of total aid). Such aid does not go through recipients' budgets but can still generate fiscal responses from recipients. Figure 3.5 shows that UMICs receive more in technical assistance than LMICs and LDCs. As UMICs are in more advanced stages of development, they have the basic (necessary) stock of human and physical capital, as well as the required institutional capacity to benefit fully from the transfer of knowledge from donors through technical assistance. Fiscal institutions are weaker in LDCs, and policies designed to improve capacity building are at their nascent stage of implementation. As such, LDCs cannot fully reap the benefits of donors' technical assistance, reason why they receive relatively less in technical cooperation. In absolute terms, the amount of technical cooperation LDCs receive is large but relative to middle income countries, the amount is considerably less.

Figure 3. 2:Distribution and Evolution of fiscal variables over time (1980 – 2013)



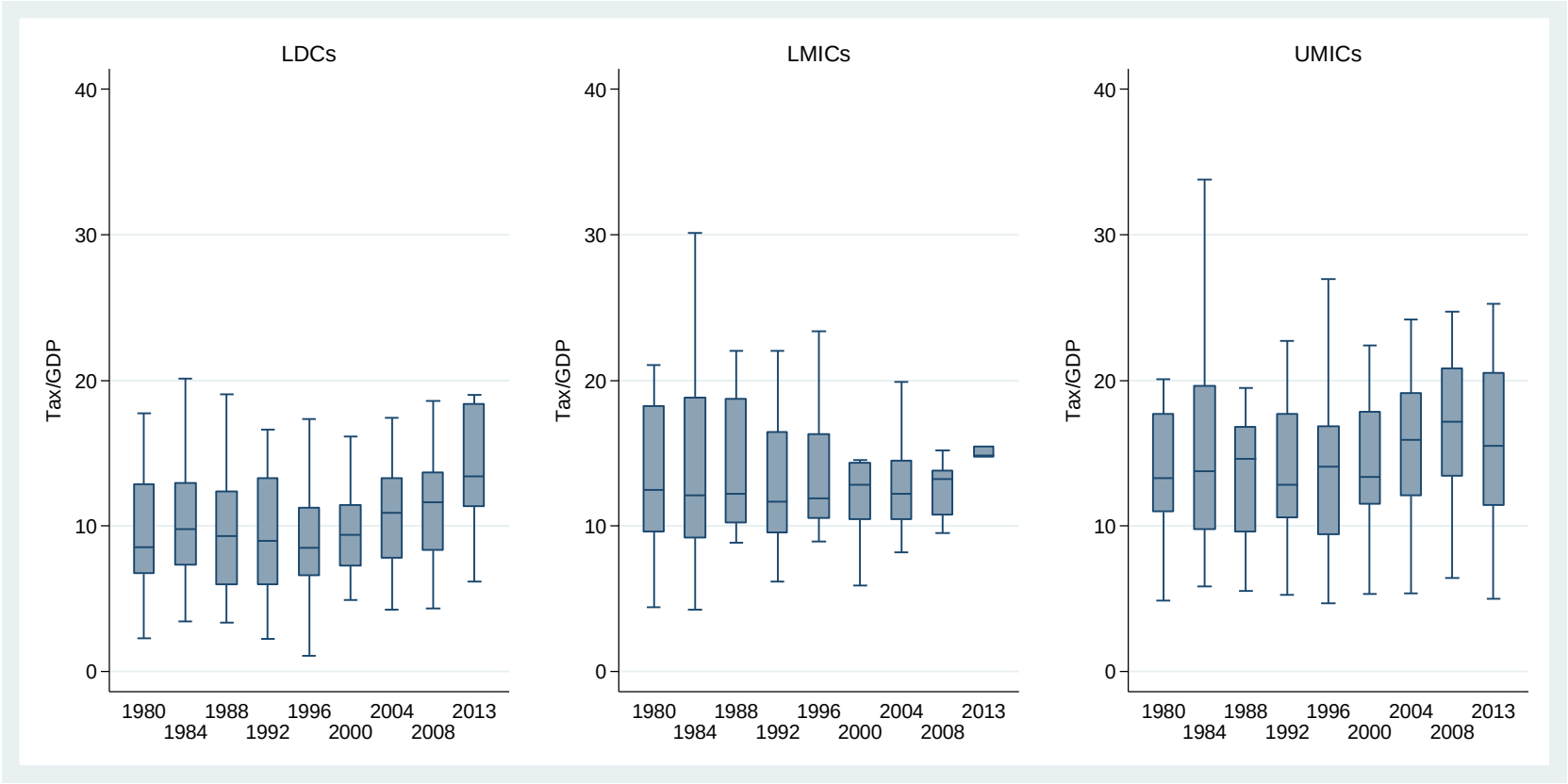
Notes: The diagram above shows the distribution and evolution of aid/GDP, spending/GDP, and tax/GDP rates for all 69 countries in the sample covering 1980-2013. **Sources:** OECD-DAC (2015), *World Development Indicators* (2015), ICTD GRD (2014).

Figure 3. 3: ODA Loans and Grants by Income Group (1980 – 2013)



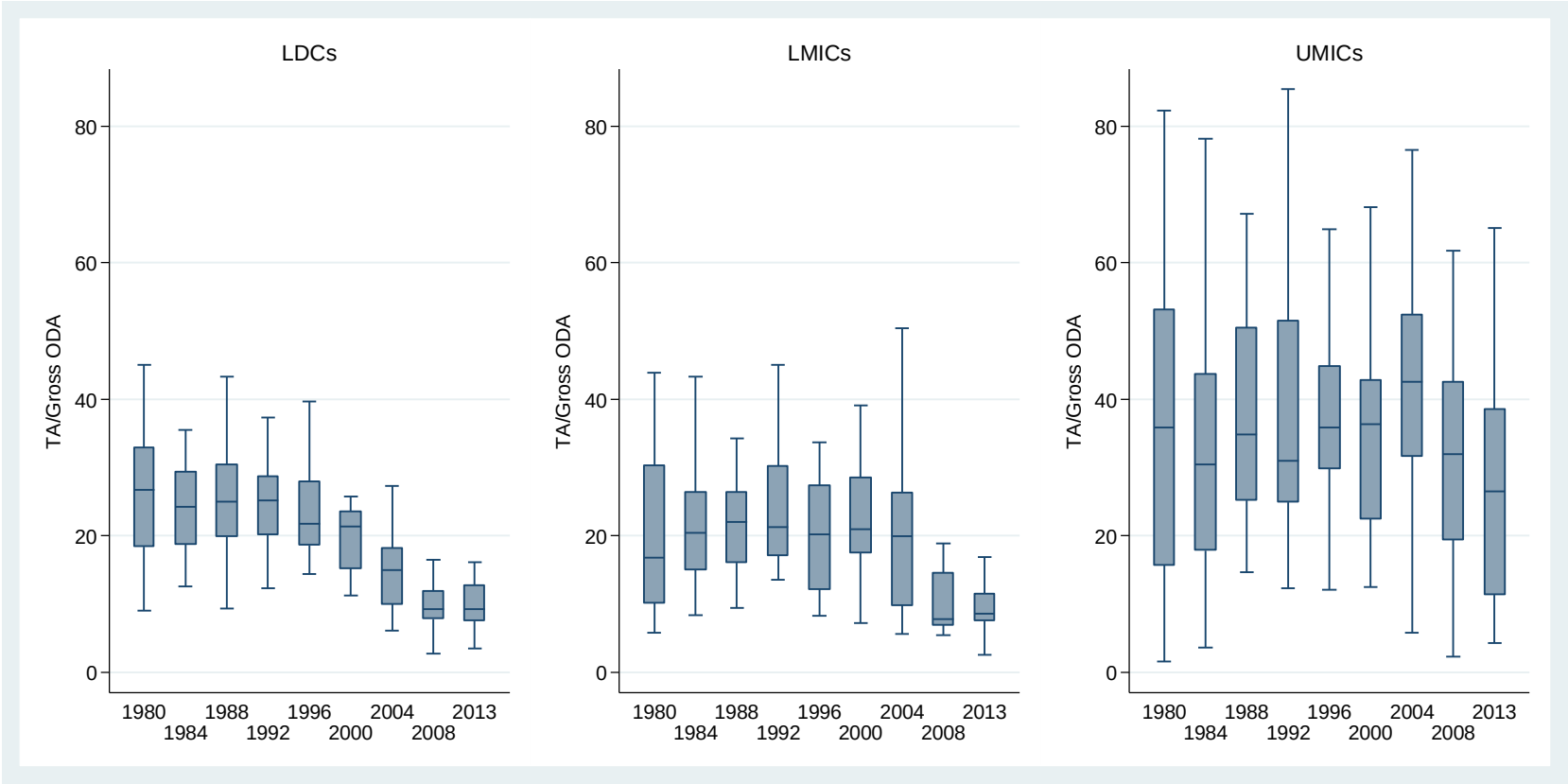
Notes: The blue boxes represent loans while the red ones represent grants. Countries are classified according to their level of economic development; based on the World Bank's income classification. LDCs are Least Developed Countries; LMICs are Lower Middle-Income Countries and UMICs are Upper Middle-Income Countries. See appendix B2 for details of the sample for each income group. **Source:** OECD DAC (2015)

Figure 3. 4: Tax Revenue by Income Group (1980 – 2013)



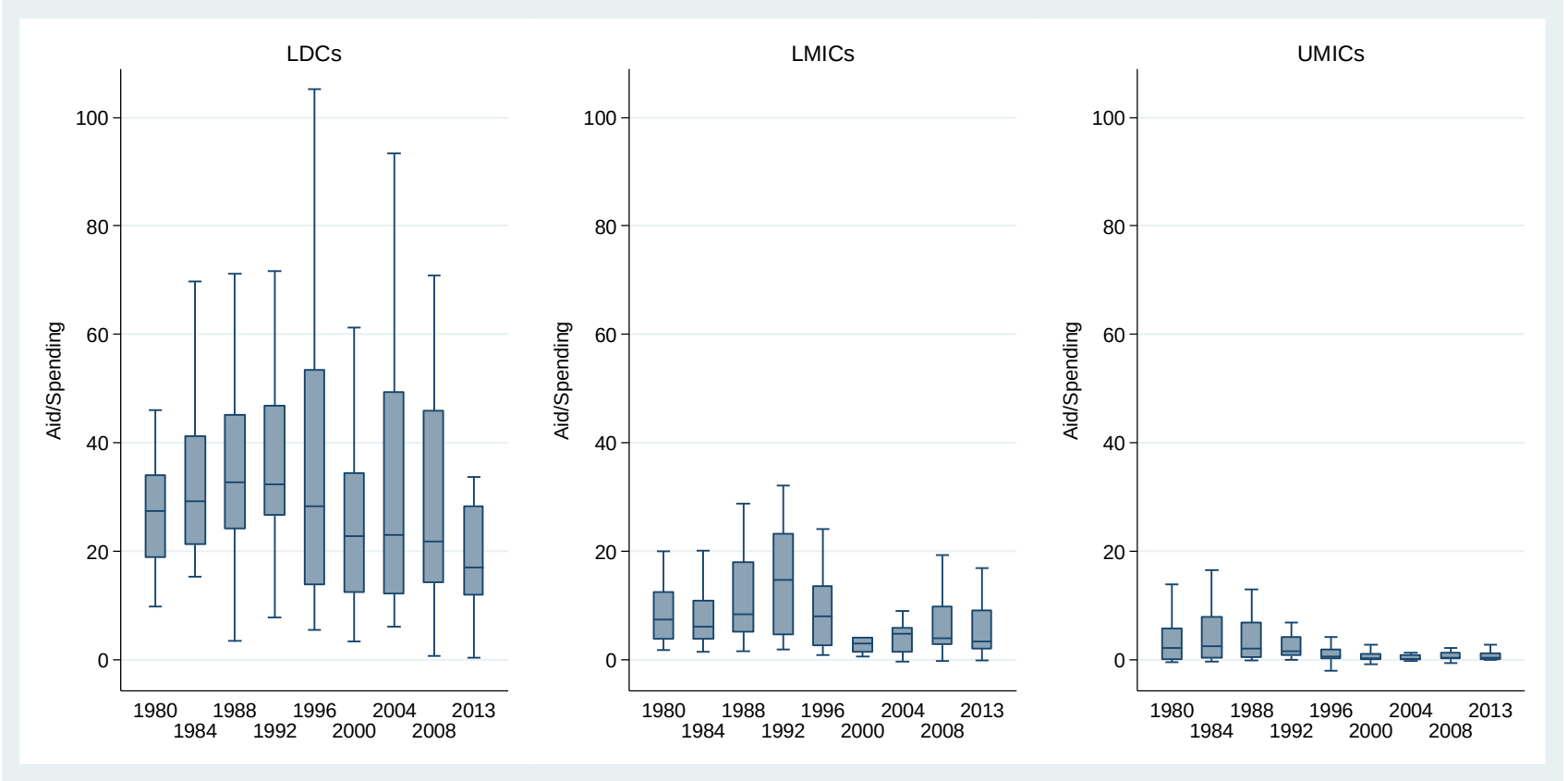
Source: ICTD GRD (2014)

Figure 3. 5: Technical Assistance by Income Group (1980 – 2013)



Notes: TC/Gross ODA refers to technical cooperation as a share of gross aid disbursements. **Source:** Author's calculations based OECD DAC (2015)

Figure 3. 6: Aid to Spending Ratio by Income Group (1980 – 2013)



Notes: See figures 3.2 and 3.3 for details. **Source:** Author's calculations based on OECD DAC (2015) and *World Development Indicators* (2015)

Figure 3.6 shows the aid/spending ratio for countries in the three income groups. On average, the aid/spending ratio is substantially larger for least developed countries, with aid accounting for 80% of spending in Guinea-Bissau, over 50% of spending in Burundi, Mozambique, and Rwanda and over 40% in Malawi, Chad and Uganda. These figures indicate the importance of aid to the poorest countries, and aid is expected to have a financing impact on spending in those countries. The average aid/spending ratio is much smaller for middle income countries (0.09% in Venezuela, 0.14% in Argentina, 0.18% in Chile). While these descriptive statistics are informative on the distribution of fiscal variables across different groups, they are also highly stylised. Much cannot be inferred from the diagrams, except that countries receive significant amounts of aid (disbursed in varying ways), with aid/GDP ratios much higher for low-income countries. In addition, expenditures are higher than aid and taxes, indicating that expenditure patterns cannot be sustained solely by either tax revenue or aid. Hence aid and taxes must be complementary, and the *observable* impact (and direction of effects) of aid and taxes on spending can only be determined empirically.

3.4 EMPIRICAL MODEL SPECIFICATION

3.4.1 Cross-Section Dependence and Unit Roots

Following the discussion in section 3.2.3, it is important to investigate for cross-section dependence in the data. This can be done by taking a variable series for country i (or residuals from an estimating equation for country i) and correlating it with the variable series (or residual) for the other $N-1$ countries. Doing that for all countries in the sample, we end up with $N(N-1)$ correlation coefficients from which we can obtain the average correlation and the average absolute correlation coefficients. Alternatively, these $N(N-1)$ correlation coefficients can be used to obtain a more formal test statistic (for example, the Pesaran CD statistic). The Pesaran (2015) CD test is based on the pairwise correlations of variable series or residuals, and the statistic is approximately normally distributed as N and T get sufficiently large (De Hoyos and Sarafidis, 2006). For a balanced panel, the statistic can be defined as:

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right) \tag{3.4}$$

Where $\hat{\rho}_{ij}$ is the average pairwise correlation of the variable series (or residuals) and under of null of weak cross-section independence, CD is distributed $N(0,1)$ for sufficiently large T and $N \to \infty$. De Hoyos and Sarafidis (2006) explain, theoretically and empirically, the most commonly used tests of cross-sectional dependence. Hence, we will provide the CD statistic of the variable series, the average of the $N(N-1)$ correlation coefficients, as well as the average of their absolute values.

Guided by insights from the conceptual framework we aim to investigate the time-series properties of the data (i.e. testing for the presence of unit roots in the variable series). Consider a p^{th} order Augmented Dickey-Fuller (ADF) regression of the form:

$$\Delta y_{it} = \mu_i + \beta_i t + (\rho_i - 1) y_{it-1} + \sum_{j=1}^{p} \delta_{ij} \Delta y_{it-j} + u_{it} \quad (3.5)$$

where y_{it} can be the logarithm of total government spending, net aid, and tax revenue; or regression residuals. t is the country-specific linear time trend. We can use both 'first generation' and 'second generation' panel unit root tests to test for variable and residual (non)stationarity. 'First generation' tests assume cross-section independence, and the tests were developed to increase power from pooling low-powered[51] country-specific unit root tests (Eberhardt and Teal, 2011). 'Second generation' tests, on the other hand, assume that the variable series or residual has a *single* factor creating the cross-section dependence. The null hypothesis for the unit root tests is:

$$H_0: \rho_i - 1 = 0, i = 1, \dots, N \quad (3.6)$$

Against the alternative that:

$$H_1: \rho_i - 1 < 0, i = 1, \dots, N;\ \rho_i - 1 = 0, i = N_1 + 1, \dots, N \quad (3.7)$$

Where N is the number of countries in the sample, $N_1 < N$ and N_1/N is non-zero and fixed as $N \to \infty$

(Baltagi and Moscone, 2010). In words, the null hypothesis is the variable series (or regression residuals) is nonstationary for *all* countries in the sample; with the alternative of stationarity in at least some countries. Rejection of the panel unit root hypothesis does not imply panel stationarity, but rather rejection of nonstationarity in *all* countries (Eberhardt and Teal, 2011). Smith and Fuertes (2007, p. 39)

[51] Time-series unit root tests have low power against I(0) alternatives that are close to I(1). That is the unit root tests cannot easily distinguish highly persistent stationary series from nonstationary processes (Smith and Fuertes, 2007, p. 39).

discuss the empirical challenges in testing for unit roots; single time-series unit root tests suffering from low power while panel unit root tests are difficult to interpret. In practice, we will most likely be faced with a mixture of countries in terms of the time-series properties of their variable series; hence estimation methods that accommodate this mixture should be used.

The first-generation test often considered is the Im, Pesaran and Shin (IPS, 2003) test. ADF tests akin to equation (3.5) are run separately for each country in the sample, and the panel ADF test statistic obtained is an average of the t-statistics from the N country ADF regressions. As the distribution of the average t-statistic is non-standard; the critical values have to be simulated. The main drawback of the IPS test is it does not allow for the impact of unobserved common factors. Pesaran (2007) proposes a test for equation (3.5), referred to as the 'CIPS' test, which includes cross-section averages of the dependent and independent variables to account for cross-section dependence. Hence equation (3.5), augmented with cross-section averages of the observables will be:

$$\Delta y_{it} = \mu_i + \beta_i t + (\rho_i - 1) y_{it-1} + \sum_{j=1}^{p} \delta_{ij} \Delta y_{it-j} + \theta_{1i}^{CA} \overline{\Delta y}_{it} + \theta_{2i}^{CA} \bar{y}_{it-1} + \theta_{3i}^{CA} \overline{\Delta y}_{it-p} + u_{it} \qquad (3.8)$$

where in addition to the terms in equation (3.5), cross-section averages of the dependent and independent variables are included. The 'CIPS' test can deal with a single common factor which affects countries to varying degrees.

3.4.2 The Econometric Model: Common Factor Representation

The equation of primary interest in this analysis is a static structural equation akin to equation (3.2), modelling the effects of aid and taxes on spending. Building on a common factor approach, the equation will be of the form:

$$y_{it} = \alpha_i + \beta_{i1} aid_{it} + \beta_{i2} tax_{it} + \varepsilon_{it} \qquad \varepsilon_{it} = \gamma_i' \Gamma_t + \mu_{it} \qquad (3.9)$$

where y is total government spending, aid_{it} is net ODA and tax_{it} is tax revenue – all in logarithms. The vector of slope coefficients β_i differs across countries, but is constant over time. Equation (3.9) also includes country-specific intercepts (α_i) and a vector of unobserved common factors Γ_t with country-specific factor loadings (γ_i) to account for the levels and evolution of unobservables, respectively. These common factors can be a combination of *weak* and *strong* factors (see section 3.2.3). Furthermore, the common factors not only influence government expenditures, but also aid and taxes,

leading to endogeneity. To elucidate this point, assume any independent variable from equation (3.9), x, evolves in the form:

$$X_{it} = \pi_i + \tau_i X_{it-1} + \Phi_{1i}\Gamma_{1t} + \cdots + \Phi_{ni}\Gamma_{nt} + \delta_i \Psi_t + \upsilon_{it} \tag{3.10}$$

$$\Gamma_t = \eta\Gamma_{t-1} + \epsilon_{\Gamma t} \qquad \Psi_t = \theta\Psi_{t-1} + \epsilon_{\Psi t} \tag{3.11}$$

for $i = 1, \ldots, N$, and $t = 1, \ldots, T$. As seen in equation (3.10) the independent variables (aid and tax revenue) are driven by a set of common factors (Γ_{nt} and Ψ_t)[52], some of which influence expenditures in equation (3.9). Hence if $\gamma_i \neq 0$ and $\Phi_i \neq 0$ the error term and the regressors from equation (3.9) are correlated, creating serious problems for estimation (Kapetanios *et al.,* 2011).[53] In addition, equation (3.11) indicates that the factors can be nonstationary ($\eta = 1,\ \theta = 1$), again with important implications for estimation and inference. Based on equations (3.9), (3.10), and (3.11); and guided by the conceptual discussions in section 3.2 we are interested in using a model that allows government expenditures to fluctuate to short-run changes in aid and taxes, and simultaneously correspond to the long-run levels of aid and taxes. We thus employ an unconditional error correction model (ECM) of the form:

$$\Delta y_{it} = \alpha_i + \rho_i[y_{it-1} - \beta_{i1} aid_{it-1} - \beta_{i2} tax_{it-1} - \gamma_i'\Gamma_{t-1}]$$

$$+\psi_{i1}\Delta aid_{it} + \psi_{i2}\Delta tax_{it} + \psi_{i3}\Delta\Gamma_t + \varepsilon_{it} \tag{3.12}$$

Where the β_i's represent the long-run equilibrium relationship between spending, aid and taxes in the model (a potential cointegrating relationship) and ψ_i's represent the short-run relations. We include the unobservable common factors Γ in the long-run equation as we posit that they are nonstationary, hence forming part of the cointegrating relationship.[54] ρ_i represents the speed with which the economy is returned to its long-run equilibrium, following a deviation from its long-run path (Hendry, 1995). The ECM specification above has at least three advantages over static or more restrictive dynamic models that assume parameter homogeneity (for example, Remmer, 2004). First, we can distinguish long-run

[52] The $'n'$ in Γ_{nt} refers to the number of common factors included in the model.

[53] The presence of unobserved factors, as well as the underlying equilibrium relationship differing across countries, makes the standard instrumental variables approach invalid in this setup (Eberhardt and Presbitero, 2015).

[54] The unobservable common factors are not restricted to be stationary. For example, a global shock like the recent financial crisis will have more long-lasting effects on recipients' abilities to raise taxes, hence influencing their spending decisions. The shock will also influence the amount of aid bilateral donors can disburse because of the ensuing fiscal austerity in their respective countries, impinging on their decisions to disburse to multilateral organisations. This 'uncertainty' regarding how much tax and foreign aid can be raised to meet spending requirements after the financial crisis is what potentially makes the unobservable common factors non-stationary.

from short-run dynamics, the theoretical premise from which ECMs are derived. Second, the error correction term ρ_i and the long-run coefficients ($\beta_{i,s}$) are useful in determining the exogeneity status of the variables (Lloyd *et al.,* 2009). Third, we can investigate and test for cointegration in the ECM based on the statistical significance of the error correction term in the ECM (Eberhardt and Presbitero, 2015). A negative and significant error correction coefficient represents cointegration, indicating that the economy returns to its long-run equilibrium following a deviation from equilibrium.

In the context of aid and spending Remmer (2004), Martins (2011) and Marć (2017) are closest to our approach. Thus a few comments on our specification and how it relates to theirs are noteworthy. First, the main hypothesis of interest in this chapter differs from that of the three studies mentioned above. Guided by the literature on growth in government size, Remmer (2004) models the determinants of government size (measured by changes in the expenditure/GDP ratio), including aid as the variable of principal interest. She also includes other economic, institutional and demographic[55] that may affect government size. Martins (2011) investigates the extent to which 53 African economies coordinated fiscal (related to increased government spending, particularly on investment) and macroeconomic (relating to aid 'absorption'; aid used mostly to finance imports and less to build up international reserves) responses to aid surges. Marć (2017) estimates the degree of fungibility, hence additionality of aid, both on-budget (aid given directly to the government) and off-budget (aid given to recipients through donor-funded project and technical assistance, the latter used as a general proxy for off-budget aid).

In this chapter, we investigate if aid forms part of the long-run budgetary equilibrium (i.e. the presence of a cointegrating relationship between aid, taxes and spending) and test which of the sources of finance, aid or taxes, have a stronger association with expenditures. We rely on a political calculus between aid and tax, based on the relative importance of aid and taxes which can be attributed to how recipients perceive their respective political costs, and how these political costs offset each other. These costs are evaluated according to autonomy, accountability and bureaucratic costs (Morrissey, 2015b). Thus, we employ a parsimonious specification by including only aid and tax revenue, arguing that the control variables included in the Remmer (2004) and Marć (2017) analyses are themselves potential determinants of tax effort. Hence in our analysis tax revenue will act as a proxy for all the control

[55] The variables include trade openness, central government total revenue, government debts, *per capita* GDP, population and the dependency ratio.

variables included in the Remmer (2004) and Marć (2017) analyses, as well as, other unobservable time-varying factors that affect both expenditure and aid allocation decisions. This makes finding cointegration in our analysis very important; as evidence of cointegration between aid, spending and taxes would imply that no nonstationary variables have been omitted from estimation (Herzer and Morrissey, 2013; Herzer, 2017).

Lütkepohl (2007) also states that the cointegration property is invariant to model extensions. This means if other sources of finance (domestic/foreign borrowing) are included in the model it may result in further cointegration relations but the initial long-run relationship between aid, taxes and spending will still hold. This raises the possibility that there may be more than one cointegrating relationship, as there are other sources of finance that influence recipients' spending. Nevertheless Lloyd *et al.,* (2009) state that there is no economic justification for more than one long-run equilibrium relationship between aid and domestic fiscal variables. Hence in this chapter we treat the sole long-run relationship as a statistical analogue to the domestic budgetary equilibrium. Moreover, including other nonstationary variables into the system may result in spurious relations (Herzer, 2017). Specifically, including a nonstationary variable that is not cointegrated with the other variables will lead to nonstationarity in the error term, hence a breakdown of the cointegrating relationship because the coefficient on the recently included variable will not converge to zero as expected of irrelevant variables in a standard regression (Herzer, 2017). These considerations, then, justify a parsimonious model such as equation (3.9).

Second, the dynamic ECM Remmer (2004) estimates is more restrictive as the model imposes parameter homogeneity without explicit testing for such homogeneity. Tests for unit roots are conducted, and there is evidence of homogenous cointegration (judged by a negative and significant lagged dependent variable). However, potential levels relationships between the nonstationary variables are ignored. Moreover, no attempts are made to accommodate cross-section dependence into the analysis. Cross-section dependence is a recurrent feature in macro data and should always be accounted for in analysis. Thus, in this chapter, we test for the presence of a long-run (equilibrium) relationship between aid, taxes and spending (implying no potentially important nonstationary variables would have been omitted); allowing for this equilibrium to differ across countries (heterogeneous cointegration) and incorporating cross-section dependence.

The Common Correlated Effects Mean Group (CCEMG) estimator of Pesaran (2006) will be used to estimate the relationship between aid, taxes and spending. The CCEMG estimator augments each

country's OLS regression with cross-sectional averages of the dependent variable and the independent variables, $\bar{y}_t$ and $\bar{x}_t$. These newly included regressors account for the prevalence of unobserved common factors (Pesaran, 2006; Coakley *et al.,* 2006; Eberhardt, 2012). Cross-section averages for all observable variables in the model are computed and then added as explanatory variables of the N regression equations. These estimated coefficients are then averaged across panel members as follows:

$$\hat{\beta}^{CCEMG} = \frac{\sum_{i=1}^{N} \hat{\beta}_i}{N} \tag{3.13}$$

where $\hat{\beta}^{CCEMG}$ is the country-specific estimate from the CCEMG estimator. Coakley *et al.,* (2006) and Kapetanios *et al.,* (2011) show that the estimator is consistent in the presence of multiple common factors (Γ_t and Ψ_t in equations (3.9) and (3.10)), factor loading dependence ($\gamma_i = \Phi_i$), cointegration or noncointegration of the model variables, and in the presence of regressor-specific common factors (for instance, Ψ_t in equation (3.10)). Additionally, the estimator is robust to nonstationary common factors ($\eta = 1,\ \theta = 1$), structural breaks and outliers. However, Chudik and Pesaran (2015) find that the CCEMG estimator is subject to small sample bias; especially in samples with moderate time series dimensions. Furthermore, they relax the strict exogeneity assumption, allowing for feedback between variables in the system which poses a challenge for the original Pesaran (2006) estimator. To solve these two problems Chudik and Pesaran (2015) suggest including lags of cross-section averages, in addition to the cross-section averages of all variables already included in the standard CCEMG estimation equation. Hence, augmenting equation (3.12) with cross-section averages (and lags of the cross-section averages) of the dependent and independent variables we get:

$$\begin{aligned}\Delta y_{it} = {} & \pi_{0i} + \pi_i^{EC} y_{it-1} + \pi_i^{aid} aid_{it-1} + \pi_i^{tax} tax_{it-1} + \Psi_i^{aid} \Delta(aid)_{it} + \Psi_i^{tax} \Delta(tax)_{it} + \pi_{1i}^{CA} \overline{\Delta y}_t \\ & + \pi_{2i}^{CA} \bar{y}_{t-1} + \pi_{3i}^{CA} \overline{\text{aid}}_{t-1} + \pi_{4i}^{CA} \overline{\text{tax}}_{t-1} + \pi_{5i}^{CA} \overline{\Delta aid}_t + \pi_{6i}^{CA} \overline{\Delta tax}_t + \sum_{l=1}^{p} \pi_{7i}^{CA} \overline{\Delta y}_{t-p} \\ & + \sum_{l=1}^{p} \pi_{8i}^{CA} \overline{\Delta aid}_{t-p} + \sum_{l=1}^{p} \pi_{9i}^{CA} \overline{\Delta tax}_{t-p} \\ & + \varepsilon_{it}\end{aligned} \tag{3.14}$$

where the coefficients π_s and Ψ_s represent the long-run and short run coefficients respectively, and the coefficients $\pi^{CA}{}_s$ represent the coefficients on the cross-section averages of the dependent and

independent variables (all coefficients yielding the standard CCEMG estimator). The coefficients $\sum_{l=1}^{p} \pi^{CA}{}_{s}$ represent the coefficients on the additional lags of cross-section averages which Chudik and Pesaran (2015) suggest being added to the standard CCEMG estimator (yielding the dynamic CCEMG estimator). As a rule of thumb, the lags of the cross-section averages to be added to the standard model are chosen by $p = T^{\frac{1}{3}}$ (Chudik and Pesaran, 2015). Chudik and Pesaran (2015) show that once the CCEMG estimator has been augmented with the sufficient number of lags, the estimator is unbiased in the presence of dynamics (the lagged dependent variable), and in the presence of weakly exogenous regressors.

We estimate equation (3.14) by relaxing the common factor restriction between ρ_i and β_i implicit in equation (3.12) and reparametrizing the model following Eberhardt and Presbitero (2015). From the levels terms (π_i^{aid} and π_i^{tax}) we obtain the long-run coefficients on aid and taxes in the form:

$$\beta_i^{aid} = -\frac{\pi_i^{aid}}{\pi_i^{EC}} \qquad \beta_i^{tax} = -\frac{\pi_i^{tax}}{\pi_i^{EC}} \tag{3.14*}$$

whereas the regression coefficients on the terms in first differences capture the short-run (transitory) effects, and can be read off directly from estimation. Inference on π_i^{EC}, the speed of convergence to equilibrium, provides insights into the presence of a long-run (cointegrating) relationship between aid, taxes and spending. If $\pi_i^{EC} = 0$ then there is no cointegraion, and the model reduces to one with variables in first differences. If $\pi_i^{EC} \neq 0$ then there is 'error correction' in the model. That is, following a shock the economy returns to its long-run equilibrium path, and therefore there exists a cointegrating relationship between aid, taxes and spending.

3.5 EMPIRICAL RESULTS

3.5.1 Cross-Section Dependence and Unit Roots

Results for cross-section dependence (Table 3.1) provide evidence of the pervasiveness of cross-section correlation in the sample, based on the cross-country correlation coefficients and the Pesaran (2015) *CD* test. These results hold for the individual variables, both in levels and first differences. The correlation coefficients and CD statistic are considerably lower for variables in first differences, but cross-section dependence is still pervasive.

Cross-section dependence (CSD) leads to standard panel unit root suffering from significant size distortions, resulting in them over-rejecting the null of nonstationarity (Pesaran, 2007; Eberhardt and Presbitero, 2015). Thus, panel unit root tests that accommodate such dependence are more appropriate. To that end, we use the 'CIPS' test by Pesaran (2007). Table 3.2 provides the results from conducting the 'CIPS' test. We report the Ztbar statistic (and its corresponding p-value) for H_0 = nonstationarity in all countries' variable series versus H_1 = stationarity in some countries' variable series. The panel statistic is obtained by normalising the individual country t-statistics using simulated values of the mean and variance (Söderbom *et al.,* 2014). Normalization makes the Ztbar statistic distributed $N(0,1)$.

Table 3. 1: Cross-Section Dependence

Panel A	Variables in Levels			
	Exp_{it}	Aid_{it}	TC_{it}	Tax_{it}
avg $\hat{\rho}_{ij}$	0.507	0.132	0.314	0.572
avg $\lvert\hat{\rho}_{ij}\rvert$	0.566	0.288	0.438	0.628
CD	154.80	41.61	97.95	174.72
p-value	0.00	0.00	0.00	0.00
Panel B	Variables in First Differences			
	ΔExp_{it}	ΔAid_{it}	ΔTC_{it}	ΔTax_{it}
avg $\hat{\rho}_{ij}$	0.111	0.039	0.222	0.107
avg $\lvert\hat{\rho}_{ij}\rvert$	0.203	0.184	0.278	0.205
CD	33.31	12.09	67.10	32.22
p-value	0.00	0.00	0.00	0.00

Notes: We use the stata routine 'xtcd' developed by Markus Eberhardt. We report the average correlation (avg $\hat{\rho}_{ij}$) and average absolute correlation (avg $|\hat{\rho}_{ij}|$) coefficients of the $N(N-1)$ sets of correlations. CD is the Pesaran (2015) test for cross-section dependence distributed $N(0,1)$ under the null of cross-section independence. Panels A and B test for cross-section dependence in the variable series for levels and first differences respectively. Government expenditure (Exp), net ODA (Aid), technical cooperation (TC) and tax revenue (Rev) all in logs.

For all variables in levels, nonstationarity cannot be rejected once the ADF equation is augmented with a sufficient number of lags and/or a trend. Nonstationarity is rejected for all variables in first differences. Given all the caveats and problems of individual country and panel unit roots tests, we suggest *most conservatively* that nonstationarity cannot be ruled out in this dataset. Nonstationarity of

these fiscal variables implies they potentially form a cointegrating relationship. We now formally test for the presence of this budgetary equilibrium (cointegrating relationship).[56]

Table 3. 2: Pesaran (2007) Unit Root Test

Levels: CIPS with intercept only								
Variable	Aid		TC		Rev		Exp	
Lags	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*p*
0	-8.72	0.00	-4.47	0.00	-2.80	0.00	-2.33	0.01
1	-3.84	0.00	-1.01	0.16	-2.37	0.01	-3.72	0.00
2	-1.90	0.03	0.62	0.73	-0.58	0.28	-1.05	0.15
3	-1.30	0.10	-0.18	0.43	-1.12	0.12	-1.11	0.13
4	2.58	1.00	0.12	0.55	-0.55	0.29	0.37	0.65
Levels: CIPS with intercept & trend								
Variable	Aid		TC		Rev		Exp	
Lags	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*p*
0	-8.01	0.00	-3.32	0.00	-0.97	0.17	-2.36	0.01
1	-2.86	0.00	0.60	0.73	-0.81	0.21	-4.44	0.00
2	0.11	0.54	3.79	1.00	2.43	0.99	-1.36	0.09
3	-0.03	0.49	3.00	0.99	1.32	0.91	0.06	0.52
4	6.22	1.00	3.57	1.00	2.01	0.98	1.24	0.89
Differences: CIPS test with drift								
Variable	Aid		TC		Rev		Exp	
Lags	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*p*
0	-33.26	0.00	-35.35	0.00	-29.28	0.00	-30.63	0.00
1	-21.70	0.00	-22.13	0.00	-19.55	0.00	-20.72	0.00
2	-12.56	0.00	-11.35	0.00	-8.40	0.00	-12.31	0.00
3	-8.80	0.00	-9.57	0.00	-5.64	0.00	-8.04	0.00
4	-0.27	0.39	-3.90	0.00	-4.45	0.00	-5.34	0.00

Notes: Net ODA (Aid), technical cooperation (TC), tax revenue (Rev) and government expenditure (Exp) all in logs. 'Lags' denote the number of lags of the differenced dependent variable included to wipe out serial correlation.

3.5.2 Heterogeneous Baseline Estimates

Having confirmed the prevalence of cross-section dependence, and established that all the variables are nonstationary in levels we proceed to estimate the heterogeneous dynamic ECM using a dynamic CCEMG estimator; results from which are reported in Table 3.3. We report results for the standard

[56] Panel unit root tests results, as well as tests for cross-section dependence for variables used in exploratory analysis can be found in Appendix tables B5 and B6.

CCEMG (columns 1 and 2), as well as variants augmented with one and two lags of cross-section averages respectively (columns 3 to 6). Long-run averages and short-run coefficients of the variables are reported. The coefficient on the lagged dependent variable is reported as well.

Table 3. 3: CCEMG estimates

	CCEMG		**One-lag CCEMG**		**Two-Lag CCEMG**	
Long-Run						
Tax	0.760***	0.719***	0.726***	0.735***	0.825***	0.734***
	[0.079]	[0.076]	[0.085]	[0.085]	[0.092]	[0.089]
Aid1	0.041**		0.025*		0.032**	
	[0.016]		[0.013]		[0.015]	
Aid2		0.055**		0.092***		0.066**
		[0.027]		[0.025]		[0.027]
Short-Run						
Tax	0.513***	0.573***	0.582***	0.582***	0.586***	0.591***
	[0.044]	[0.045]	[0.048]	[0.050]	[0.055]	[0.056]
Aid1	0.023**		0.017**		0.017**	
	[0.006]		[0.007]		[0.008]	
Aid2		0.014		0.007		0.029**
		[0.011]		[0.007]		[0.012]
EC Coefficient						
y_{it-1}	-0.674***	-0.728***	-0.744***	-0.777***	-0.788***	-0.822***
	[0.035]	[0.033]	[0.038]	[0.039]	[0.040]	[0.046]
t-statistic	-19.01	-22.02	-19.73	-19.76	-19.45	-17.78
Diagnostics						
RMSE	0.106	0.104	0.094	0.092	0.079	0.078
Stationarity ℸ	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)
CD test	-0.46	-0.57	-0.65	-0.60	-0.07	-0.25
(p-value)	0.649	0.565	0.515	0.546	0.943	0.804
Observations	2086	2033	2038	2007	1989	1921

Notes: Results are based on an ECM for all 69 countries in the sample with the first difference of log spending as dependent variable. The long-run averages (the β's from equation (3.14*)) are computed from the robust mean estimates of the CCEMG models, with standard errors (reported below the averages) computed through the Delta method. The short-run coefficients (the Ψ′s from equation (3.14)) are read off directly from estimation. All models are augmented with country-specific linear trend terms. The t-statistic on the lagged dependent variable is a non-parametric statistic derived from the country-specific coefficients following Pesaran and Smith (1995). RMSE is the root mean square error, ℸ Pesaran (2007) test results for ADF tests on the residuals: I(0) – stationary, I(1) – nonstationary. CD test is the Pesaran (2015) test distributed $N(0,1)$ under the null of cross-section independence (p-value in parantheses below). *, ** and *** indicate significance at 10%, 5% and 1% respectively.

The long-run average coefficient is obtained by averaging ECM coefficients, then computing the long-run coefficient, with standard errors computed through the Delta method. We employ the robust regression (see Hamilton, 1992) – which weighs down outliers in computing the averages – in all estimations. The first column of each model reports the results with net ODA (excluding technical cooperation) as the primary regressor of interest (*Aid1*) while the second columns report the results with net ODA including technical cooperation (*Aid2*). Relevant diagnostics (RMSE, CD test statistic) are reported at the bottom of the table. Nonstationarity of residuals is tested in all models and the null of a unit root in residuals is rejected in all cases (i.e. at varying levels of significance and the inclusion of further lags of the dependent variable and/or a linear trend). Given the small sample bias the standard CCEMG faces, in addition to the *favourable* results and diagnostics from the variant with two additional lags of the cross-section averages, we only discuss results based on the CCEMG augmented with two lags of cross-section averages.

As the variables in the analysis are all I(1) we can test for cointegration by investigating the statistical significance of the lagged dependent variable as shown in Table 3.3. The coefficient on the lagged dependent variable is negative, statistically significant and different from zero, indicating that the system reverts to its equilibrium path following a shock. Additionally, the t-statistic[57] is *sufficiently* greater than 10 in the model, providing evidence of a long-run cointegrating relationship between aid, taxes and spending. The results indicate that on average there is a long-run budgetary equilibrium between fiscal variables and aid is an important determinant of the equilibrium. Hence, increases in government spending are sustained by movements in taxes and foreign aid.

Panel cointegration tests have been proposed in the econometric literature, each with their strengths and flaws (see, *inter alia*, Eberhardt, 2011 for a detailed review). Analogous to panel unit root tests, the 'first-generation' of panel cointegration tests assumes cross-section independence while 'second-generation' tests incorporate cross-section dependence. Again, like panel unit roots tests, these cointegration tests are for the null hypothesis of cointegration in *all* country series against the hypothesis of non-cointegration in *at least* some country series (Söderbom *et al.,* 2014). If the null is rejected there are complex issues on how to entertain a mixture of countries with cointegrated data and others with no cointegration. Although the CCEMG estimator is consistent in the presence of

[57] The t-ratios on the error correction terms are not t-distributed and their critical values are likely to be significantly higher than in standard analysis. Though the t-statistic on the lagged dependent variable does not follow a t-distribution, a high value of, say 10, is 'solid' evidence of cointegration.

noncointegration, we emphasize the difficulties in carrying out 'solid' inference on the existence of cointegration. Hence our results should be merely indicative.

The long-run average coefficients on aid and taxes are positive and statistically significant, consistent with the fiscal effects literature (Bwire *et al.,* 2017; Mascagni and Timmis, 2017). A positive relationship between aid and spending is to be expected, as aid still represents an important source of revenue for most developing countries. In the long-run, a one-percentage point increase in aid is associated with a 0.032% increase in spending. This average effect is fairly small, given the perceived importance of aid to developing countries[58], but provides insight into the *general tendency* in the panel that on average, there is a positive association between aid and expenditures.

As regards taxes, higher tax revenue is also associated with higher spending in the long-run. A one percentage point increase in taxes is associated with a 0.825% increase in government expenditures in the long-run. The coefficient on taxes is large (and larger than that of aid) indicating that on average, long-run spending plans are driven mainly by tax revenue (or domestic revenue in general). While developing countries still maintain high shares of aid their spending patterns are dictated mainly by their domestic sources of revenue. This is plausible as spending driven by domestic revenue reduces the risk of fiscal vulnerability resulting from aid unpredictability.

Turning to the short-run coefficients; again, aid and taxes are positively associated with spending. The short-run coefficient on aid is smaller than the long-run average, but still positive and significant. In the short-run, a one percentage-point increase in aid is associated with a 0.02% increase in spending. Not only is aid a component of the long-run budgetary equilibrium, on average, it also relaxes the budget constraint in recipient countries. This short run impact may also reflect the volatility of aid flows to some countries, with such volatility making aid it impossible for aid to be used for planning in those countries. Hence it merely relaxes the budget constraint. Regarding taxes, a one percentage-point increase in taxes is associated with a 0.59% increase in expenditures in the short-run.

Overall the results suggest that aid is important for long-run budgetary planning, but is also used as a substitute for private sources of finance in the short-run. Spending in recipient countries is driven

[58] Using sample data to illustrate, on average aid accounted for about 16 per cent of government spending for all 69 countries. On average, aid was approximately 80 per cent of spending in Guinea-Bissau, over 50 per cent of spending in Burundi, Mozambique, and Rwanda and over 40 per cent in Malawi, Chad and Uganda. These statistics illustrate the importance of aid in developing countries.

mainly by tax revenue though recipients form some expectation of the amount of aid to be received in the long-run, and incorporate these expectations into their budgetary planning processes. The choice between tax and aid as the primary source of financing expenditures also relates to the political costs associated with tax and aid; evaluated according to autonomy, accountability and bureaucracy.

Recipients that are overly dependent on aid will have to account to donors on how their aid is spent, and also negotiate on conditionality, reducing their policy discretion; since increased aid dependence means they will have to cede some of their policy influence to donors (Morrissey and Torrance, 2015; Morrissey, 2015b). In that regard, any government that can make independent policy choices is an autonomous one. The desire for greater autonomy encourages governments to expend effort on improving tax collection, reducing their dependence on aid. Morrissey and Torrance (2015) posit that increasing taxes makes the public-sector decision makers more accountable to their constituencies, but the benefits of autonomy offset such costs of accountability to the domestic constituencies. They also state that domestic revenue mobilization with accountability to constituencies can enhance legitimacy and state building. Therefore, to the extent that recipients dislike ceding policy influence to donors, increasing taxes is more preferable than aid dependence as these recipients cede less influence to donors.

The costs of accountability refer to whom and the extent to which a government has to account for its uses of revenue, and these costs are likely to be greater for aid than taxes (Morrissey, 2015b). The donor agencies themselves have to account to their own governments and parliaments, so they implement measures to monitor the use of aid and minimise fungibility. Donors often provide aid with policy reform conditions (usually relating to public finance management), and exert considerable effort in monitoring the use of their aid. This means recipients have to expend effort in negotiating conditions with donors, and trying to circumvent those conditions is usually costly. In contrast, accountability to taxpayers is much weaker in least developed countries that are major recipients of aid, which reflects the broader institutional setup in those countries. Hence the costs of accountability are higher for aid, especially in these countries with weak institutions and comparatively lower revenues.

In addition to costs of autonomy and accountability, there are also bureaucratic costs of tax and aid. The former relates to the costs of tax administration while the latter refers to the costs of organising, and attending meetings with different donor agencies (Morrissey and Torrance, 2015). Morrissey (2015b) states that in the last decade most developing countries have implemented fiscal reforms and

improved tax administration, reducing the bureaucratic cost of taxation. In contrast, the bureaucratic costs of aid are more of a function of the number of donors, than the amount of aid. Donor proliferation, disbursement heterogeneity (i.e. aid disbursed in different ways for different purposes) and the changing requirements on monitoring aid result in high bureaucratic costs of aid. Even if donors coordinate and form donor groups, the bureaucratic costs of aid will still be high as recipients will have to attend meetings with the multiple donor groups. This means the bureaucratic costs of taxation are declining while those of aid are still high.

In general, the political calculus between taxes and aid is heterogeneous across countries. Our results suggest costs of taxation are likely to be lower than those of aid, which is one of the main reasons why taxes are the main driver of expenditures in recipient countries.

3.5.3 Exploratory Analysis

We undertake a series of robustness tests to explore further the relationship between aid, taxes and government expenditures.

3.5.3.1 Region

The sample is split into four regions: Sub-Saharan Africa (SSA), Asia and the Pacific (Asia), Latin America and the Caribbean's (LAC) and the Middle East and North Africa (MENA).[59] We re-estimate equation (3.14) for each region, results from which are presented in Table 3.4. Aid has a positive long-run, in addition to a short-run impact in two of the four regions (SSA and MENA), and the long-run average is considerably larger for the SSA subsample. This is mainly because countries in SSA depend a lot on aid to finance their expenditures as aid still represents a huge share of GDP (and government spending) in those countries. Of the 33 SSA countries in the sample, 24 are least developed countries and are major recipients of aid. Due to the weak nature of tax institutions they may be taxing as much as they can but is still not sufficient to finance the level of expenditure required for development, hence their reliance on aid. The positive effect for MENA countries is driven by the positive long-run and short-run impact of aid on spending in Iran. Over the years Iran has been subject to economic embargos so it is possible that more aid is provided to them to boost their economy. Taxes have a positive long-run and short-run impact on spending in all four regions. The long-run average of taxes is

[59] Details on the countries comprising each region can be found in Appendix table B1.

lowest for the SSA sample, further emphasizing the importance of aid to those countries and their inability to raise sufficient taxes to fund desired levels of expenditure

Table 3. 4: Heterogeneity across regions

	SSA	MENA	Asia	LAC
Long-Run				
Tax	0.669***	0.945***	1.046***	0.896***
	[0.113]	[0.237]	[0.278]	[0.243]
Aid	0.108***	0.015***	-0.001	0.007
	[0.040]	[0.004]	[0.034]	[0.006]
Short-Run				
Tax	0.526***	0.491***	0.636***	0.695***
	[0.069]	[0.176]	[0.182]	[0.116]
Aid	0.074***	0.017***	0.022	0.003
	[0.022]	[0.007]	[0.025]	[0.003]
EC Coefficient				
y_{it-1}	-0.817***	-0.712***	-0.752***	-0.779***
	[0.052]	[0.120]	[0.149]	[0.082]
t-statistic	-15.76	-6.00	-5.06	-9.48
Diagnostics				
RMSE	0.099	0.039	0.041	0.063
Stationarity ד	I(0)	I(0)	I(0)	I(0)
CD test	-1.01	-0.32	0.47	2.39
(p-value)	(0.314)	(0.748)	(0.638)	(0.017)
Observations	974	170	307	538
Countries	33	6	11	19

Notes: The sample is disaggregated into four sub-regions. SSA represents Sub-Saharan Africa, MENA - Middle East and North Africa, Asia - Asia and the Pacific, and LAC - Latin America and the Caribbean's. Error correction models are estimated for each sub-region; with the first difference of log expenditure as dependent variable. For all other details see Table 3.3.

3.5.3.2 Level of Development

Here the sample is split into two income groups-least developed countries (LDCs) and low-income countries (LICs)-based on the World Bank's classification. We thus re-estimate equation (3.14) for each income group, results from which are presented in Table 3.5. After re-estimating equation (3.14) for each income group, there is still considerable cross-section dependence in the residuals. It is possible that interdependencies between countries create common factors that have not been captured. Chudik and Pesaran (2015) suggest that in addition to cross-section averages and lags of cross-section averages

in equation (3.14), cross-section averages of one or more covariates (other than aid and taxes) be included. These cross-section averages may help identify the multiple unobserved common factors not fully captured by the original set of cross-section averages (Eberhardt and Presbitero, 2015). Hence in this disaggregated model we include;

$$\sum_{l=0}^{p} \pi_{10i}^{CA} \overline{\Delta Z}_{t-p}$$

for each covariate Z and equally for further covariates. The lags of cross-section averages of these further covariates are also determined based on the rule of thumb $p = T^{\frac{1}{3}}$ (Chudik and Pesaran, 2015). The country-series for these additional covariates *do not* enter the model as regressors; just their cross-section averages and lags of cross-section averages enter the model. The objective here is to help identify the unobserved common factors Γ_t so including variables that may be directly linked to expenditures is reasonable. Therefore, we include exports (in logs) as an additional covariate as it potentially influences recipients' expenditures through its impact on taxes; and the largest exporters in developing countries are government-owned. Furthermore, Remmer (2004) argues that international exposure generates pressures for recipient governments to increase spending; making exports a good candidate for inclusion here.

Results indicate that aid has a positive long-run (and short-run) impact in least developed countries, with no discernible impact in other low-income countries. Of the 26 LDCs in the sample, 23 are Sub-Saharan African, the highest recipients of aid. Hence finding a positive impact of aid on spending in LDCs is consistent with a positive relationship between aid and spending in SSA (see Table 3.4). As mentioned earlier, these LDCs are aid dependent and as such their political costs of aid are lower than their political costs of taxation. Furthermore, LDCs lack the necessary human capital development, financial market development and infrastructure to attract significant amounts of FDI; and also obtain foreign debt portfolios. The ability to attract FDI will also depend on their institutional framework (rule of law, level of corruption, government effectiveness, and risk of doing business among others), which is much weaker in LDCs than other low-income countries. Moreover, some of these LDCs have exchange rates pegged to more developed countries so they cannot print more money to finance their expenditures. All these factors contrive to make them aid dependent. Of course, tax revenues are still the most important source of financing expenditures in developing countries. Nevertheless, low and

middle-income countries have the capability to attract more *suitable* complementary funds (FDI, foreign borrowing) than LDCs, reason why the latter depend so much on aid.

Table 3. 5: Heterogeneity in Levels of Development

	LDCs	**LICs**
Long-Run		
Tax	0.675***	0.831***
	[0.064]	[0.150]
Aid	0.199***	0.004
	[0.145]	[0.010]
Short-Run		
Tax	0.603***	0.584***
	[0.079]	[0.074]
Aid	0.092**	-0.0004
	[0.035]	[0.004]
EC Coefficient		
y_{it-1}	-0.872***	-0.769***
	[0.078]	[0.061]
t-statistic	-11.15	-12.52
Diagnostics		
RMSE	0.086	0.048
Stationarity ד	I(0)	I(0)
CD test	0.11	4.04
(p-value)	(0.914)	(0.000)
Observations	764	1225
Countries	26	43

Notes: LDCs refers to least developed countries and LICs to other low-income countries. Error correction models are estimated for each income group; with the first difference of log expenditure as dependent variable. For all other details see Table 3.3.

3.5.3.3 Disaggregated Expenditures

As government spending is a composite of capital (development) spending and recurrent (consumption) spending, it would be insightful to estimate the disaggregated spending impact of net aid so one can get an idea of what aid is funding. Thus, we re-estimate equation (3.14) with capital expenditures and recurrent expenditures as dependent variable, respectively. Results for the disaggregated spending impact are reported in Table 3.6. Investigation of the lagged dependent variable indicates that aid, capital expenditures and taxes form an equilibrium (cointegrating) relationship. This implies that physical capital projects in recipient countries are sustained by aid and taxes. On average,

aid has a positive long-run impact on capital expenditures. A one-percentage point increase in aid is associated with a 0.040% increase in capital expenditures. As a large share of aid is intended to boost recipients' development prospects (i.e. much aid is intended for investment) we would expect aid to have a positive long-run impact on capital spending, the magnitude of which will be influenced by the productivity of investment in the recipient country. The productivity of investment, itself, depends on the institutional setup of the country.

Table 3. 6: Heterogeneity in Expenditures

	Capital Expenditure	**Recurrent Expenditure**
Long-Run		
Tax	0.718***	0.820***
	[0.100]	[0.105]
Aid	0.040**	0.012
	[0.018]	[0.021]
Short-Run		
Tax	0.692***	0.492***
	[0.069]	[0.045]
Aid	0.015	0.009
	[0.010]	[0.006]
EC Coefficient		
y_{it-1}	-0.783***	-0.604***
	[0.038]	[0.041]
t-statistic	-20.36	-14.88
Diagnostics		
RMSE	0.108	0.074
Stationarity ך	I(0)	I(0)
CD *test*	0.54	-0.20
(p-value)	(0.592)	(0.839)
Observations	1954	1962
Countries	69	69

Notes: 'Capital Expenditure' and 'Recurrent Expenditure' refer to error correction models for all 69 countries with the first difference of log capital expenditure and log recurrent expenditure as dependent variables, respectively. The CCEMG with two lags of cross-section averages is used. For all other details see Table 3.3.

Taxes have a larger coefficient than aid which, again, may suggest that public sector decision-makers in recipient countries rely more on their domestic sources of revenue for financing their development projects. A one-percentage point increase in taxes is associated with a 0.718% increase in capital expenditures. The absence of evidence of a short-run impact of aid on capital spending is intuitive. As capital expenditures consist mainly of capital projects that mature in the medium to long-term, the

observable impact of aid is restricted to the long-run only. Short-term capital expenditures are financed mainly via tax revenue (as shown by the magnitude of taxes) and possibly domestic borrowing.

Aid does not have any significant impact on recurrent spending while taxes impact on recurrent spending in both the long-run and short-run. Martins (2010) also finds no long-run relationship between aid and recurrent spending. We do not overstate this finding as the proportion of aid intended for different spending headings is unknown.[60] Increasing social sector spending (on health, education and sanitation) is one of the intentions of donors, and maintenance costs for these social sector investments (hospitals, schools, water plants) are usually classified as recurrent expenditures. Hence this result should not be treated as evidence of no aid fungibility, but as absence of evidence of aid fungibility. The results differ from Osei *et al.,* (2005), who find that aid appeared to be associated with higher recurrent spending but not capital spending in Ghana. This was not due to a financing impact of aid *per se* as policy conditions attached to aid were associated with higher tax revenue (which implied higher recurrent spending) and lower domestic borrowing (which implied lower capital spending).

3.5.3.4 Disaggregated Aid Flows

Here we model the heterogeneous effects of aid loans, aid grants and technical cooperation. From section 3.3, we see that the composition of aid differs across countries (with poorer countries receiving more grants than loans and middle-income countries receiving more technical cooperation than other countries), meaning different types of aid will have different effects on spending. Accordingly, we re-estimate equation (3.14) with, respectively, grants, loans and technical cooperation as the measure of aid. Results are reported in Table 3.7. Regarding grants, there is evidence of an equilibrium (cointegrating) relationship between grants, taxes and spending, with a significant long-run impact of grants on spending. A one-percentage point increase in grants is associated with a 0.046% increase in total government spending. Loans, on the other hand, have no significant long-run or short-run impact on government expenditures. This suggests that grants come with stronger pressures to spend than loans. As seen from Table 3.7, the long-run average of technical cooperation has the appropriate sign, but is statistically insignificant. This negative sign and insignificant long-run effect is plausible both empirically and theoretically.

[60] It is not until the early 1990s that donors started providing data on aid for specific purposes. Historical aid data are void of that level of disaggregation.

Table 3. 7: Heterogeneity in Aid Flows

	Grants	Loans	Technical Assistance
Long-Run			
Tax	0.689***	0.747***	0.714***
	[0.088]	[0.094]	[0.081]
Aid	0.046**	0.015	-0.041
	[0.023]	[0.018]	[0.052]
Short-Run			
Tax	0.588***	0.587***	0.595***
	[0.052]	[0.046]	[0.051]
Aid	0.014	0.011	-0.042
	[0.013]	[0.007]	[0.029]
EC Coefficient			
y_{it-1}	-0.811***	-0.769***	-0.818***
	[0.047]	[0.041]	[0.040]
t-statistic	-17.25	-18.76	-20.39
Diagnostics			
RMSE	0.075	0.077	0.082
Stationarity ך	I(0)	I(0)	I(0)
CD test	-1.19	-0.28	-1.28
(p-value)	(0.234)	(0.780)	(0.202)
Observations	1987	1865	1987
Countries	69	69	69

Notes: Error correction models are estimated for all 69 countries first with aid grants as the aid variable (column 2), then aid loans (column 3). TC (column 4) stands for technical cooperation. The CCEMG with two lags of cross-section averages is used. For all other details see Table 3.3.

Technical cooperation, by definition, does not go through the budgets of recipients so it becomes difficult to detect, empirically, any observable long-run effect it may have on recipients' spending. Hence the insignificant coefficient should not be interpreted as 'evidence of absence' of a long-run impact, but instead as 'absence of evidence' of a long-run impact of technical cooperation on spending. Theoretically, the negative sign is appropriate as technical cooperation is often provided to countries to enhance public sector reform (i.e. to improve public sector management). As such reforms often entail a reduction in recipients' expenditures, the negative relationship between technical cooperation and spending is to be expected. There is still evidence of error correction (hence cointegration) but no observable long-run effect of technical cooperation on spending. In the short-run technical

cooperation, again, has the appropriate sign but is statistically insignificant. Irrespective of the measure of aid considered, tax revenue is still the main driver of government expenditures.

3.5.3.5 Domestic Revenue

Royalties and other revenue from natural resources are important in countries endowed with natural resources. Thus, we re-estimate equation (3.14) with two new measures of revenue; total tax revenue and total government revenue. The former comprises revenue from non-resource and resource taxes (both direct and indirect tax components), while the latter is a composite of tax and non-tax revenues. Results are reported in Table 3.8. Regarding total tax revenue (column 1), the results are broadly similar to those with non-resource taxes as the measure of domestic revenue (see Table 3.3).

Table 3. 8: Heterogeneity in Domestic Revenue

	Total Tax Revenue	**Total Domestic Revenue**
Long-Run		
Tax	0.805***	0.390***
	[0.088]	[0.087]
Aid	0.032**	0.019
	[0.014]	[0.014]
Short-Run		
Tax	0.538***	0.300***
	[0.053]	[0.072]
Aid	0.021***	0.023***
	[0.007]	[0.009]
EC Coefficient		
y_{it-1}	-0.789***	-0.635***
	[0.039]	[0.050]
t-statistic	-20.14	-12.59
Diagnostics		
RMSE	0.078	0.092
Stationarity ך	I(0)	I(0)
CD *test*	-0.22	1.63
(p-value)	(0.826)	(0.104)
Observations	1961	1940
Countries	69	69

Notes: 'For all other details see Table 3.3.

There is evidence of an equilibrium (cointegrating) relationship between aid, total tax revenue and spending. Aid has a positive long-run and short-run impact on spending, with the coefficients on total

taxes higher than those on aid. When total government revenue (column 2) is used the results are fairly similar, except now there is no significant long-run impact of aid on spending. Additionally, the coefficients on all variables are now smaller. There are many competing uses of total domestic revenue (debt servicing, loan repayment, accumulation of reserves), of which government spending is just one. This may explain the smaller average on spending when total domestic revenue is used.

3.5.3.6 Disaggregated Aid Flows and Expenditures

We estimate the heterogeneous effects of aid grants and loans on the different components of government spending. Thus equation (3.14) is re-estimated with capital expenditures and recurrent expenditures as dependent variable, respectively; and with grants and loans as the measures of aid. Results are reported in Table 3.9. There is evidence of a long-run (cointegrating) relationship between grants, taxes and capital expenditures; and also between loans, taxes and capital expenditures. Grants and loans both have positive, long-run significant impacts on capital expenditures, with grants also having a short-run impact. In the long-run, a one percentage point increase in grants is associated with a 0.061% increase in spending. Mascagni and Timmis (2017) also find a positive relationship between grants and capital expenditures in Ethiopia. They state that as grants do not require repayment they may be given with more rigid conditions to spend on capital rather than recurrent expenditures, hence the positive relationship between grants and capital expenditures.

With regard to loans, as they are disbursed with a 'payback' clause, they are expected to be used on more productive expenditures, hence their positive long-run association with capital spending. The argument is that increased public investment crowds in private investment, both of which are necessary for economic development and growth. With increased development comes better tax administration, improved fiscal management, improved tax collection efficiency, and a larger formal tax base. These factors increase the amount of revenue raised domestically, increasing the possibility of recipients servicing and repaying their loans. In the long-run a one percentage point increase in loans is associated with a 0.048% increase in spending. The long-run average is slightly higher for grants than for loans, suggesting that the relation between grants and capital spending is possibly stronger than that between loans and capital spending. This is plausible in situations where loans are largely concessional, making repayment a trivial issue in time with no direct policy implications (Mascagni and Timmis, 2017).

Neither grants nor loans have any impact on recurrent spending; be it in the long-run or short-run. Tax revenue is the main source of funding for recurrent spending.

Table 3. 9: Heterogeneity in Aid Flows and Expenditures

	Capital Expenditure		Recurrent Expenditure	
	Grants	**Loans**	**Grants**	**Loans**
Long-Run				
Tax	0.703***	0.770***	0.676***	0.819***
	[0.109]	[0.116]	[0.093]	[0.116]
Aid	0.061*	0.048**	0.039	-0.011
	[0.033]	[0.024]	[0.025]	[0.023]
Short-Run				
Tax	0.725***	0.673***	0.483***	0.451***
	[0.069]	[0.074]	[0.047]	[0.049]
Aid	0.033*	0.013	0.003	-0.004
	[0.018]	[0.009]	[0.012]	[0.008]
EC Coefficient				
y_{it-1}	-0.815***	-0.756***	-0.645***	-0.585***
	[0.048]	[0.040]	[0.042]	[0.040]
t-statistic	-17.12	-19.07	-15.52	-14.68
Diagnostics				
RMSE	0.104	0.102	0.072	0.070
Stationarity ٦	I(0)	I(0)	I(0)	I(0)
CD test	-0.53	-1.68	0.36	-2.22
(p-value)	(0.596)	(0.093)	(0.721)	(0.027)
Observations	1952	1831	1960	1838
Countries	69	69	69	69

Notes: 'Capital Expenditure' and 'Recurrent Expenditure' refer to error correction models for all 69 countries with the first difference of log capital expenditure and log recurrent expenditure as dependent variables, respectively. Each of the models are estimated, first, with aid grants as the primary regressor of interest (columns 2 and 4); then with aid loans (columns 3 and 5). The CCEMG with two lags of cross-section averages is used. For all other details see Table 3.3.

3.5.4 Weak Exogeneity Testing

As with all empirical studies, there are concerns about endogeneity. So far, we have discussed one type of endogeneity; whereby the unobserved common factors drive both the dependent variable and the independent variables ($\gamma_i \neq 0, \Phi_i \neq 0$). Another source of endogeneity may be reverse causality. In the aid literature, this reverse causality arises because of the non-random allocation of aid (Temple and Van de Sijpe, 2017). We are interested in investigating if donors respond to recipients' fiscal imbalances

when disbursing aid, or if disbursement is independent of the fiscal situation in recipient countries. In a simplified version, we can express equations (3.9) and (3.10) as follows:

$$y_{it} = \beta_i x_{it} + u_{it} \qquad u_{it} = \alpha_i + \gamma_i \Gamma_t + \varepsilon_{it} \tag{3.15}$$

$$x_{it} = \pi_i + \lambda_i g_t + \rho_i \Gamma_t + \phi_i \varepsilon_{it} + \nu_{it} \tag{3.16}$$

for any independent variable x and a single factor Γ driving both y and x in equations (3.15) and (3.16) respectively. Baseline estimates from Table 3.3 can be interpreted as covariate(s) x having an 'impact' on covariate y. However, nothing is known about the direction of causality in the model yet. As $\phi_i \varepsilon_{it}$ is also present in equation (3.16), we are uncertain whether x 'causes' y or y 'causes' x or both.

A standard instrumental variable (IV) approach can address the endogeneity problem, whereby variable x is instrumented for by a set of variables z. Crucially, the instrument(s) must be *valid* (that is they should be uncorrelated with the error term) and *informative* (they should have explanatory power over the endogenous variable(s)). Given the unavailability of adequate instruments (Temple, 1999), it is common in the aid effectiveness literature to use lagged aid as an instrument for contemporaneous aid. Nonetheless, in cases where past disbursement patterns do not adequately predict current patterns, there is a weak instruments problem, with severe implications for consistency of the IV estimator. Hence Temple and Van de Sijpe (2017) fill the gap on "unavailable and/or inadequate instruments" using a supply-push instrument for aid. To the best of our knowledge, they are the first study to use that instrument in a heterogeneous panel regression framework. They then apply the common correlated effects IV (CCEIV) estimator to address the aforementioned two types of endogeneity.

Using aid data from the OECD DAC the supply-push instrument is constructed as follows: For each donor, they calculate the average of the annual shares of any given recipient country in a donor's aid for an initial period (from 1960 to 1970) and multiply that average by the donor's current budget (the sum of the donor's aid over all recipients in period t). They then sum this composite across different donors, yielding a time-varying measure of aid used to instrument for net aid in the regressions. This means for each recipient country; the instrument approximates the aid that the recipient would have received at each date if its shares in the various donors' budgets had remained constant. This instrument is valid $[E(z, \varepsilon) = 0]$ as the total aid budget of most donors is orthogonal to individual,

time-varying characteristics of recipient countries; and informative [$E(x,z) \neq 0$] as there are multiple donors considered in the analysis, with different budget shares.

In this chapter, we are agnostic about the exogeneity and endogeneity status of aid and other fiscal variables. Provided the variables are nonstationary and cointegrated, we can test for weak exogeneity, which entails testing for the direction of causality (Canning and Pedroni, 2008; Eberhardt and Presbitero, 2015). The Granger Representation Theorem (Engle and Granger, 1987) states that at least one variable must adjust to maintain an equilibrium relation, making it intuitive to know variables that adjust to maintain equilibrium and those that are exogenous for the equilibrium.

If there exists a cointegrating relationship between variables, the Granger Representation Theorem (Engle and Granger, 1987) states that these variable series can be represented in the form of a dynamic ECM. For cointegrated variables, we can then test for weak exogeneity in the following models:

$$\Delta y_{it} = \rho_{1i} + \theta_{1i}\hat{e}_{it-1} + \sum_{j=1}^{K} \lambda_{11ij}\Delta \mathrm{y}_{it-j} + \sum_{j=1}^{K} \lambda_{12ij}\Delta x_{it-j} + \epsilon_{1it} \quad (3.17)$$

$$\Delta x_{it} = \rho_{2i} + \theta_{2i}\hat{e}_{it-1} + \sum_{j=1}^{K} \lambda_{21ij}\Delta y_{it-j} + \sum_{j=1}^{K} \lambda_{22ij}\Delta x_{it-j} + \epsilon_{2it} \quad (3.18)$$

where ρ_i are constant terms and $\hat{e}_{it-1}$ is the disequilibrium term $\hat{e} = y - \hat{\beta}_i x - \hat{d}$ constructed using the cointegrating relationship between the variables (d represents deterministic terms like a constant and a country-specific trend). Equations (3.17) and (3.18) also add cross-section averages of the non-Error Correction terms to the weak exogeneity regressions. The disequilibrium term represents how far the variables are from the equilibrium relationship, with the error correction mechanism then indicating the speed of adjustment following a deviation from the long-run equilibrium (Canning and Pedroni, 2008). Each variable may react to its lagged differences, as well as lagged differences of other variables in the cointegrating relationship. The Granger representation theorem implies that at least one of the adjustment coefficients θ_{1i}, θ_{2i} must be non-zero if a cointegrating (long-run) relationship between the variables is to hold (Canning and Pedroni, 2008 p. 512). If $\theta_{1i} \neq 0$ then x has a causal impact on y (which in our case means expenditures adjust to maintain fiscal equilibrium following an imbalance) and if $\theta_{2i} \neq 0$ then y has a causal impact on x (in our case this will mean donors disburse aid in response to budgetary disequilibria in recipient countries, and that taxes adjust to such fiscal disequilibria as well). If both θ_{1i} and θ_{2i} are non-zero then x and y determine each other jointly.

One of the advantages of using the disequilibrium term from a cointegrating relationship is that all the variables in equations (3.17) and (3.18) are stationary. This means once ECMs are estimated for each country, estimates for θ_i can be investigated using standard t-ratios (Canning and Pedroni, 2008; Eberhatrdt and Teal, 2013). Following Canning and Pedroni (2008) we use two separate statistics to test for weak exogeneity. The first is the group-mean statistic (GM hereafter) which averages the θ_i from individual country estimations of equations (3.17) and (3.18) and the GM test for the null of 'no long-run causal impact' is computed from the averaged t-ratio from country regressions ($\bar{t}_{\theta_2} = N^{-1}\sum_{i=1}^{N} t_{\theta_2}$). The GM statistic follows a standard normal distribution under the null hypothesis of 'no causal impact'. The second statistic is a Fisher-type (*Lambda*-Pearson) statistic which is constructed from the p-values of the t-tests from the country regressions to get the overall marginal significance associated with those p-values. The Fisher statistic follows a x^2 distribution with $2N$ degrees of freedom under the null hypothesis of 'no causal impact'.

The null and alternative hypotheses for both tests are the same when the θ_i coefficients are the same for all members of the panel. This translates into a null that $\theta_i = 0$ for all members in the panel against an alternative $\theta_i \neq 0$ for some non-negligible members of the panel (Canning and Pedroni, 2008). The interpretation of the tests, however, differs when θ_i differs across countries. The GM test is a two-tailed test so can take on positive or negative values under the null and alternative hypothesis depending on whether $\hat{\theta}_i$ is positive or negative whereas the Fisher statistic is a one-tailed test that only takes positive values in both the null and alternative hypotheses. If these two tests fail to agree on the direction of causality between variables, this can be interpreted as θ_i being on average zero (allowing for large negative and positive values to cancel each other), but not pervasively zero in the panel (Canning and Pedroni, 2008; Eberhardt and Presbitero, 2015). If that is the case, it provides evidence of the heterogeneity of θ_i across countries. We also report the robust $\hat{\theta}_i$ estimate, and its associated t-statistic. In the last column, we report the share of countries in the sample (N_i/N) that fail to reject the null of 'no causal' impact.

Table 3. 10: Weak Exogeneity Tests

	GM	(p)	Fisher	(p)	Mean $\hat{\theta}_i$	t-stat	N_i/N
Expenditure Equation 1	-1.459	0.14	361.20	0.00	-0.782	-9.95	58%
Expenditure Equation 2	-1.464	0.14	396.61	0.00	-0.755	-8.50	62%
Expenditure Equation 3	-1.132	0.26	282.22	0.00	-0.624	-8.97	64%
Tax Equation 1	0.270	0.79	171.34	0.03	0.156	1.92	83%
Tax Equation 2	0.098	0.92	160.36	0.09	0.078	0.96	83%
Tax Equation 3	0.205	0.84	151.66	0.12	0.200	2.63	73%
Aid Equation	-0.053	0.96	146.23	0.30	-0.193	-0.75	88%
Grants Equation	-0.154	0.88	145.41	0.32	-0.226	-0.99	54%
TC Equation	0.190	0.85	137.80	0.49	0.057	0.69	80%
Loans Equation	0.034	0.97	160.88	0.04	0.069	0.17	65%
Consumption Equation	-1.776	0.08	449.37	0.00	-0.710	-13.11	55%
Capital Equation	-1.703	0.09	428.57	0.00	-0.841	-10.88	54%

Notes: We report both statistics developed by Canning and Pedroni (2008). GM gives the group-mean statistic which is the average of country-specific t-ratios on the disequilibrium term which is distributed $\mathrm{N}(0,1)$. Fisher is $-2\sum_{\mathrm{i}=1}^{\mathrm{N}}\ln\Pi$, where Π is the p-value of the country-specific t-value on the disequilibrium term. The Fisher statistic is distributed$\chi^2(2\mathrm{N})$. We also report the robust $\hat{\theta}_{\mathrm{i}}$ estimate, and its associated t-statistic. In the last column, we report the percentage of countries in the sample that fail to reject the null of 'no causal' impact.

We present results for weak exogeneity tests in Table 3.10; using specifications of equations (3.17) and (3.18) with two lags. The results are based on the dynamic CCEMG model augmented with two lags of cross-section averages (this is the long-run relationship from which the disequilibrium term is constructed). 'Expenditure Equations' (1), (2) and (3) refer to the ECM regression with expenditure as dependent variable and net ODA, grants and loans as aid variable, respectively. 'Tax Equations' are estimated analogously. The 'Aid Equation' is estimated with net aid as dependent variable and taxes and expenditures as independent variables. Grants, Loans and TC equations are estimated analogously. 'Consumption and Capital Equations' are estimated with net aid and taxes as independent variables and recurrent spending and capital spending as dependent variables, respectively. We then report the two statistics developed by Canning and Pedroni (2008); the GM and Fisher statistics, as well as their respective p-values. We also report the robust mean $\hat{\theta}_i$ with its t-statistic: we would expect a typically high t-statistic on the average $\hat{\theta}_i$ coefficients in the expenditure equation (which can be interpreted as evidence of a long-run causal relationship from aid/taxes to spending) and a low t-statistic (below 1.96) in the other equations (Eberhardt and Presbitero, 2015).

For the expenditure equations, the GM test fails to reject the null of 'no causal impact' from aid (grants and loans) and taxes; whereas the Fisher statistic rejects the null of 'no causal impact'. This offers insights into the cross-country heterogeneity of θ_i. Moreover, the t-statistic on the robust $\hat{\theta}_i$ is fairly high for the three expenditure equations, indicating that there is potential long-run causality from aid and taxes to spending. However, approximately 58% of countries in the sample fail to reject the null of 'no causal impact' from x to y when net aid is the main regressor of interest; 62% of countries fail to reject the null in the case of grants; and 64% fail to reject the null in the case of loans. As these test results are not overwhelmingly in favour of (or against) weak exogeneity, we discuss both possibilities. On the one hand, spending policies are often prepared for the medium to long-term, meaning spending (especially statutory expenditures and public payroll) is not easily reversed once implemented (Bwire, 2012). In the fiscal response context, this implies that expenditures do not adjust to maintain the budgetary equilibrium. On the other hand, spending may be endogenous to the long-run-equilibrium in situations when government spending is planned based on the expected revenue packet but spending allocation is affected when the revenue outcome is realized (Bwire, 2012). This latter pattern of results (endogeneity for the long-run equilibrium) is largely replicated when expenditures are disaggregated into capital and consumption expenditures.

In the first two tax equations, the GM test fails to reject the null of 'no causal impact' from expenditures and aid to taxes, while the Fisher statistic rejects the null. Following Canning and Pedroni (2008), this can be interpreted as taxes being weakly exogenous on average; but not *pervasively* weakly exogenous in the sample. When loans are the aid variable of interest, the tax equation shows that both the GM and Fisher statistics fail to reject the null of 'no causal impact'. When net aid is used as measure for aid 83% of the countries in the sample cannot reject the null of 'no causal impact'. When grants and loans are used, respectively, 83% and 73% of the countries in the sample fail to reject the null of 'no causal impact' from expenditures and grants/loans to taxes. Additionally, the t-statistic on the robust mean $\hat{\theta}_i$ coefficients is less than 1.96 (evidence of no causal impact). This provides tentative evidence that tax revenues are weakly exogenous. Tax systems are also statutory, and are not easily changed once implemented. Faced with a deficit, recipients cannot just increase tax rates as such bills usually need to be agreed upon by congress; and that is a time-consuming process. In addition, the behaviour of tax administration and policy makers is persistent, and change only slowly. Aid may also impact tax administration such that tax rates do not increase but the collection efficiency of taxes increases.

Nonetheless, improvements in efficiency also take time, meaning taxes would not immediately adjust to fiscal imbalance.

When the tests are applied to net aid (as well as grants and technical cooperation) both test statistics, in addition to the robust mean θ_i coefficient agree that the three aid variables are indeed weakly exogenous. This provides insights into the disbursement behaviour of donors. Aid plays an important role in determining the budget but its level does not reflect budget imbalance in recipient countries. Nonetheless, as shown in Table 3.3 aid influences other variables in the system (it is *long-run forcing*). While fiscal planners in recipient countries have a planned target for aid revenue (as portrayed by the long-run relationship) they take the aid as given. Donors do not adjust the level of aid to recipients, but possibly adjust how the aid is delivered (i.e. the modality of aid) according to certain recipients' characteristics (such as rule of law and government effectiveness). In the case of loans, the GM test fails to reject the null of no causal impact while the Fisher statistic rejects the null. However, 65% of countries in the sample fail to reject the null of 'no causal impact' implying we can conclude that loans, like grants and net aid, are weakly exogenous. These results depict pervasive cross-country heterogeneity in the form of disequilibrium such that it could be a budget surplus in some countries while it is a deficit in other countries. Nevertheless, fiscal variables do not adjust to maintain equilibrium in the face of such imbalances.

3.6 CONCLUSION

This chapter investigated the relationship between aid, taxes and spending using novel panel time series methods to address the limitations of previous cross-country research: neglecting long-run levels relationships and distinguishing long-run from short-run dynamics, cross-country heterogeneity, cross-section dependence and aid endogeneity. Using annual data for 69 developing countries over the period 1980 to 2013, we provide evidence of an average long-run (cointegrating) relationship between aid, taxes and spending, which differs across countries. This finding is largely consistent with the FRM literature (Osei *et al.,* 2005; Mascagni and Timmis, 2017; Bwire *et al.,* 2017). Estimates show that on average, aid has a positive long-run and short-run impact on spending. This average positive long-run relationship is quite small; indicating that increases in aid are positively associated with marginal increases in spending. In addition, we find that the coefficient on taxes is higher than the coefficient on aid. This implies taxes are the main driver of domestic expenditures, in the long-run as well as the

short-run. We ascertain that aid positively influences spending, but tax revenue is more strongly associated with recipients' expenditures.

Delving further into the relationship between aid, taxes and spending we find that the long-run and short-run impact of aid on spending is indeed very large in LDCs (especially SSA countries). This is to be expected as LDCs, of which SSA form the bulk, are aid dependent. Moreover, the fiscal capacity in these LDCs is relatively low, hence the maximum amount of tax they collect may still not be enough to generate development gains. While improving tax administration and fiscal capacity in LDCs is very important, aid for financing spending is clearly as important for those countries.

Aid heterogeneity is salient. Of the three aid components considered in this chapter (grants, loans and technical assistance) only grants have an association with government spending. This finding is consistent with the notion that since grants come with no obligation of repayment (hence, 'free' money), they are given with more stringent monitoring mechanisms and conditions to spend so they have a positive impact on government spending. Technical assistance, by design, does not go through recipients' budgets but is typically given to countries to improve on public finance management (for countries with huge public sectors, cutting down on government spending is usually one of the pillars of public finance management). To the extent that countries implementing public finance management follow the stipulations in technical assistance reports, a significant effect of technical assistance on spending is to be expected.

Aid is associated with increased 'development spending' but there is no discernible effect on recurrent spending in the long-run; and this finding is replicated when aid is disaggregated into grants and loans. The coefficient of grants on capital spending is larger than that of loans, suggesting that the relationship between grants and capital spending may be stronger than the relationship between loans and capital spending. This emphasizes the premise that grants are given with stronger conditions to spend on more productive development expenditures rather than on recurrent expenditures (Mascagni and Timmis, 2017).

Rather than just asking if there is a positive relationship between aid (and its components), taxes and spending (and its components) we can isolate the presence of an effect of aid and taxes on government spending while simultaneously controlling for the reverse effect of spending on aid and taxes. We find that causality runs mainly from aid and taxes to spending, and aid is weakly exogenous.

In the primary model and at different levels of disaggregation, the average coefficients on tax revenue are consistently larger than those on aid (Bwire *et al.,* 2017; Morrissey *et al.,* 2011 have similar findings). This suggests that taxes are the main driver of expenditures, and aid is a source of complementary finance in both the long-run and short-run. We posit two reasons for this larger average coefficient on taxes. First, government expenditures financed by taxes reduce the risk of fiscal vulnerability associated with aid since aid is highly volatile and unpredictable (Morrissey and Osei, 2004; Bulir and Hamann, 2003). Second, the budgetary choice between tax and aid as alternative sources of revenue may depend on attendant political costs of aid and taxes; and the evidence suggests that the political costs of tax have been reducing over the years, making taxes a more logical choice for financing spending. The salience of these political costs warrants an analysis of the relationship between aid and taxes in the spirit of tax effort models. That is where attention now turns.

4. THE ECONOMICS AND POLITICS OF FOREIGN AID AND DOMESTIC REVENUE MOBILIZATION

Increasing tax revenue, one of the facets of domestic revenue mobilization (DRM hereafter), is essential for developing countries given the increased financial need to meet sustainable development targets. This is particularly salient for aid recipients, as traditional donor assistance is unlikely to increase sufficiently to meet future development finance requirements. Increasing tax revenue is a challenge for most low-income countries because: (a) tax bases are small and narrow; (b) large informal and agricultural (subsistence) sectors; (c) natural resource dependence, and volatility of resource tax revenues; (d) weak tax administrations; (e) the political environment and the influence of interest groups (for example, Besley and Persson, 2014; Mascagni, Moore and McCluskey, 2014; Junquera-Varela, Verhoeven, Shukla, Haven, Awasthi, and Moreno-Dodson, 2017). These challenges allow foreign aid to have direct effects on DRM, not least because aid and taxes are alternative sources of revenue, with the choice between them dependent on domestic political economy factors (Morrissey, 2015b). This has bred a huge strand of literature, rather tenuous, exploring the impact of aid on tax effort (measured as the tax/GDP or the revenue/GDP ratio) in developing countries.

The main aim of this chapter is to contribute to the aid-tax literature by examining, empirically, the long-run equilibrium relationship between foreign aid (and its components) and tax ratios in 84 developing countries over the period 1980 to 2013; employing a different econometric method than in the existing literature. The novelty of our empirical analysis is borne from the use of panel time-series techniques which have a huge bearing on how the relationship between aid and tax has been modelled in the past, and our empirical approach diverges from existing studies in three ways: first, we test for a positive long-run relationship between aid and taxes, and allow for cross-country heterogeneity in the long-run relationship across countries. Second, we employ a flexible dynamic empirical strategy which permits us to distinguish long-run (equilibrium) from short-run behaviour in the aid-tax relationship. This allows us to estimate long-run and short-run parameters in the model, test for the existence of a cointegrating (long-run equilibrium) relationship between aid and taxes; while addressing simultaneity

and endogeneity concerns using recently developed tests for the direction of long-run causality. Third, we account for unobserved recipient heterogeneity in a more flexible way by employing the common factor approach (Kapetanios *et al.,* 2011; Pesaran, 2006). The common factor approach allows for cross-country heterogeneity in the relationship between aid and taxes, as well as cross-section correlations in the data; *created* by global shocks (for example, the oil price shocks of the 1970s or the recent financial crisis) that affect countries to varying degrees, and *represented* by unobserved common factors.

There are at least four ways in which aid may affect taxes (and DRM in general). First, aid can have behavioural effects on taxation: because aid provides revenue it can substitute for efforts to raise tax revenue (governments will decide whether to expend effort in collecting taxes). The choice between tax and aid will depend on the political costs of taxes (increasing taxes is unpopular) and aid (increased dependency and lack of autonomy), and how these costs offset each other (Morrissey, 2015b). Second, technical assistance (transfer of knowledge and capacity building) associated with aid also influences taxes. Third, donor conditions (for example, trade liberalization and revenue conditionality in donor-supported programs) and recipient policies associated with aid (for example, creating autonomous revenue authorities), as distinct from the amount of aid, affect tax revenue. Fourth, the nature of donor-recipient relationships, reflected by the stability and predictability of aid flows would impact on tax revenues. If the level of aid has high year-on-year variability, any impact aid has on tax revenues may be eroded. Conversely, aid volatility may also underpin recipient countries' need for revenue mobilization. Aid is likely to influence tax revenue mobilization through multiple mechanisms, with the effects being country-specific.[61] Lone focus on the amount of aid conflates the ways in which aid can influence taxes, and this chapter disentangles these different ways through which aid shapes revenue (tax) performance.

Extant empirical literature addressing the effect of aid (usually disaggregated into grants and loans) on tax revenue has been dominated by individual country studies estimating fiscal response models (FRMs, modelling the dynamics of aid and other components of the budget) and cross-country regressions (including aid among the determinants of the tax/GDP ratio). Country-specific studies addressing the

[61] At a broad level, aid has macroeconomic effects through its potential influence on growth and tax revenues are affected by macroeconomic performance, via an expanding tax base. Thus, there might be indirect effects of aid on taxes through its effects on macroeconomic performance. This possibility is not explored in this chapter mainly because there is a myriad of factors that potentially influence growth, and it is uncertain whether aid is one of such factors. Even if the effects of aid on growth depends on other conditioning variables, the exact conditioning variables are unknown (Herzer and Morrissey, 2013).

fiscal effects of aid typically find aid to be associated with increased tax revenue (Osei *et al.,* 2005 for Ghana; Mascagni and Timmis, 2017 for Ethiopia; Bwire *et al.,* 2017 for Uganda). For the cross-country studies, some find that aid crowds out tax revenue (Remmer, 2004; Bräutigam and Knack, 2004) – and go as far as positing that grants (with no obligations for repayment) crowd out tax revenue and loans (which have to be repaid) encourage tax effort (see *inter alia*, Gupta, Clemens, Pivovarsky and Tiongson, 2004; Benedek, Crivelli, Gupta and Muthoora, 2012) - while others find a positive (sometimes meagre) impact of aid on tax revenues (Clist and Morrissey, 2011; Clist, 2016; Gupta, 2007 among others). Generally, these panel estimates provide no consensus view on the impact of aid on taxes as results are sensitive to specification, empirical strategy, sample and data. We propose four reasons for dissension in the literature: persistence in fiscal data, measuring aid and tax (as distinct from non-tax revenue), cross-country heterogeneity and endogeneity; and state how we attempt to circumvent these difficulties.

First, the studies apply standard panel approaches (OLS, fixed effects, difference and system GMM) which typically ignore the time-series properties of the data, thus ignoring potential long-run (levels) relationships between aid and tax ratios. Fiscal variables are usually trending (nonstationary) in the long-run, hence in a levels specification a mixture of stationary and nonstationary variables, or a mixture of nonstationary variables of different order may lead to unreliable results (Herzer and Morrissey, 2013). Carter (2013) uses more flexible empirical methods (allowing for variable nonstationarity) and finds a marginal, positive impact of aid on taxes. Our approach, like Carter's (2013), considers the time-series properties and dynamics of the data, permitting us to make credible claims about long-run (equilibrium) and short-run relationships between the aid/GDP and tax/GDP ratios. Specifically, we test for the existence of a long-run equilibrium (cointegrating) relationship between aid and taxes in the panel of 84 developing countries; and provide estimates for the long-run and short-run parameters.

Second, measuring aid and revenue in a way that best describes behavioural effects. Regarding aid, the analyst is interested in getting a measure of aid that has behavioural effects on taxes, that is aid that goes through recipient governments' budgets (or at least a measure of aid 'close' to that which goes through the budget). Only in the recent past has aid data specifically for DRM been available (and it is considerably smaller than social sector aid), with most studies in the tax performance literature using net aid (as a proportion of GDP) instead. For time-series analysis, this is an innate limitation beyond the scope of the analyst since data on aid for DRM is available from 1995 onwards: which amounts to

18 years of data in this sample, making it inadequate for meaningful time-series analysis. Nonetheless, the aid/GDP ratio is likely to be problematic because: (i) not all aid is expected to influence recipients' tax/GDP ratios. Some aid finances human and physical capital development, and based on the total aid/GDP ratio it is uncertain how much of the aid is meant for DRM. Additionally, such a broad measure of aid likely includes technical assistance as well as other types of off-budget aid, and as argued in section 4.1: technical assistance and policy conditionality, independent of the amount of aid, play an important role in influencing DRM. (ii) More aid tends to go to countries experiencing growth-retarding factors independent of their ability to raise tax revenue (or lack thereof), creating endogeneity concerns.

Regarding tax revenue, most studies use total revenue: tax and non-tax revenue (which includes revenue from natural resources), but interest should be on non-resource tax revenue as that is the revenue category expected to respond to aid. Gupta *et al.,* (2004), Clist and Morrissey (2011), Benedek *et al.,* (2012), and Carter (2013) use total government revenue while Crivelli and Gupta (2017) and Combes, Ouedraogo and Tapsoba (2016) use tax revenue data; the studies obtaining data from the International Monetary Fund (IMF) databases. Morrissey *et al.,* (2014), Morrissey and Torrance (2015) use tax revenue data (excluding natural resource revenue) from the Government Revenue Dataset (GRD) compiled by the International Centre for Tax and Development (ICTD) and the United Nations University World Institute for Development Economics Research (UNU-WIDER). In this chapter, we use a measure of net aid void of technical assistance (see section 4.2), and a measure of tax revenue (void of natural resource components) like the measure used by Morrissey and Torrance (2015).

Third, the cross-country studies ignore heterogeneity in fiscal effects, with institutional differences across countries fundamental in permeating the impact of aid on taxes. Recently, there have been country-specific studies estimating the fiscal effects of aid and the general conclusion from those studies is that aid is associated with increased domestic revenue (see *inter alia* Osei *et al.,* 2005; Mascagni and Timmis, 2017; Bwire *et al.,* 2017). In this chapter, we build on the country-specific, time series analysis by estimating the effect of aid (and its components) on taxes, over time on average, in a panel of 84 developing countries, allowing for those effects to differ across countries; and disentangling the different ways through which aid influences taxes.

Fourth, potential aid endogeneity plagues existing cross-country approaches. Poor countries that attract aid typically have low tax/GDP ratios (because of weak tax bases); and aid flows (especially grants) are higher to countries facing difficulties in raising revenue. This creates a reverse causality problem, and the literature attempts to control for this endogeneity using instrumental variable and GMM techniques. However, Temple (1999) documents the difficulty in finding variables that qualify as instruments, alongside the spuriousness of estimates when the instruments are weak or invalid. This means previous results may be tenuous; hence they should be interpreted with caution.

Closely related to the issue of endogeneity is cross-section dependence. Internal and external factors that influence recipients' taxation capacities, and the amount of aid they receive (for example, the recent financial crisis resulted in fiscal austerity in donor countries, impinging on their aid disbursement patterns), create interdependencies across countries. This means in standard panel data approaches that the country variable series, as well as residuals from country-specific regressions, will be correlated. Such correlations are palpable in macro panel data, and ignoring them results in inconsistent and biased estimates (Chudik and Pesaran, 2015). The conventional approach to dealing with common shocks has been to include time dummies. However, this approach implicitly assumes that the effects of the shocks are identical across countries; which may not be true since institutional differences across countries ensure that they respond differently to shocks. Hence in this chapter we employ nonstationary panel methods that allow for heterogeneous cross-section correlation and test for the existence of a long-run (equilibrium) relationship between aid and taxes. We then test for exogeneity (direction of long-run causality) in taxes and aid, providing evidence on how recipients and donors react to deviations from the equilibrium.

Specifically, our findings are five-fold. First, the results provide evidence of a long-run equilibrium (cointegrating) relationship between aid and taxes which represents a behavioural relationship between aid and taxes. The average long-run effect of aid on taxes is positive, and robust to variable and residual correlation, outliers and omitted variables. Second, the composition of aid matters as grants are associated with increases in tax/GDP ratios in developing countries. This contrasts with Gupta *et al.,* (2004) and Benedek *et al.,* (2012) but is consistent with Clist and Morrissey (2011) and Mascagni and Timmis (2017). We argue that the political costs of accountability for grants outweigh the political costs of tax, such that recipients will prefer tax increases to aid-dependence. Third, technical assistance is vital in improving revenue performance (and fiscal policy in general) in developing countries; especially

through its impact on improving tax administration, assisting in implementing policy reforms and establishing revenue authorities. Fourth, for countries with *met* revenue conditionality in IMF-supported programs aid has a positive long-run relationship on tax revenues. Fifth, long-run causality runs from aid to taxes, suggesting that on average (or in general), changes in aid induce permanent changes in taxes. Aid, on the other hand, is weakly exogenous; emphasising our claims of a behavioural representation in which taxes adjust positively to changes in aid.

The rest of the chapter is organized as follows: Section 4.1 provides a conceptual framework from which hypotheses will be tested; emphasising the ways through which aid can shape tax performance, as well as the econometric issues faced in estimating the effects of aid on taxes. Section 4.2 presents a brief discussion of the data used in the analysis while section 4.3 sets out the empirical model specification. Section 4.4 presents results for tests for cross-section dependence and unit roots, estimates for the impact of aid on taxes, as well as results from exploratory analysis and analysis of weak exogeneity. Section 4.5 concludes.

4.1 CONCEPTUAL FRAMEWORK AND RELATED LITERATURE

4.1.1 Conceptualizing the Dynamics between Aid and Taxation.

In least developed countries (LDCs) domestic revenue is too low to finance the provision of public goods and services required for growth and development; reason why they receive aid and that aid is more likely to be in the form of grants. Low domestic revenue does not imply that tax effort is weak, nor does it signify fiscal nonchalance on the part of recipient governments' policy-makers. Given the relatively small tax bases in these countries, which in part reflects their large informal and agricultural sectors, revenue mobilization may be as high as feasible but is still not enough to generate economic gains (Keen and Simone, 2004; Morrissey, 2015b). Due to these revenue constraints, aid provides a direct alternative source of revenue since donors acknowledge the need for recipients to spend at levels higher than their tax revenue. This makes the choice between tax and aid a complex one, and there are legitimate concerns as to whether aid complements or substitutes for domestically raised revenue. In exploring the relationship between aid and taxes, the alternative ways through which aid can influence tax revenue mobilization must be considered.

First, most studies of tax performance (*inter alia* Gupta *et al.,* 2004; Benedek *et al.,* 2012) assume that in recipient countries there is a behavioural impact of aid on tax revenue (or government revenue in general): because aid (especially grants) provides revenue, governments are less inclined to expend political and administrative effort on tax collection. This is plausible because increasing taxes is unpopular, and recipients may see aid as a politically less costly source of revenue to cover government expenditure; reducing the urgency of tax revenue collection. However, there are also political costs associated with aid: increased dependency; costs of accountability (donors account to their parliaments while recipient governments account to their constituencies, and donors); as well as bureaucratic costs of administration. This makes the choice between aid and tax dependent on the respective costs, and how they offset each other (Morrissey, 2015b; Morrissey and Torrance, 2015). These costs are evaluated according to accountability, autonomy and bureaucratic costs.

The costs of accountability refer to whom and the extent to which a government (be it a recipient or donor) must account for its uses of revenue, and the costs are likely to be higher for aid than taxes (Morrissey, 2015b). Donor agencies have to account to their governments on how their aid is used so they implement strong monitoring mechanisms to minimize fungibility. They also attach conditions to their aid; and recipients have to expend effort in trying to circumvent the conditions. The costs of autonomy are reflected in a country's (in)ability to make independent policy choices since aid-dependent governments cede some policy influence to donors, and lose leverage in negotiating on policy conditionality (Morrissey and Torrance, 2015) with other donors.

In addition, there are bureaucratic costs of tax and aid. The former relates to the costs of tax administration (with fiscal reform implemented in many developing countries tax administration has improved, reducing the bureaucratic costs of tax) while the latter, which is a function of the number of donors, refers to the costs of organising and attending meetings with different donor agencies. The bureaucratic costs of aid are still high, and this is exacerbated by donor proliferation, disbursement heterogeneity, and the changing requirements on monitoring aid. Knack and Rahman (2007) discuss the short-term and long-term costs of donor fragmentation: the former relating to unnecessary waste of resources and duplication of country analytic work (such as public expenditure reviews and poverty assessment reports), resulting in high transaction costs. The longer-term costs undermine the quality of governance in already weak administrations characterising developing countries; for example, the use of

expatriates instead of building domestic capacity through 'learning by doing', and funding investment projects with high recurrent costs in future years.

This line of argument suggests that if the political costs of taxation are higher than those of aid (which is an implicit assumption from the Remmer, 2004; Gupta *et al.,* 2004 and Benedek *et al.,* 2012 findings), recipients will choose to expend less effort on tax collection; and this will be reflected empirically by the negative relationship between aid and taxes. Conversely, if the political costs of aid are higher, then recipients expend more effort on tax collection while systematically reducing the aid they receive. Empirically, this will be reflected by a positive relationship between aid and taxes.

Second, Morrissey and Torrance (2015) state that transfer of knowledge and capacity building from donors through technical assistance, as distinct from the amount of aid *per se*, is what potentially influences revenue mobilization through strengthening of weak tax institutions and improving the formulation of tax policy. Technical assistance also has the potential to relax capacity constraints in implementing institutional policy reforms; thereby improving revenue performance in developing countries. Third, donor-instigated policies and institutional reforms, such as trade liberalization, currency devaluation, creation of revenue administration and enforcement agencies, might also be associated with changes in tax revenues (Clist and Morrissey, 2011), with the country-specific effects potentially moving in opposite directions. The net tax effects of such policy reforms are thus uncertain (Carter, 2013); and it is difficult to distinguish between the direct causal effects of aid on taxes, and effects that can be associated with changes in policy reforms. This is exacerbated by donor and aid proliferation; with many recipients having multiple donor-instigated initiatives implemented over the years (Carter, 2013). Fiscal reforms supported by donors may improve tax administration and collection efficiency, but this may not necessarily translate to an observable increase in tax revenue (Morrissey *et al.,* 2014).

Fourth, donor conditionality associated with aid would also have effects on tax revenue through its effect on tax rates, tax collection and the tax base (Morrissey *et al.,* 2014). Conditionality takes different forms, including: prior actions (measures a country agrees to take before financing is approved or a review is completed), quantitative performance criteria (specific and quantifiable conditions that have to be met to complete a review, relating to macroeconomic variables under the control of the recipient), indicative targets (established to supplement quantitative performance targets) and structural benchmarks (typically non-quantifiable reform measures intended to assess program implementation

during a review). Crivelli and Gupta (2016) find that revenue conditionality in IMF-supported programs has a positive impact on tax revenue performance in 126 developing countries from 1993-2013, while Brun, Chambas and Laporte (2010) find evidence of a positive impact of donor-supported conditionality on total revenues in Sub-Saharan Africa from 1984-2007. Crivelli and Gupta (2017) state that other donors tend to rely on the IMF to implement macroeconomic conditionality, such that focusing on revenue conditionality from the IMF is enough to capture broader donor conditionality accompanying aid.

Fifth, the impact of aid on tax revenues may be influenced by donor policies; particularly the stability of donor-recipient relationships and how they relate to the stability of aid flows to developing countries (Lensink and Morrissey, 2000). There is a degree of continuity in donor-recipient relations such that recipients expect to receive aid every year. These recipient governments also have some form of expectations of the exact amount of aid to be received, as aid commitments are known some time in advance (Lensink and Morrissey, 2000). Additionally, knowing past values of aid flows; recipients expect some variability in aid so they plan fiscal policy accordingly. Thus, if disbursement (donor) difficulties create relatively high year-on-year variation in the level of aid, there may be no discernible impact of aid on tax ratios as aid is too unpredictable to be useful for fiscal planning (implementing reforms that will help to improve fiscal performance); with a net effect of zero. Plausibly, increased aid instability may result in fiscal vulnerability in developing countries, resulting in reduced tax/GDP ratios. Aid receipts may also vary due to macroeconomic uncertainty; causing donors to deviate from recipients' expectations, creating some unanticipated instability in aid which may also determine the way aid impacts on tax revenues. It is conceivable that more aid instability will mean countries need to strengthen DRM and shift from aid dependence to tax reliance. Ultimately, the impact of aid volatility on tax performance can be deciphered empirically.

4.1.2 Econometrics

In this sub-section, we motivate the empirical issues faced with estimating cross-country effects of aid on taxes: the heterogeneous nature of the aid-tax relationship, time series properties and dynamics characterising the data, as well as endogeneity and ensuing cross-section dependence in the aid-tax relationship. We begin by discussing time-series properties of the data, and then proceed to motivate cross-country heterogeneity, endogeneity and cross-section properties of the data.

Aid/GDP and tax/GDP ratios are typically approximated by stochastic (through the presence of a unit root), rather than deterministic (through the presence of higher order time trends) processes (Herzer, 2017). That implies for most developing countries both aid/GDP and tax/GDP ratios are non-stationary in the long-run, albeit with positive and/or negative trends. Thus, a linear combination of these non-stationary variables is stationary if aid/GDP and tax/GDP ratios are cointegrated (Engle and Granger, 1987; Granger and Newbold, 1974); that is if there is a long-run equilibrium relationship between the aid/GDP and tax/GDP ratios and permanent changes in the aid/GDP ratio are associated with permanent changes in the tax/GDP ratio. If both variables are not cointegrated then any linear combination between them is spurious (Granger and Newbold, 1974); a situation where even if aid/GDP and tax/GDP ratios are unrelated, the regression results indicate a highly significant relationship since standard tests for significance and goodness of fit are now invalid. A salient characteristic of heterogeneity in fiscal effects is the presence of heterogeneous cointegration; that is the long-run relationship between aid/GDP and tax/GDP ratios differs for all countries in the sample.

There is pervasive heterogeneity in government fiscal behaviour across developing countries; with domestic political and economic, internal and external, factors interacting with foreign aid (and its components) in different ways across recipient countries. This creates heterogeneous tax/GDP ratios across countries over time. Furthermore, the standard revenue (tax) performance equation is a contemporaneous relationship whereby the current tax/GDP ratio is determined by current values of the economic structure variables (Clist and Morrissey, 2011; Carter, 2013) which represent the determinants of taxable capacity. These country level determinants of tax/GDP ratios are not captured by available data (Morrissey, 2015b), resulting in the use of (often poor) proxy variables for the tax base; such as *per capita* income, sectoral output shares of agriculture, manufacturing and trade. In addition, these data do not account for policy changes in tax rates and tax administration.

Nonetheless, changes in the proxy variables will be associated with contemporaneous changes in tax/GDP ratios but the relationship between the aid/GDP and tax/GDP ratios (the relationship of primary theoretical interest in this chapter) is most likely dynamic since taxation policy and tax systems are statutory, making tax/GDP ratios highly persistent over time (at least in the short-run). Changing tax structures, tax rates and improving the efficiency of tax collection are all time-consuming processes, delaying the potential impact of aid. Furthermore, faced with the uncertainties of changes (increases/decreases) in the level of aid, recipient governments may delay in altering fiscal policy

(O'Connell, Adam and Buffie, 2008); underscoring the importance of dynamics in the relationship between aid and taxes.

Introducing dynamics in the relationship between aid and taxes allows for the possibility of feedback between both variables, with revenue performance in recipient countries potentially influencing donor aid allocation; creating a reverse causality problem. It is also conceivable that there is a bi-directional (simultaneous) relationship; with recipients' structural characteristics determining both high (low) aid and low (high) revenue. Clist and Morrissey (2011) and Morrissey and Torrance (2015) argue that lagging aid by one or two years as is done in previous studies (see *inter alia* Gupta *et al.,* 2004; Benedek *et al.,* 2012) is insufficient to curb the simultaneity. Due to the persistence of tax/GDP ratios, uncertainties of the timeline for which aid is likely to influence revenue performance, and because the innate structural characteristics determining both low tax and high aid change slowly, longer lags of aid are needed to deal with simultaneity. Morrissey and Torrance (2015) attempt to deal with endogeneity by using longer lags of aid.

In a (panel) time series context, however, endogeneity is dealt with differently. If aid and taxes are both nonstationary and co-integrated, then tests for weak exogeneity (i.e. the direction of long-run causality) are applicable (Eberhardt and Teal, 2013; Eberhardt and Presbitero, 2015; Canning and Pedroni, 2008). If donors in their aid allocation decisions respond to changes in revenue performance in receiving countries, this implies aid is endogenous for the long-run equilibrium; suggesting a behavioural impact of taxes on aid for the donors. If donors do not respond to such changes in their allocation decisions but aid/GDP influences tax/GDP ratios, aid is weakly exogenous or *long-run forcing* (Lloyd *et al.,* 2009).

Tax ratios, hence revenue performance may be determined by unobserved country-specific factors (Morrissey and Torrance, 2015), such as indigenous institutions, colonial heritage and resource endowments. The unobserved factors may be influenced by shocks that affect all countries to varying degrees (for example the recent financial crisis or the 1970s oil crises) or by multiple economic, social and cultural ties between countries; representing mere spill-over effects. In addition, the individual evolution paths of the unobservables are unrestricted to simple linear trends, allowing for non-linearity and nonstationary in evolution (Eberhardt and Teal, 2013). Interest is in the cross-country average effect of aid/GDP ratios on tax/GDP ratios, making the use of annual time-series data appropriate (Clist and Morrissey, 2011). However, use of annual data raises concerns about the distorting influence of business cycles on empirical inference (Eberhardt and Teal, 2013; Temple, 1999), such that analysis

is usually carried out with time-averaged data (Morrissey and Torrance, 2015; Morrissey *et al.,* 2014). In this chapter, we argue that adopting a common factor approach deals with any business cycle effects, whether they represent spill-over effects (idiosyncratic to a small number of countries) or global shocks with more profound, albeit heterogeneous impacts.

In summary, the effect of foreign aid on taxation depends on several factors, the most important of which are the dynamic political and economic factors. These factors, themselves influenced by policy changes, are not captured by available data hence not adequately incorporated into econometric specifications. In addition to the data concerns, donor-supported reforms and conditionality, and technical assistance, independent of the level of aid, also influence revenue performance. Furthermore, institutions are country-specific, and tax systems and policy display strong persistence over time; such that the dynamic relationship between aid and taxation is specific to each country. These issues will be addressed in the empirical analysis.

4.2 DATA

For the econometric analysis, we collect data on 84 developing countries covering the period 1980 to 2013. Data on net aid disbursements, gross aid disbursements, gross aid loans, gross aid grants and technical assistance are sourced from the OECD's Development Assistance Committee (2016) database. One of the objectives of this chapter is to estimate, independently, the impact of technical assistance on tax/GDP ratios in developing countries. Thus, we need to measure aid in a way that influences taxes (typically a measure of aid 'close' that which goes through recipients' budgets). We deduct technical assistance from grants to obtain a new measure of grants which we then add to net loans to get net ODA figures for the econometric analysis; and scale it with real GDP data (constant US$ 2010) sourced from the IMF's *World Economic Outlook*. We also estimate variants of the main model with grants, loans and technical assistance (all as percentages of GDP) as regressors of primary interest.[62]

For data on domestic revenue mobilization we rely on the Government Revenue Dataset (GRD 2016) from the International Centre for Tax and Development (ICTD) and the United Nations University World Institute for Development Economics research (UNU-WIDER). This includes non-resource tax

[62] Emergency (humanitarian) aid and development food aid also make up off-budget aid, but are excluded from the analysis. The most basic reason is such types of aid are designed to deal with economic and social crises, and by implication are volatile (Fielding and Mavrotas, 2005).

revenue, total tax revenue and total government revenue; all excluding grants and social contributions so we get measures of domestic revenue suitable for econometric analysis (Prichard *et al.,* 2014). The tax data, in local currency units, are scaled by recipients' GDP series (sourced from *World Economic Outlook*), also in local currency units. Non-resource tax revenue excludes royalties and natural resource taxes (Prichard *et al.,* 2014). Total tax revenue comprises all direct and indirect tax revenues while total government revenue is a composite of all tax and non-tax revenues (for instance, central bank receipts). The UNU-WIDER/ICTD GRD (2016) dataset has two major advantages over other tax datasets.

First, it combines fiscal revenue data from major international databases (for example the *Government Finance Statistics* database which suffer from missing values), as well as IMF Article IV reports and national budgets. This significantly improves data coverage, particularly in the more recent past (from the 1990s onwards). Second, it attempts to distinguish between resource and non-resource components of tax revenue, allowing for consistency in the treatment of natural resource revenue in econometric analyses, while also permitting the construction of a tax variable exclusive of natural resources. This is very important as fiscal theory posits that aid should affect only non-resource taxation (Morrissey *et al.,* 2014).

Table 4. 1: Descriptive Statistics for groups of countries

	Tax/GDP	Aid/GDP	Grants/GDP	Loans/GDP	TA/GDP
All countries (84)	12.92	5.58	3.51	3.11	2.07
LDCs (38)	11.30	9.63	6.22	3.54	3.50
LICs (46)	14.30	2.27	1.29	1.21	0.89
SSA (40)	12.51	8.08	5.48	3.36	2.53
LAC (19)	13.37	1.61	0.97	0.98	0.57
MENA (6)	13.48	1.61	1.04	0.94	0.43
AsiaPAC (18)	12.87	5.69	2.73	1.62	3.24
RR (26)	11.30	4.10	2.74	1.77	1.26
NRR (58)	13.62	6.24	3.85	2.47	2.43

Notes: LDCs = Least Developed Countries; LICs = Other Low-income Countries; SSA = Sub-Saharan Africa; LAC = Latin America and the Caribbean's; MENA = Middle East and North Africa; AsiaPAC = Asia and the Pacific. RR = Resource Rich Countries; NRR = Non-Resource Rich Countries. Tax/GDP = non-resource tax/GDP ratio; TA/GDP = Technical assistance to GDP ratio. Number of countries in brackets.

On average, least developed countries have a higher aid/GDP ratio and lower non-resource tax/GDP ratio than other low-income countries (see table 4.1). The average grants/GDP is also greater than the average loans/GDP for these LDCs, reflecting their relatively lower income levels.

Table 4. 2: Average aid/GDP and non-resource tax/GDP ratios over the sample period

	Aid/GDP	Tax/GDP		Aid/GDP	Tax/GDP
Algeria	0.26	11.73	Madagascar	7.55	9.69
Angola	1.90	6.67	Malawi	10.40	14.56
Argentina	0.04	15.07	Maldives	4.40	10.74
Bangladesh	2.11	5.91	Mali	9.23	10.89
Belize	2.75	20.05	Mauritania	11.40	12.61
Benin	0.32	12.87	Mauritius	1.04	17.57
Bhutan	10.34	8.23	Mexico	0.03	9.26
Botswana	2.02	15.02	Morocco	1.43	20.34
Burkina Faso	9.31	10.31	Mozambique	16.41	10.54
Burundi	16.44	12.23	Nepal	5.29	8.49
Cameroon	2.95	10.28	Nicaragua	8.90	14.24
Cape Verde	15.45	15.36	Niger	10.16	9.13
CAR	8.57	9.24	Pakistan	1.20	9.85
Chad	6.70	5.03	Panama	0.33	11.24
Chile	0.08	16.11	Papua New Guinea	3.61	18.00
China	0.14	15.03	Paraguay	0.70	10.16
Colombia	0.21	9.49	Peru	0.54	13.37
Comoros	11.59	11.23	Philippines	0.67	13.03
Congo Rep.	4.17	10.25	Rwanda	14.02	9.96
Costa Rica	0.87	1.11	Sao Tome & Principe	27.03	10.13
Cote D'Ivoire	3.50	16.13	Senegal	7.15	15.86
Dominica	5.53	20.27	Seychelles	3.35	30.46
Dominican Republic	0.44	10.30	Sierra Leone	10.84	6.99
DRC	6.17	5.69	Solomon Islands	18.34	17.19
Ecuador	0.50	8.46	Sri Lanka	2.89	15.35
Egypt	1.81	12.18	St. Vincent	3.20	20.82
El Salvador	2.85	11.11	Sudan	4.79	6.81
Eq. Guinea	8.76	10.86	Swaziland	1.74	23.62
Ethiopia	7.42	9.45	Tanzania	9.53	8.71
Gabon	0.83	10.89	Thailand	0.25	15.21
Gambia	10.38	12.62	Togo	6.54	14.71
Ghana	3.90	10.64	Tonga	10.46	15.61
Guatemala	1.06	9.51	Turkey	0.17	13.61
Guinea	5.94	7.88	Uganda	7.73	7.29
Guinea-Bissau	16.18	5.05	Uruguay	0.13	16.17
Honduras	4.05	13.06	Vanuatu	11.84	16.46
India	0.29	9.51	Venezuela	0.03	8.69
Indonesia	0.45	8.45	Zambia	9.95	15.72
Iran	0.04	5.57			
Jamaica	1.49	23.33			
Jordan	5.95	17.32			
Kenya	3.61	13.98			
Kiribati	21.93	16.36			
Laos	8.10	7.30			
Lesotho	9.88	42.07			

Notes: Aid/GDP = Aid to GDP ratio, Tax/GDP =Non-resource tax to GDP ratio. CAR – Central African Republic, DRC – Democratic Republic of Congo, Congo Rep – Republic of Congo, St. Vincent – St. Vincent and the Grenadines.

These basic statistics point to the simultaneity problem mentioned in section 4.1.2: LDCs with weak tax bases receiving more aid in the form of grants. Across regions, SSA has the highest aid/GDP, grants/GDP and loans/GDP ratios and the lowest average non-resource tax/GDP ratio. 31 of the 38 LDCs are Sub-Saharan African countries which face difficulties in raising domestic revenue; hence, receive more aid (especially in grants). Resource rich countries have lower non-resource tax/GDP ratios than their non-resource rich counterparts. Table 4.2 lists the countries along with the average values of the aid/GDP and non-resource tax/GDP ratios over the period 1980 to 2013.

What is immediately apparent is the cross-country heterogeneity in the average values of the series: (i) Sao Tome and Principe and Kiribati are the most aid-dependent economies with aid amounting to over 21 percent of GDP. Some other least developed countries are still very aid-dependent with an average ratio of aid to GDP more than 15% (Burundi, Cape Verde, Guinea-Bissau, Mozambique, and Solomon Islands). (ii) Even in some least developed countries that are supposedly more aid-dependent, the aid/GDP ratio is fairly similar to the tax/GDP ratio; underscoring the burgeoning importance of domestic resource mobilization in developing countries. For example, for the most aid-dependent countries Cape Verde has an average aid/GDP ratio of 15.45% with a tax/GDP ratio of 15.36% and 18.34% versus 17.19% in Solomon Islands. For other least developed countries, Comoros has an average aid/GDP of 11.59% with an average tax/GDP ratio of 11.23%, Mali 9.23% against 10.89%, Niger 10.16% against 9.13%, and Tanzania 9.53% against 8.71%. (iii) Middle-income countries with the highest tax/GDP ratios tend to have the lowest aid/GDP ratios. Belize, Fiji, Argentina, Botswana, Jamaica, and Mauritius, for example, are among the countries with the highest tax/GDP and lowest aid/GDP ratios in our sample.

4.3 EMPIRICAL MODEL SPECIFICATION

4.3.1 Linear Dynamic Model

To estimate the relationship between the aid/GDP and tax/GDP ratios in country i at time t we employ a multifactor error framework of the form:

$$tax_{it} = \beta_i' aid_{it} + u_{it} \qquad u_{it} = \alpha_i + \lambda_i' f_t + \varepsilon_{it} \tag{4.1}$$

where tax_{it} is the log of the tax/GDP ratio over time periods t=1, 2,…, T and countries i=1, 2,…, N. aid_{it} is the log of the percentage of net Official Development Assistance (excluding technical

assistance) to GDP. The vector of parameter coefficients (β_i) differs across countries, but is constant over time. Equation (4.1) also includes country-specific intercepts (α_i) and a vector of unobserved common factors f_t with country-specific factor loadings λ_i to account for the levels and evolution of unobservables, respectively. We allow for the possibility that the growth of unobservables not only differs across countries, but within countries over time (Eberhardt and Vollrath, 2016); with the main concern now being how to separate the country-time specific shock, λ_{it}, from the random error term, ε_{it}. However, we can model such country-specific unobservable evolution by adopting a multi-error factor structure for the error term, u_{it}. Let

$$u_{it} = \alpha_i + \lambda_i' f_t + \varepsilon_{it} = \alpha_i + \lambda_{S,i}^{S} f_t^{S} + \lambda_{W,i}^{W} f_t^{W} + \varepsilon_{it} \tag{4.2}$$

where the common factors, which are orthogonal to each other, can be a combination of a limited number of 'strong' factors (f^S) (following Stock and Watson, 2002) and an infinite number of 'weak' factors (f^W) (Chudik *et al.,* 2011). Strong shocks like the global recession of the 1980s and the recent financial crisis are assumed to affect all countries, albeit to varying degrees. Weak shocks, (for example, the devaluation of the CFA franc in 1994 and the Arab Spring in 2011) on the other hand, affect only a sub-sample of countries so they represent localized (spill-over) effects. In addition, the unobservable factors not only drive tax/GDP ratios, but also aid/GDP ratios: creating an endogeneity problem (Kapetanios *et al.,* 2011) whereby the parameter β_i^{aid} is not identified unless (i) we can account for the unobservable factors in the error term u, or (ii) provide a *valid* and *informative* set of instruments for potentially endogenous aid. Nonetheless, Bazzi and Clemens (2013) state that satisfactory instruments are unavailable. Furthermore, standard pooled instrumental variables techniques are inappropriate in this set up due to the heterogeneous equilibrium relationships across countries (Eberhardt and Presbitero, 2015) and the omnipresence of unobserved common factors (Eberhardt and Presbitero, 2015; Temple and Van de Sijpe, 2017). The unobserved common factors can also be nonstationary, with implications for estimation and inference since both observable and unobservable processes in the model are now integrated (Kao, 1999; Eberhardt and Presbitero, 2015).

Given the importance of dynamics and time series properties of aid/GDP and tax/GDP ratios, we employ an unconditional error correction model (ECM)[63] of the form:

$$\Delta tax_{it} = \alpha_i + \rho_i\left(tax_{it-1} - \beta_i^{aid} aid_{it-1} - \lambda_i' f_{t-1}\right) + \gamma_i^{aid}\Delta aid_{it} + \gamma_i^{F}\Delta f_t + \varepsilon_{it} \quad (4.3)$$

where the expression in brackets represents the potential cointegrating relationship we seek to identify, β_i^{aid} represents the long-run equilibrium (cointegrating) relationship between the tax/GDP and aid/GDP ratios, the γ_i^j represent the short-run adjustment dynamics and ρ_i indicates the speed of convergence of the economy to its long-run equilibrium. Unobserved common factors f are included in the long-run relation, which implies we will investigate an equilibrium relationship between taxes, aid and the unobservables. We can test for cointegration in the ECM based on the statistical significance of the error correction term in the ECM, with a negative and significant error correction coefficient representing cointegration; indicating that the economy returns to its long-run equilibrium following a deviation.

Finding cointegration between the tax/GDP and aid/GDP ratios is important as it would imply no potentially important nonstationary variables have been omitted from estimation: any omitted nonstationary variable that is part of the cointegrating relationship will now be part of the error, producing nonstationary residuals and failure to detect cointegration (Herzer, 2017; Herzer and Morrissey, 2013). Lütkepohl (2007) states that if there is cointegration between a set of variables, then this property extends into the variable space. There are many determinants of tax revenue performance, most of which are nonstationary (for example, export- and import-to-GDP ratios), which if included in our model may result in further cointegrating relations. The original cointegrating relation, however, is unaffected by these recently included nonstationary variables.

In addition to the appeal of parsimony in (panel) time series applications, we do not include other covariates as is typical in the tax performance literature for one reason. There are correlations between low tax/GDP and high aid: the most aid-receiving countries have higher aid relative to GDP (and more aid in grants) because they are inherently poor (with small tax bases). The tax/GDP ratio is determined by variables capturing the tax base, to which tax rates are applied. If disaggregated data on each tax base were available, for instance consumption spending, trade, natural resources or income, tax revenue can

[63] See Eberhardt and Presbitero (2015) for advantages of a heterogeneous ECM specification over static and/or more restrictive dynamic specifications.

be calculated as an aggregate of tax rates applied to the various tax bases (Morrissey, 2015b). The tax performance literature seeks to explain the tax/GDP ratio allowing for the tax base; by using proxy variables for the tax base which may or may not themselves be determinants of tax. The proxy variables do not account for policy changes in tax rates and tax administration, nor do they incorporate the salience of donor-recipient relationships.

To estimate the dynamic ECM in equation (4.3) given the common factor framework we focus on novel panel time-series estimators that allow for heterogeneity in the aid-tax relationship and cross-section dependence. Following Pesaran (2006), the Common Correlated Effects Mean Group (CCEMG) estimator uses (weighted) cross-section averages of the dependent ($\overline{tax}_t$) and independent variables ($\overline{aid}_t$) constructed to filter out the unobserved common factors f and omitted elements of the cointegrating relationship. Kapetanios *et al.,* (2011) and Coakley *et al.,* (2006) show that the estimator is consistent in the presence of structural breaks, nonstationary common factors, regressor-specific common factors, factor loading dependence and the presence of multiple common factors. Augmenting equation (4.3) with cross-section averages of the dependent and independent variables we get:

$$\Delta tax_{it} = \pi_{0i} + \pi_i^{EC} tax_{it-1} + \pi_i^{aid} aid_{it-1} + \Phi_i^{aid} \Delta aid_{it} + \pi_{1i}^{CA} \overline{\Delta tax}_t + \pi_{2i}^{CA} \overline{tax}_{t-1} + \pi_{3i}^{CA} \overline{aid}_{t-1} + \pi_{4i}^{CA} \overline{\Delta aid}_t + \varepsilon_{it} \quad (4.4)$$

Chudik and Pesaran (2015) extend the standard Pesaran (2006) approach to accommodate dynamics (feedback) from weakly exogenous regressors (a result of the inclusion of a lagged dependent variable); and find that the standard CCEMG is subject to small sample bias, especially in samples of moderate time series (30 to 50 years of annual time-series data). Chudik and Pesaran (2015) provide an empirical strategy to deal with the bias: in addition to the cross-section averages from the standard CCEMG, they suggest including lags of cross-section averages in the ECM, in our setup

$$\Delta tax_{it} = \pi_{0i} + \pi_i^{EC} tax_{it-1} + \pi_i^{aid} aid_{it-1} + \Phi_i^{aid} \Delta aid_{it} + \pi_{1i}^{CA} \overline{\Delta tax}_t + \pi_{2i}^{CA} \overline{tax}_{t-1} + \pi_{3i}^{CA} \overline{aid}_{t-1} + \pi_{4i}^{CA} \overline{\Delta aid}_t + \sum_{l=1}^{p} \pi_{5i}^{CA} \overline{\Delta tax}_{t-p} + \sum_{l=1}^{p} \pi_{6i}^{CA} \overline{\Delta aid}_{t-p} + \varepsilon_{it} \quad (4.5)$$

and/or the inclusion of cross-section averages of one or more further covariates (other than aid) which may help identify the multiple unobserved factors. In our setup,

$$\sum_{l=0}^{p} \pi_{7i}^{CA} \overline{\Delta Z}_{t-p}$$

where the π_s and Φ_s represent the long-run and short-run coefficients respectively, the $\pi^{CA}{}_s$ represent the coefficients on the cross-section averages of the dependent and independent variables (all coefficients yielding the standard CCEMG estimator), and Z represents further covariates included in the model. The $\sum_{l=1}^{p} \pi^{CA}{}_s$ represent the coefficients on the additional lags of cross-section averages which Chudik and Pesaran (2015) suggest be added to the standard CCEMG estimator (yielding the dynamic CCEMG estimator). As a rule of thumb, the lags of the cross-section averages to be added to the standard model are chosen by $p = T^{\frac{1}{3}}$ (Chudik and Pesaran, 2015). The country-series for additional covariates *do not* enter the model as regressors; just their cross-section averages and lags of cross-section averages enter the model. The objective here is to help identify the unobserved common factors f_t so including variables that may be directly linked to the tax/GDP ratio is reasonable. Therefore, we include any of the robust determinants of tax revenue performance fit for purpose (*per capita* income, the share of agricultural value added in GDP, and/or exports – all in logs), following Gupta (2007).

Chudik and Pesaran (2015) show that once the CCEMG estimator has been augmented with the sufficient number of lags and/or lags of other covariates, the estimator is unbiased in the presence of dynamics (the lagged dependent variable), and in the presence of weakly exogenous regressors. We estimate equation (4.5) by relaxing the common factor restriction between the parameters ρ_i and β_i implicit in equation (4.3) and reparametrize the model following Eberhardt and Presbitero (2015). From the levels terms (π_i^{aid}) we obtain the long-run coefficient on aid in the form:

$$\beta_i^{aid} = -\frac{\pi_i^{aid}}{\pi_i^{EC}} \qquad (4.5^*)$$

whereas the regression coefficients on the terms in first differences capture the short-run (transitory) effects, and can be read off directly from estimation. Inference on π_i^{EC}, the speed of convergence to equilibrium, provides insights into the presence of a long-run (cointegrating) relationship between aid and taxes. If $\pi_i^{EC} = 0$ then there is no cointegraion, and the model reduces to one with variables in first differences. If $\pi_i^{EC} \neq 0$ then there is 'error correction' in the model. That is, following a shock the

economy returns to its long-run equilibrium path, and therefore there exists a cointegrating relationship between aid and taxes.

4.3.2 Endogeneity and Causality

So far, we have discussed one type of endogeneity; whereby the unobserved common factors drive both the dependent variable and the independent variables. In studying the relationship between aid and taxes (and other macroeconomic variables in general), one must consider the fact that aid is allocated in a non-random manner (Temple and Van de Sijpe, 2017; Carter, 2013). Structural characteristics may determine both low (high) revenue and high (low) aid; with poor countries that have weak tax bases and low tax ratios attracting more aid and vice versa. Thus, interest is in investigating if donors respond to recipients' fiscal imbalances (relating to taxes) when disbursing aid, or if disbursement is independent of the fiscal situation in recipient countries. To test for causality, we follow the procedure in Canning and Pedroni (2008) and Eberhardt and Teal (2013).

Provided there exists a cointegrating relationship between the aid/GDP and tax/GDP ratios the Granger Representation Theorem (Engle and Granger, 1987) states that at least one variable must adjust to maintain an equilibrium relation; and the variables can be represented in the form of a dynamic ECM. For a pair of cointegrated variables, we can then test for weak exogeneity in the following models:

$$\Delta tax_{it} = \rho_{1i} + \theta_{1i}\hat{e}_{it-1} + \sum_{j=1}^{K} \lambda_{11ij}\Delta \text{tax}_{it-j} + \sum_{j=1}^{K} \lambda_{12ij}\Delta aid_{it-j} + \epsilon_{it}^{tax} \quad (4.6)$$

$$\Delta aid_{it} = \rho_{2i} + \theta_{2i}\hat{e}_{it-1} + \sum_{j=1}^{K} \lambda_{21ij}\Delta aid_{it-j} + \sum_{j=1}^{K} \lambda_{22ij}\Delta tax_{it-j} + \epsilon_{it}^{aid} \quad (4.7)$$

where ρ_i are constant terms and $\hat{e}_{it-1}$ is the disequilibrium term $\hat{e} = y - \hat{\beta}_i x - \hat{d}$ constructed using the cointegrating relationship between the variables (d represents deterministic terms like a constant and a country-specific trend). Equations (4.6) and (4.7) also add cross-section averages of the non-Error Correction terms to the weak exogeneity regressions. Each variable may react to its lagged differences, as well as lagged differences of other variables in the cointegrating relationship. The Granger representation theorem implies that at least one of the adjustment coefficients θ_{1i}, θ_{2i} must be non-zero if a cointegrating (long-run) relationship between the variables is to hold (Canning and Pedroni, 2008 p. 512). If $\theta_{1i} \neq 0$ then aid_{it} has a long-run causal impact on tax_{it} and if $\theta_{2i} \neq 0$ then

tax_{it} has a long-run causal impact on aid_{it}. If both θ_{1i} and θ_{2i} are non-zero then aid_{it} and tax_{it} determine each other jointly.

One of the advantages of using the disequilibrium term from a cointegrating relationship is that all the variables in equations (4.6) and (4.7) are stationary. This means once ECMs are estimated for each country, estimates for θ_i can be investigated using standard t-ratios (Canning and Pedroni, 2008; Eberhatrdt and Teal, 2013). Following Canning and Pedroni (2008) we use two separate statistics to test for weak exogeneity. The first is the group-mean statistic (GM hereafter) which averages the θ_i from individual country estimations of equations (4.6) and (4.7) and the GM test for the null of 'no long-run causal impact' is computed from the averaged t-ratio from country regressions ($\bar{t}_{\theta_2} = N^{-1}\sum_{i=1}^{N} t_{\theta_2}$). The GM statistic follows a standard normal distribution under the null hypothesis of 'no causal impact'. The second statistic is a Fisher-type (*Lambda*-Pearson) statistic which is constructed from the p-values of the t-tests from the country regressions to get the overall marginal significance associated with those p-values. The Fisher statistic follows a x^2 distribution with $2N$ degrees of freedom under the null hypothesis of 'no causal impact'.

The null and alternative hypotheses for both tests are the same when the θ_i coefficients are the same for all members of the panel. This translates into a null that $\theta_i = 0$ for all members in the panel against an alternative $\theta_i \neq 0$ for some non-negligible members of the panel (Canning and Pedroni, 2008). The interpretation of the tests, however, differs when θ_i differs across countries. The GM test is a two-tailed test so can take on positive or negative values under the null and alternative hypothesis depending on whether $\hat{\theta}_i$ is positive or negative whereas the Fisher statistic is a one-tailed test that only takes positive values in both the null and alternative hypotheses. If these two tests fail to agree on the direction of causality between variables, this can be interpreted as θ_i being on average zero (allowing for large negative and positive values to cancel each other), but not pervasively zero in the panel (Canning and Pedroni, 2008; Eberhardt and Presbitero, 2015). If that is the case, it provides evidence of the heterogeneity of θ_i across countries.

4.4 EMPIRICAL RESULTS

4.4.1 Preliminary Analysis

We investigate the cross-section correlation properties in the data using the CD test following Pesaran (2015), and report the cross-country correlation coefficients and the CD test statistic (Appendix tables C1 and C3). The results point to pervasive cross-section dependence across different variable specifications (levels versus first differences). The correlation coefficients and CD statistics are considerably lower for variables in first differences. Cross-section dependence results in over-rejection of the null hypothesis of nonstationarity in standard panel unit roots tests (Pesaran, 2007). Thus, we employ a panel unit root test, the 'CIPS' test, which allows for cross-section correlation (see sections 3.5.1 and 3.6.1). Appendix tables C2 and C4 provide the results from conducting the 'CIPS' test. We report the $Ztbar$ statistic (and its corresponding p-value) for H_0 = nonstationarity in all countries' variable series versus H_1 = stationarity in some countries' variable series. For both variables in levels, nonstationarity cannot be rejected once the equation is augmented with lags and/or a linear trend. Nonstationarity is rejected for both variables in first differences.

4.4.2 Heterogeneous Baseline Estimates

Having confirmed the prevalence of cross-section dependence, and established that all the variables are nonstationary in levels we proceed to estimate the heterogeneous ECM using a dynamic CCEMG estimator; results from which are reported in Table 4.3. We report results for the standard CCEMG (Pesaran, 2006), as well as variants augmented with one and two lags of cross-section averages respectively (Chudik and Pesaran, 2015). Long-run averages and short-run coefficients of the variables are reported. The coefficient on the lagged dependent variable is reported as well. The long-run average coefficient is obtained by averaging ECM coefficients, then computing the long-run coefficient with standard errors computed through the Delta method. We employ the robust regression (see Hamilton, 1992) – which weighs down outliers in computing the averages – in all estimations. The short-run coefficients are read off directly from estimation. Relevant diagnostics (RMSE, CD test statistic, the CIPS test statistic) are reported at the bottom of the table. Given the small sample bias the standard CCEMG faces, in addition to the *favourable* results and diagnostics from the variant with two additional lags of cross-section averages, we only discuss results based on the CCEMG augmented with two lags of cross-section averages.

Table 4. 3: CCEMG Estimates

	CCEMG	One-Lag CCEMG	Two-Lag CCEMG
Long-Run			
Aid/GDP	0.080***	0.086***	0.077***
	[0.027]	[0.028]	[0.027]
Short-Run			
Aid/GDP	0.011	0.009	0.014
	[0.010]	[0.011]	[0.012]
EC Coefficient			
y_{it-1}	-0.444***	-0.472***	-0.495***
	[0.027]	[0.028]	[0.031]
t-statistic	-16.57	-16.61	-16.09
Diagnostics			
RMSE	0.107	0.098	0.092
Stationarity $\mathtt{7}$	I(0)	I(0)	I(0)
CD test	-0.79	-1.02	-1.45
(p-value)	(0.430)	(0.308)	(0.148)
Observations (N)	2473 (84)	2423 (84)	2371 (84)

Notes: The results are based on an error correction model for all 84 countries in the sample with the first difference of log (tax/GDP) as dependent variable. The aid/GDP ratio used is net disbursements (excluding technical assistance) as a share of recipient's GDP. 'CCEMG' represents the Pesaran (2006) common correlated effects mean group (CCEMG) estimator while 'one-lag' and 'two-lag CCEMG' represent the standard CCEMG augmented with one and two lags of the cross-section averages respectively. The long-run and short-run averages are reported, with standard errors reported below the averages. RMSE is the root mean square error, $\mathtt{7}$ Pesaran (2007) test results for ADF tests on the residuals: I(0) – stationary, I(1) – nonstationary. $\mathtt{CD}$ test is the Pesaran (2015) test distributed $\mathtt{N(0,1)}$ under the null of cross-section independence ($\mathtt{p}$-value in parantheses below). *, ** and *** indicate significance at 10%, 5% and 1% respectively.

Both aid/GDP and tax/GDP ratios are I(1) so we can test for cointegration by investigating the statistical significance of the lagged dependent variable as shown in Table 4.3. Across all specifications, the coefficient on the lagged dependent variable is negative, statistically significant and different from zero, indicating that the system reverts to its equilibrium path following a shock. The results indicate that on average there is a long-run equilibrium relationship between the tax/GDP and aid/GDP ratios, with increases in the tax/GDP ratio sustained by movements in the aid/GDP ratio. Additionally, as

residual testing for stationarity also provides a different test for cointegration, we confirmed cointegration across the three specifications.[64]

The long-run average coefficient on the aid/GDP ratio is positive and statistically significant across models. This average effect is robust to outliers, omitted variables and structural breaks. The results are largely consistent with country-specific FRMs (Bwire *et al.,* 2017; Mascagni and Timmis, 2017) and the relatively recent evidence from cross-country regressions (Clist and Morrissey, 2011; Clist, 2016; Gupta, 2007) We allude to this long-run effect as being a behavioural relationship between aid and taxes based on political costs associated with aid and taxes, for two reasons. First, our measure of aid is close to that which goes through the budget, such that it will have a direct impact on taxation. Second, the ECM distinguishes between short-run and long-run effects; such that for the long-run effect it is not essential to specify the variable lags (as *per* Clist and Morrissey, 2011; Morrissey, 2015b and Morrissey and Torrance, 2015) through which aid will impact taxes (Herzer and Grimm, 2012). On average, the evidence suggests that the political costs of aid are likely higher than those of taxes.

The costs of accountability of aid are likely higher than those of tax. Some donor agencies may operate in domestic environments where there are opponents to aid (usually political parties or vocal politicians), especially in cases where some aid projects financed by said donor agencies failed; thereby increasing the accountability costs of aid. The accountability costs of tax are much lower, especially in developing countries with weak political and tax systems. Typically, political systems in most developing countries place few constraints (checks and balances) on the power of the executive, and non-state actors, because they do not pay much in taxes (huge informal sectors may suggest that they pay much less taxes) are unable to control and limit elites' access to resources. Such political systems are less transparent and political elites easily evade taxes and bend tax rules in their favour (Riccuiti, Savoia and Sen, 2016; Besley and Persson, 2014). Regarding the costs of autonomy; to the extent that recipients meet the policy reform conditions stipulated to them by donors when disbursing aid; and there is evidence to suggest that *met* revenue conditionality in donor-supported programs either increases tax/GDP ratios (Crivelli and Gupta, 2016) or mitigates the negative effects of aid on taxes (Crivelli and Gupta, 2017), recipients cede less policy influence to donors. This suggests the costs of autonomy for recipients, relating to aid dependence, have reduced.

[64] Panel cointegration tests have been proposed in the econometric literature, each with their strengths and weaknesses. The tests can be classified into 'first-generation' and 'second-generation' tests, the latter incorporating cross-sectional dependence which the former ignores. See, *inter alia*, Eberhardt (2011) for a detailed review.

The bureaucratic costs of aid are also higher than those of tax. Moore (2014) and Fossat and Bua (2013) document fiscal reforms in Anglophone and Francophone Africa, respectively, with many other developing countries implementing reforms and improving tax administration in the last decade. These reforms reduce the bureaucratic costs of taxation, while also increasing the efficiency of tax collection. Contrarily, the bureaucratic costs of aid are still high. This is exacerbated by donor fragmentation, and the emergence of novel donors with changing requirements for aid allocation and monitoring. The evidence, based on our analysis, suggests that the political calculus has shifted in favour of taxation.

4.4.3 Exploratory Analysis

We explore, further, the relationship between aid and taxes and rely on dummy variables to group countries with similar characteristics.

4.4.3.1 Level of Development

The sample is split into two income groups- least developed countries (LDCs) and other low-income incomes (LICs) - based on the World Bank's income classification (see appendix table C6), to further explore the heterogeneous effects of aid on tax/GDP ratios across different levels of development. Results are reported in Table 4.4. There is a long-run and short-run positive association between the aid/GDP and tax/GDP ratios. The low tax/GDP ratios in these LDCs point to deep-rooted difficulties in increasing revenues, which include a mixture of structural features of the economy (underdevelopment of information technology, low *per capita* GDP, share of agriculture in GDP and informality, underdevelopment of the corporate sector), administrative constraints (paucity of tax practitioners and accounting professionals, over-complexity of tax systems) and political constraints (vested interests of elite groups, many tax incentives).

However, increases in the aid/GDP ratio in LDCs will plausibly be associated with long-term increases in the tax/GDP ratio; as confirmed by the results from Table 4.4. This can be achieved through improvements in revenue administration and broadening the revenue base by creating efficient taxation in the informal sector. Additionally, the evidence from Table 4.3 suggests that the political calculus may have shifted in favour taxes, with a tendency for governments to increase domestic revenue than accept aid as the political costs of aid are higher. Developing countries are still aid dependent because they are

constrained in their abilities to raise taxes (Keen and Simone, 2004), but our line of argument implies that they would prefer increasing domestic revenue to aid.

Table 4. 4: Heterogeneity in Levels of Development

	LDCs	**LICs**
Long-Run		
Aid/GDP	0.125**	0.048
	[0.051]	[0.031]
Short-Run		
Aid/GDP	0.046**	-0.003
	[0.023]	[0.013]
EC Coefficient		
y_{it-1}	-0.505***	-0.487***
	[0.047]	[0.041]
t-statistic	-10.74	-11.75
Diagnostics		
RMSE	0.113	0.069
Stationarity ך	I(0)	I(0)
CD test	-0.76	-0.65
(p-value)	(0.447)	(0.515)
Observations (N)	1078 (38)	1293 (46)

Notes: LDCs refer to least developed countries and LICs refer to other low-income countries. Error correction models are estimated for each region; with the first difference of log (tax/GDP) as dependent variable. For all other details see Table 4.3.

4.4.3.2 Region

From Table 4.2, there are clear differences in the average aid/GDP ratio across regions; with SSA receiving more aid on average than the other three regions. SSA countries also have the lowest tax/GDP ratio than other regions, making it interesting to see if there is a heterogeneous association between aid and taxes across regions. For that purpose, the sample is split into four regions: Sub-Saharan Africa (SSA), Latin America and the Caribbean's (LAC), Asia and the Pacific (AsiaPAC) and the Middle East and North Africa (MENA). Results are presented in Table 4.5. There is evidence of a long-run and short-run positive association between the aid/GDP and tax/GDP ratios in the SSA region only, with no discernible relationship between aid and taxes for the other three regions. 31 of the 38 LDCs are SSA countries so this finding is not surprising.

Table 4. 5: Heterogeneity across regions

	SSA	LAC	MENA	AsiaPAC
Long-Run				
Aid/GDP	0.119***	0.040	-0.0211	0.051
	[0.043]	[0.053]	[0.092]	[0.059]
Short-Run				
Aid/GDP	0.040*	0.004	0.002	-0.022
	[0.022]	[0.025]	[0.020]	[0.016]
EC Coefficient				
y_{it-1}	-0.531***	-0.484***	-0.378**	-0.452***
	[0.042]	[0.067]	[0.188]	[0.066]
t-statistic	-12.71	-7.27	-2.01	-6.84
Diagnostics				
RMSE	0.106	0.060	0.074	0.091
Stationarity ד	I(0)	I(0)	I(0)	I(0)
CD test	-1.45	1.82	-0.25	0.72
(p-value)	(0.148)	(0.069)	(0.805)	(0.472)
Observations (N)	1161 (40)	512 (19)	174 (6)	501 (18)

Notes: The sample is disaggregated into four regions. SSA stands for Sub-Saharan Africa, MENA for Middle East and North Africa, AsiaPAC for Asia and the Pacific, and LAC for Latin America and the Caribbean's. Error correction models are estimated for each region; with the first difference of log (tax/GDP) as dependent variable. For all other details see Table 4.3.

The challenges low-income countries face in increasing domestic revenue (see the introduction and sub-section 4.4.3.1) are particularly rife in Sub-Saharan Africa. For most SSA countries political constraints to revenue mobilization are as severe as economic constraints: low political support from top officials for revenue reform; huge turnover of those in managerial positions (usually resulting in the 'death' of fledging reforms); high dependence on foreign aid and natural resources; endemic corruption; tax exemptions and tax expenditures; the influence of interest group politics (Junquera-Varela *et al.,* 2017; Fossat and Bua, 2013; Moore, 2013). These are countries with huge potential for increases in tax/GDP ratios, hence countries in which increases in the aid/GDP ratio will be associated with increases in the tax/GDP ratio. Overcoming political constraints is more difficult because reforms are difficult to implement and sustain since politicians often view them as intrusive.[65]

[65] Resistance to reform is typical in most developing regions, not just SSA.

Accordingly, donors can pursue a strategy to support effective reform and alter politicians' preferences, based on the two following components. First, demonstrate benefits of promoting fiscal autonomy, such as increased independence of policy choices and more flexibility in negotiating conditionality with other donors. Second, contribute to creating transparent and sustainable tax systems with broader state-building benefits to the recipients. Increasing domestic revenue supports responsiveness (government's ability to spend on public goods and services that improve the welfare of its citizens) and accountability. This fosters fiscal systems with checks and balances on the executive, strengthening the social contract between the government (through the provision of public goods and services) and the public (through the taxes they pay, and their willingness to pay).

4.4.3.3 Heterogeneity in Aid Flows

We estimate the heterogeneous effects of grants, loans and technical assistance on the tax/GDP ratio. Accordingly, we re-estimate equation (4.5) with respectively, grants (column 1), loans (column 2) and technical assistance (column 3) as the measure of aid and report the results in Table 4.6. Grants have a long-run positive association with tax/GDP ratios in recipient countries, while loans have no effect on tax/GDP ratios. A plausible explanation for this is the costs of accountability, for both the donors and recipients, are likely to be higher for grants than for loans. For donors, it is easier to justify to their governments and parliaments, the disbursement of a loan than a grant; the straightforward reason being that loans come with obligations of repayment and servicing while grants are seen as 'free' money. Thus, donors place more stringent policies to monitor their aid grants and minimize fungible use. For recipients, they will have to account to the donors how the grants they disbursed are being spent. These accountability costs also lead to increases in costs of autonomy for the recipient, as they will have to expend effort to circumvent those donor-installed monitoring policies, as well as cede some policy influence to donors.

When technical assistance is used as a measure of aid, cross-section correlation is not entirely wiped out from equation 4.5. Technical assistance is a form of aid that may not be given in response to specific characteristics of a recipient country. Thus, while the absolute amount of technical assistance varies across countries, the purpose for disbursing it is broadly similar across countries. This creates pervasive cross-section correlations across countries with respect to technical assistance. Hence, in addition to the

lags of cross-section averages, cross-section averages of GDP *per capita* (and their lags) are included to wipe out cross-section correlation (see section 4.3.1).

Table 4. 6: Heterogeneity in Aid Flows

	Grants	**Loans**	**Technical Assistance**
Additional covariate(s) †			*gdppc*
Long-Run			
Aid/GDP	0.058***	0.010	0.077**
	[0.018]	[0.018]	[0.039]
Short-Run			
Aid/GDP	0.013	0.0007	0.015
	[0.008]	[0.007]	[0.018]
EC Coefficient			
y_{it-1}	-0.521***	-0.517***	-0.503***
	[0.029]	[0.026]	[0.034]
t-statistic	-17.81	-19.66	-14.98
Diagnostics			
RMSE	0.092	0.089	0.085
Stationarity ‡	I(0)	I(0)	I(0)
CD test	-0.07	-1.60	-1.64
(p-value)	(0.940)	(0.110)	(0.102)
Observations (N)	2414 (84)	2328 (84)	2412 (84)

Notes: Error correction models are estimated for all 84 countries in the sample; first with grants/GDP as the aid variable of interest (column 1), then loans/GDP (column 2), and finally technical co-operation/GDP (column 3). The CCEMG with two lags of cross-section averages is used for estimation. † The CCEMG estimator is implemented with two lags of cross-section averages and cross-section averages of other variables (gdppc – GDP *per capita* in constant $2010 values, in logs) as indicated – see main text for details. For all other details see Table 4.3.

Technical assistance has a long-run positive association with tax/GDP ratios. Such technical assistance has the potential to relax capacity constraints in tax administration and policy, as well as increase tax collection efficiency without necessarily increasing tax rates; thereby reducing the bureaucratic costs of taxation. Due to the persistence of tax/GDP ratios such improvements are mostly medium to long-term; corresponding to the long-run positive association between the aid/GDP and tax/GDP ratios.

4.4.3.4 Domestic Revenue

Royalties, taxes and other revenue from natural resources are important in countries endowed with natural resources. Thus, we re-estimate equation (4.5) with two new measures of revenue; total tax

revenue and total government revenue. The former comprises revenue from non-resource and resource taxes (both direct and indirect tax components), while the latter is a composite of tax and non-tax revenues. Including lags of cross-section averages does not completely expunge the cross-section correlation present in total tax revenue. Total tax revenue is shaped by entrenched historical factors, some of which include indigenous colonial heritage (Mkandawire, 2010). Hence, countries that share colonizers will plausibly have similar tax systems (see Fossat and Bua, 2013). In addition, taxation reforms, introduction of the VAT, pervasive trade liberalization in developing countries have been carried out broadly around the same time (from the 1980s to the early 2000s). This results in strong correlations in total tax revenues across countries.

Table 4. 7: Heterogeneity in Domestic Revenue

	Total Tax Revenue	**Total Domestic Revenue**
Additional covariates ך	*gdppc, agriculture*	
Long-Run		
Aid/GDP	0.080***	0.052**
	[0.026]	[0.021]
Short-Run		
Aid/GDP	0.012	-0.003
	[0.012]	[0.010]
EC Coefficient		
y_{it-1}	-0.548***	-0.539***
	[0.036]	[0.032]
t-statistic	-15.16	-16.64
Diagnostics		
RMSE	0.083	0.091
Stationarity ך	I(0)	I(0)
CD *test*	-1.47	-1.40
(p-value)	(0.143)	(0.162)
Observations	2374 (84)	2343 (83)

Notes: 'Total Tax Revenue' and 'Total Domestic Revenue' refer to error correction models for all 84 countries first with total tax revenue (including natural resource taxes) as the measure of domestic revenue (column 1), then total government revenue as the measure of domestic revenue (column 2). ך The CCEMG estimator is implemented with two lags of cross-section averages and cross-section averages of other variables (gdppc – GDP *per capita* in constant $2010 values; agriculture – the share of agriculture value added in GDP, all in logs) as indicated – see main text for details. For all other details see Table 4.3.

Thus, in addition to the lags of cross-section averages, cross-section (and their lags) averages of GDP *per capita* and the share of agriculture value added in GDP are included to expunge cross-section correlation (see section 4.3.1). Results are reported in Table 4.7. Regarding total tax revenue (column 1), the results do not differ so much to those with non-resource taxes as the measure of domestic revenue. There is a positive long-run relationship between the aid/GDP and the (total) tax/GDP ratios. Regarding total government revenue (column 2), the coefficient on the aid/GDP ratio is relatively smaller. This is to be expected as total domestic revenue comprises non-tax revenue (which includes natural resources), and theory is not predictive on how aid can affect such non-tax revenue. It is possible that the smaller effect shows aid having a positive association with the non-resource tax revenue component of total government revenue.

4.4.3.5 Donor Conditionality

In line with the argument in section 4.1 we test if there is a role for revenue conditionality in improving tax/GDP ratios. Data on revenue conditionality in IMF-supported programs is obtainable from the IMF's Monitoring of Fund Arrangements (MONA) database; following Crivelli and Gupta (2016, 2017). In choosing the economic descriptors for conditionality in the MONA database, we focus on those related to revenue conditionality: specifically, revenue measures and revenue administration. From these descriptors, only "met" revenue conditionality was considered. Thus, we create a dummy variable which takes the value 1 for all countries in the 'dropdown' dataset (those with revenue conditionality) and zero otherwise. Results are presented in Table 4.8.

There is evidence of a positive long-run association between aid/GDP and tax/GDP ratios in countries with *met* revenue conditionality. This long-run effect reflects the all-encompassing nature of revenue conditionality, including quantitative conditionality (for example, observable targets like increasing the VAT rate) as well as structural conditionality (for example, statutory aspects of tax reform like submitting legislations to parliament). There is also evidence of a positive short-run relationship between aid/GDP and tax/GDP ratios, most likely reflected through quantitative revenue conditionality in which the effects plausibly take less time to be observed. This would also suggest that the political calculus, based on costs of autonomy, is in favour of taxes. Countries that meet revenue conditions in IMF and other donor-supported programs will have the ability to make independent policy choices, thereby reducing the political costs of autonomy.

Table 4. 8: Revenue Conditionality

	Revenue Conditionality	No Revenue Conditionality
Long-Run		
Aid/GDP	0.119***	-0.006
	[0.039]	[0.032]
Short-Run		
Aid/GDP	0.032**	-0.020
	[0.016]	[0.015]
EC Coefficient		
y_{it-1}	-0.483***	-0.519***
	[0.042]	[0.043]
t-statistic	-11.50	-12.02
Diagnostics		
RMSE	0.089	0.097
Stationarity ז	I(0)	I(0)
CD test	0.34	-0.69
(p-value)	(0.731)	(0.493)
Observations (N)	1539 (54)	830 (30)

Notes: 'Revenue Conditionality' refers to countries with met revenue conditionality (either quantitative or structural) in IMF-supported programs while 'No Revenue Conditionality' refers to the rest of the countries in the sample. The CCEMG with two lags of cross-section averages is used. For all other details see Table 4.3.

4.4.3.6 Recipient Policy Reform

To capture the policy effects of aid on tax/GDP ratios we focus on the creation and operation of Semi-Autonomous Revenue Authorities (SARAs hereafter). Evidence on the effectiveness of SARAs is mixed. The benefit of having such authorities is that tax collection is handled by an independent agency (which receives performance incentives). Ideally, the effectiveness of SARAs in improving revenue performance should reduce the accountability costs of taxes in recipient countries. Indeed Ahlerup, Baskaran and Bigsten (2015), using data for 47 countries from 1980-2010, provide evidence that SARAs in Sub-Saharan Africa have been associated with at least short-term increases in tax revenue (the effects usually subside after about 5 years). A weakness of SARAs is that governments (politicians) still retain control over tax policy design and can favour select groups by granting tax exemptions. In addition, the effectiveness of SARAs depends on domestic political and economic events; with political instability and adverse economic developments undermining the positive aspects of reform. Furthermore, as politicians retain control over tax policy in developing countries, the countries are still

subject to political budget cycles (Brender and Drazen, 2005; Shi and Svensson, 2006); which is exacerbated by the weak nature of tax institutions (lack of transparency and accountability). Dom (2017), using data for 46 SSA countries from 1980-2012, suggests that there is no observable effect of SARAs on revenue collection.

Table 4. 9: Recipient Policy Reform (A)

	Revenue Authority	**No Revenue Authority**
Long-Run		
Aid/GDP	0.044	0.090***
	[0.049]	[0.033]
Short-Run		
Aid/GDP	0.015	0.011
	[0.031]	[0.013]
EC Coefficient		
y_{it-1}	-0.502***	-0.494***
	[0.048]	[0.040]
t-statistic	-10.36	-12.50
Diagnostics		
RMSE	0.083	0.095
Stationarity ך	I(0)	I(0)
CD test	0.42	-1.49
(p-value)	(0.673)	(0.135)
Observations (N)	715 (25)	1656 (59)

Notes: 'Revenue Authority' comprises countries with operational semi-autonomous revenue authorities, while 'No Revenue Authority' refers to the rest of the countries in the sample. The CCEMG with two lags of cross-section averages is used. For all other details see Table 4.3.

Following the tax performance literature, we disaggregate countries based on the presence of an operational semi-autonomous revenue authority in the country, and re-estimate equation (4.5) for both groups of countries; results from which are in Table 4.9. We find that for countries with SARAs there is no observable long-run (or even short-run) relationship between the aid/GDP and tax/GDP ratios (this finding is similar to Dom, 2017). For countries without SARAs, we find a strong positive long-run relationship between the ratios. As already mentioned the effectiveness of SARAs depends a lot on dynamic political and economic factors, which are typically country-specific. Tax administration and policy has improved over the years (Moore, 2014; Fossat and Bua, 2013) and tax ratios have also increased gradually, but most developing countries are still subject to political and economic instability,

thereby undermining the efforts of reform (see Ahlerup *et al.,* 2015 for country-specific evidence on the effectiveness of SARAs).

Table 4. 10: Recipient Policy Reform (B)

	Revenue Authority	No Revenue Authority
Long-Run		
Aid/GDP	0.104**	0.065
	[0.052]	[0.054]
Short-Run		
Aid/GDP	0.034	0.007
	[0.034]	[0.021]
EC Coefficient		
y_{it-1}	-0.518***	-0.496***
	[0.052]	[0.043]
t-statistic	-9.86	-11.62
Diagnostics		
RMSE	0.078	0.088
Stationarity ר	I(0)	I(0)
CD test	1.04	0.01
(p-value)	(0.300)	(0.993)
Observations (N)	726 (25)	1689 (59)

Notes: The aid/GDP ratio used here is 'technical assistance-to-GDP ratio'. The CCEMG with two lags of cross-section averages is used. For all other details see Tables 4.3 and 4.9.

It is also possible that technical assistance subsumes the effect of reform, such that any positive effects of SARA reform on taxes are being captured by the positive long-run impact of technical assistance. This last argument is tested by re-estimating equation (4.5) for the SARA and non-SARA groups using technical assistance as the measure of aid (see Table 4.10). We find evidence of a positive long-run relationship between technical assistance and tax/GDP ratios for countries with revenue authorities. This is to be expected since technical assistance is given to countries to help implement fiscal reforms involving tax administration and establishing independent revenue authorities. This finding implies that the effectiveness of SARAs depends as much on technical assistance from donors as domestic factors.

4.4.3.7 Stability of Donor-Recipient Relationships

Here we classify countries according to the volatility of their aid. If the level of aid is highly unpredictable from one year to the next, aid may be too unpredictable for fiscal planning, worsening

revenue performance in developing countries. Furthermore, such unpredictability may offset any possible impact aid would have on the tax/GDP ratio, with the net effect being nil. Alternatively, highly unpredictable aid may also strengthen the need for increased domestic revenue mobilization (see section 4.1.1). We estimate two measures of aid volatility; one intended to capture uncertainty while the other is a measure of instability. Aid uncertainty can be defined as the unanticipated variability in the aid/GDP resulting from macroeconomic uncertainty. It is measured by the standard deviation of the residuals of a forecasting regression (an $AR\ (2)$ process) of the aid/GDP to determine the expected component of the aid/GDP ratio. The forecasting equation is as follows:

$$aid_{it} = \gamma + \alpha_{i1} aid_{it-1} + \alpha_{i2} aid_{it-2} + e \tag{4.8}$$

where aid_{it} is net aid as a percentage of GDP, γ is a constant term and e is an error term with standard properties. We classify countries with high aid uncertainty as those with a standard deviation greater than 0.3, with the rest of the sample representing countries with low aid uncertainty. The second measure of volatility is the coefficient of variation (CoV) of the logged aid/GDP ratio; measured as a ratio of the standard deviation of the aid/GDP series to the mean value of the series over time.

Morrissey and Osei (2004) state that this is a measure of general instability of aid (a result of donor difficulties) over the period. We classify countries with high aid instability as those with the coefficient of variation greater than 0.6, with the rest of the sample representing countries with low aid instability. Results for both measures of aid volatility are reported in Tables 4.11 and 4.12. For countries with high aid uncertainty, there is no discernible effect of the aid/GDP ratio on the tax/GDP ratio. This confirms the assertion that high year-on-year variability in aid may offset any potential effects aid has on tax revenue. In countries with low aid uncertainty there is a positive long-run relationship between aid/GDP and tax/GDP ratios. The less donors deviate from their aid commitments, the more predictable aid flows will be and in such countries, aid has a positive long-run association with taxes. For countries with high aid instability, there is no observable relationship between the aid/GDP and tax/GDP ratios. For countries with low aid instability, there is a positive long-run relationship between the aid/GDP.

Table 4. 11: Heterogeneity in Aid Uncertainty

	High Aid Uncertainty	Low Aid Uncertainty
Long-Run		
Aid/GDP	0.032	0.155***
	[0.028]	[0.053]
Short-Run		
Aid/GDP	0.014	0.026
	[0.013]	[0.022]
EC Coefficient		
y_{it-1}	-0.479***	-0.502***
	[0.046]	[0.040]
t-statistic	-10.71	-12.39
Diagnostics		
RMSE	0.097	0.085
Stationarity ך	I(0)	I(0)
CD test	-1.04	0.78
(p-value)	(0.299)	(0.436)
Observations (N)	1302 (47)	1069 (37)

Notes: For all other details see table 4.3.

Table 4. 12: Heterogeneity in Aid Instability

	High Aid Instability	Low Aid Instability
Long-Run		
Aid/GDP	0.033	0.119***
	[0.031]	[0.043]
Short-Run		
Aid/GDP	0.011	0.019
	[0.014]	[0.018]
EC Coefficient		
y_{it-1}	-0.513***	-0.475***
	[0.053]	[0.037]
t-statistic	-9.74	-13.00
Diagnostics		
RMSE	0.096	0.088
Stationarity ך	I(0)	I(0)
CD test	0.01	0.80
(p-value)	(0.989)	(0.422)
Observations (N)	1042 (38)	1329 (46)

Notes: For all other details see Table 4.3.

4.4.3.8 Heterogeneity by Natural Resource wealth

Countries with natural resources may be less inclined to raise domestic revenue through taxes; the decision-makers would not want to 'burden' their citizens with unpopular taxes when they can raise funds through their natural endowments. In a similar vein, the availability of natural resources may reduce the need for aid as recipients are more likely to raise domestic revenues if they want control over how funds are being used (Morrissey, 2015b). This is because aid is subject to conditionality, and resource revenues are more accessible and fungible: the revenue is obtained independently of the government's effort and a huge chunk of the proceeds from natural resource extraction goes to the state (von Haldenwang and Ivanyna, 2017). Thus, for countries with natural resources the accountability costs of taxation will be lower than the accountability of aid such that recipient governments do not necessarily prefer aid to tax; or that they would substitute aid for tax, with the net effect of aid on taxes unchanged (empirically, this will be reflected by an insignificant relationship between aid and taxes).

Table 4. 13: Heterogeneity in Natural Resource Wealth

	Natural Resources	**No Natural Resources**
Long-Run		
Aid/GDP	0.073	0.079**
	[0.056]	[0.032]
Short-Run		
Aid/GDP	0.026	0.011
	[0.028]	[0.013]
EC Coefficient		
y_{it-1}	-0.540***	-0.473***
	[0.062]	[0.035]
t-statistic	-8.77	-13.62
Diagnostics		
RMSE	0.104	0.086
Stationarity ר	I(0)	I(0)
CD test	-0.86	-0.82
(p-value)	(0.399)	(0.415)
Observations (N)	719 (26)	1652 (58)

Notes: 'Natural Resources' includes resource-rich countries with active extractive industries; oil, gas and mining as classified in IMF (2012) while 'No Natural Resources' includes non-resource-rich countries. For all other details see Table 4.3.

We distinguish resource rich (RR) from non-resource rich (NRR) countries, the classification based on the IMF (2012) categorization; with the former comprising countries are mineral and petroleum (oil, gas) producers.[66] For countries with natural resource wealth, aid has no effect on tax/GDP ratios while for those without natural resources the aid/GDP ratio has a long-run positive impact on the tax/GDP ratio. The absence of a significant long-run impact can be attributed to the costs of autonomy: countries with natural resources typically receive less aid[67] than their non-resource rich counterparts, thus are able to make independent policy decisions. Nonetheless, we do not overstate the results because the coefficients across both groups are quite identical: 0.073 (no significance) versus 0.079 (5% significance). This suggests that the former (countries with natural resources) is imprecisely estimated.

4.4.4 Endogeneity and Long-Run Causality

In table 4.14 we present results for weak exogeneity tests; using specifications of equations (4.6) and (4.7) with two lags. The results are based on the dynamic CCEMG model augmented with two lags of cross-section averages (this is the long-run relationship from which the disequilibrium term is constructed). In each row with 'equation', the specified variable is used as dependent variable in the ECM regression. We also report the panel robust $\hat{\theta}_i$ estimate, which exists only for the group-mean tests (Canning and Pedroni, 2008), and its associated t-statistic. We would expect a typically high t-statistic on the average $\hat{\theta}_i$ coefficients in the tax equations (which can be interpreted as evidence of a long-run causal relationship from aid to taxes) and a low t-statistic (below 1.96) in the aid equations (Eberhardt and Presbitero, 2015). In the last column, we report the share of countries in the sample (N_i/N) that fail to reject the null of 'no causal' impact.

In examining the details of Table 4.14, the first clear pattern is that both the GM and Fisher statistics consistently fail to reject the null of 'no causal impact'. In addition, the share of countries that fail to reject the null of 'no causal impact' from aid to tax is uniformly low across alternative specifications, typically below 40%. This provides strong evidence in favour of a long-run causal relationship from

[66] The mining countries include: Botswana, Chile, Colombia, Democratic Republic of Congo, Ghana, Guinea, Indonesia, Lesotho, Mauritania, Papua New Guinea, Sierra Leone, and Tanzania. The petroleum countries include: Algeria, Angola, Cameroon, Chad, Colombia, Congo Republic, Democratic Republic of Congo, Cote d'Ivoire, Ecuador, Equatorial Guinea, Indonesia, Iran, Mauritania, Mexico, Niger, Papua New Guinea, Philippines, Sudan, and Venezuela.

[67] Some of these countries are LDCs (for example, Tanzania, Chad, Niger and Sudan), thus they receive high amounts of aid. Nevertheless, the average resource rich country receives less aid than its non-resource rich counterpart.

aid/GDP to tax/GDP ratios, across different measures of aid and varying degrees of heterogeneity. The results conform to the statutory nature of tax systems such that tax policy, once implemented, is not easily reversed in the short-run. Hence changes in the level of aid induce permanent changes in the level of taxation.

With regard to the ECM specifications with aid as dependent variable, the results have five characteristic features. First, we cannot reject the null that tax/GDP ratios have a zero-average long-run impact on aid/GDP ratios; for the baseline estimates (the main behavioural representation from table 4.3) and across various degrees of heterogeneity. However, for the baseline estimates, we can conclude that the long-run impact of taxes on aid is not pervasively zero; such that changes in tax/GDP ratios may induce changes in the aid/GDP ratio in some, but not all countries. Furthermore 79% of countries fail to reject the null of 'no causal impact', suggesting that aid is potentially weakly exogenous. While aid is important for long-run taxation behaviour in developing countries (fiscal planners have expectations for aid as commitments are known in advance), the level of aid is independent of revenue performance in recipient countries. Second, grants are strongly weakly exogenous but *long-run forcing*; as they have a significant long-run impact on tax/GDP ratios. Accounting for the contemporaneous correlation between high grants and low tax-to-GDP ratios (through the heterogeneous ECM), we find that in the long-run the level of grants is independent of revenue performance in recipient countries.

Third, technical assistance is weakly exogenous, which is intuitive. As this is a measure of off-budget aid it is determined irrespective of the recipients' revenue and/or growth characteristics but it has a long-term beneficial impact on tax/GDP ratios. We also test for weak exogeneity of technical assistance for countries with revenue authorities (as technical support is given for tax administration and policy design, typical activities carried out by revenue authorities). Again, technical assistance is found to be weakly exogenous; such that tax/GDP ratios have a zero-average long-run impact on technical assistance in countries with revenue authorities, and changes in technical assistance induce permanent changes in taxes in those countries.

Fourth, reverse causality may be associated with revenue conditionality; such that countries with macroeconomic and structural weaknesses – reflected by low tax/GDP ratios- may request for IMF (and other donor-) support to improve their fiscal situation. As seen from Table 4.14, we are confident

that our results for donor conditionality are not driven by reverse causality. Long-run causation is uni-directional, from aid/GDP to tax/GDP and not vice-versa. Fifth, for countries with low aid volatility (low aid uncertainty and instability), long-run causation runs from the aid/GDP to the tax/GDP ratio.

Ultimately, given the data dimensions and characteristics, and given all the problems and caveats of individual country and panel exogeneity tests, we suggest most conservatively that long-run causation runs mainly from aid/GDP to tax/GDP ratios; with aid (and its components) being weakly exogenous. There is no 'donor disbursement rule' in which recipients' revenue performance influences the level of aid received.

Table 4. 14: Weak Exogeneity Tests

	GM	(p)	Fisher	(p)	Mean $\hat{\theta}_i$	t-stat	N_i/N
Baseline Estimates							
Tax Equation	-1.974	0.048	639.52	0.000	-0.493	-12.766	38%
Aid Equation	-0.124	0.901	212.12	0.012	-0.109	-1.044	79%
Heterogeneous Aid (1)							
Tax Equation	-2.114	0.034	668.827	0.000	-0.556	-15.044	33%
Grants Equation	-0.040	0.968	172.633	0.387	-0.080	-0.564	86%
Heterogeneous Aid (2)							
Tax Equation	-2.085	0.037	686.019	0.000	-0.586	-14.293	33%
TA Equation	-0.089	0.929	189.240	0.125	-0.094	-1.214	87%
Donor Conditionality							
Tax Equation	-1.827	0.068	373.22	0.000	-0.448	-9.192	40%
Aid Equation	-0.288	0.774	135.26	0.040	-0.227	-2.059	80%
No Recipient Reform							
Tax Equation (1)	-1.971	0.049	449.058	0.000	-0.467	-9.802	39%
Aid Equation	-0.275	0.783	147.025	0.036	-0.190	-1.503	76%
Recipient Reform[68]							
Tax Equation (2)	-2.160	0.031	220.733	0.000	-0.676	-12.144	16%
TA Equation	-0.409	0.683	53.073	0.357	-0.280	-1.690	88%
LDCs							
Tax Equation	-2.057	0.040	307.660	0.000	-0.495	-8.312	37%
Aid Equation	-0.293	0.770	103.093	0.021	-0.204	-1.830	79%

[68] This is based on table 4.10, in which the measure of aid is technical assistance.

Sub-Saharan Africa							
Tax Equation	-2.050	0.040	311.46	0.000	-0.535	-9.826	33%
Aid Equation	-0.278	0.781	91.361	0.181	-0.238	-2.149	85%
No Natural Resources							
Tax Equation	-2.024	0.043	477.460	0.000	-0.466	-9.878	40%
Aid Equation	-0.198	0.843	143.265	0.044	-0.206	-1.721	78%
Low Aid Uncertainty							
Tax Equation	-1.882	0.060	472.62	0.000	-0.464	-10.526	46%
Aid Equation	-0.022	0.983	148.42	0.105	-0.095	-0.737	84%
Low Aid Instability							
Tax Equation	-2.061	0.039	366.948	0.000	-0.465	-10.706	37%
Aid Equation	-0.133	0.894	90.496	0.525	-0.134	-1.328	83%

Notes:

(i) TA is technical assistance.

(ii)We report results only for significant long-run impacts from tables 4.3 to 4.13. We report both statistics developed by Canning and Pedroni (2008). GM denotes the group-mean statistic which is the average of country-specific t-ratios on the disequilibrium term which is distributed $N(0,1)$. Fisher is $-2\sum_{i=1}^{N}\ln\Pi$, where Π is the p-value of the country-specific t-value on the disequilibrium term. The Fisher statistic is distributed $x^2(2N)$. Both test statistics are for the null of 'no causal impact' which in our case can be interpreted as the variable not adjusting to maintain fiscal equilibrium. We also report the robust $\hat{\theta}_i$ estimate, and its associated t-statistic. In the last column, we report the percentage of countries in the sample that fail to reject the null of 'no causal' impact.

4.4.5 Alternative Dataset

To analyse the robustness of results to alternative data sets, the Combes *et al.,* (2016) (COT, 2016) dataset will be used. Combes *et al.,* (2016) use an annual dataset of 59 developing countries covering the period 1974 to 2010. Their analysis explores the determinants and effects of shifts in aid dependency on fiscal policy in developing countries: thus, they compile a dataset of many macroeconomic and institutional variables, details of which can be found in their paper. They use aid disbursement data, obtainable from the OECD's Query Wizard for International Development Statistics (QWIDS) database. Data on tax/GDP ratios are obtained from various international and internal IMF datasets.

Although the original COT (2016) dataset covers 59 countries over the period 1974 to 2010, some countries have many missing observations so they are dropped from the robustness analysis (these countries include Afghanistan, Bangladesh, Congo, Algeria, Cambodia, Laos, Liberia, Mongolia, Mauritania, El Salvador and the Democratic Republic of Congo), with effectively 47 countries used in the regression analysis. Furthermore, to ensure 'direct' comparability between the COT (2016) dataset and ours, we restrict our analysis to the period from 1980 onwards. This implies some countries from the original COT (2016) dataset lose few observations.[69]The COT (2016) dataset is essentially a subset of our dataset, hence the sample is smaller. Nonetheless, the time series are adequate to test for the robustness of our findings.

COT (2016) use two measures of aid in their analysis; the aid to GDP ratio and aid *per capita*. We use only the aid to GDP in our analysis for two reasons. First, *per capita* measures of aid are preferable when the objective is determining the effectiveness on specific social sector measures like health (for example the impact of *per capita* health aid on the infant mortality rate and/or the maternal mortality ratio) and education (for example the impact *per capita* education aid on secondary and primary school completion rates), gauging the impact of aid in reducing hardship. *Aid per capita* can be used if the aim of the study is to estimate the impact of foreign assistance on specific components of tax. As our measure of taxation is the total tax to GDP ratio, this makes aid *per capita* less intuitive. Second, it is standard practice in cross-country regressions to use the aid/GDP ratio as it captures the relative importance of aid.

[69] It would be reasonable to use the COT (2016) dataset as it is. However, of the 47 countries included 25 countries have a sample starting from 1980, with the other 22 having sample start dates varying from 1974 to 1980. Based on the econometric methods used, we posit that the few dropped observations would not influence our main results.

Results are presented in the appendix (Tables C7 to C14). The findings are broadly similar to the main analyses, and the political costs of aid and tax arguments are also applicable. (i) For the baseline heterogeneous specification, there is evidence of a positive long-run relationship between aid and taxes. (ii) Both LDCs and SSA show evidence of a positive long-run relationship (though no short-run relationship) between aid and taxes. (iii) For countries with *met* revenue conditionality there is a positive relationship between aid and taxes. (iv) Countries with low aid uncertainty show a positive relationship between aid and taxes while for countries with low aid instability, there is no significant relationship between the aid and tax ratios. (v) Countries non-reliant on natural resources there is a positive relationship between aid and taxes.

4.5 CONCLUSION

This chapter first examined the relationship between aid and taxes using heterogeneous (panel) time-series techniques to deal with problems creating dissension in cross-country aid-tax research: neglecting long-run levels relationships between aid and tax ratios (a result of persistence in fiscal data), measurement of aid and revenue in a way that captures behavioural effects, heterogeneity, endogeneity, cross-country correlation and causality between aid and taxes. Using data for 84 developing countries over the period 1980 to 2013, we find that aid and taxes comprise a long-run (equilibrium) cointegrated relation. Estimates show that on average, aid has a positive long run association with taxes and the effect is robust to outliers and empirical specification. The positive long-run relationship is also robust to sample selection, with an observed effect in least developed countries and countries in Sub-Saharan Africa. The effect of aid on tax reflects a revenue choice that differs across countries based on political economy factors, which donors may influence through technical support and conditionality, over which source of revenue meets government objectives (Morrissey, 2015b). Thus, our findings are consistent with the argument in section 4.1 that the political calculus may have shifted in favour of taxes, such that recipients prefer increasing taxes instead of depending on aid since the political costs of aid are higher.

Correlations between aid and taxes have been mistaken for causation in the revenue (tax) performance literature, and empirical evidence may suggest that aid (especially in the form of grants) discourages tax effort. Given the structure of the economy (low tax bases created, in part, by high informal and subsistence agricultural sectors), aid goes to countries with *ex ante* lower income levels (hence lower tax/GDP ratios and higher need), independent of their tax effort (or implied lack thereof). Sceptics,

backed by cross-country empirical evidence, point to this contemporaneous correlation as aid having a behavioural effect on tax effort (with this perceived effect stronger for lower income countries based on the argument above). As countries experience growth, one typically observes a corresponding increase in the tax base (increases in income levels with increases in tax revenues) and a decline in the level of aid (as the need for aid decreases). Using an ECM framework allows this negative contemporaneous correlation between aid and taxes to be accounted for by distinguishing the short-run from the long-run (the period within which aid might have any behavioural effects on taxes); and the evidence points to a positive long-run association between aid and taxes. Insignificant short-run results are also intuitive. Tax/GDP ratios exhibit high persistence in the short-run, stymying any potential impact aid/GDP ratios can have on revenue performance (as measured by the tax/GDP ratio). Furthermore, tax administrators' and policy makers' behaviour also display considerable persistence so taxes do not easily adjust to changes to aid. These explain the insignificant short-run results for the aid/GDP ratio.

The importance of aid heterogeneity, with different effects for grants and loans, is confirmed in this chapter. The argument that aid grants tend to reduce effort while aid loans encourage tax effort is tenuous: there are associations between aid and tax in the data, largely due to structural characteristics of the economy whereby high aid receipts (especially in the form of grants) are associated with determinants of tax revenue. In this chapter, we find that grants are associated with increased tax/GDP ratios while loans have no impact on taxes. We argue that grants are associated with higher costs of accountability than taxes, for both recipients and donors, since they are disbursed with more stringent monitoring mechanisms and conditions. Increased accountability costs translate to increased costs of autonomy (reflected by the absence of autonomy) for the recipient as they have to expend effort in circumventing donors' monitoring mechanisms and conditionality. Technical assistance is particularly crucial in improving revenue performance in developing countries, especially in countries engaged in revenue reform; through improving the design and implementation of tax policy reforms, and improving processes to increase tax collection efficiency. Such technical support from donors will help to reduce the bureaucratic costs of taxation, thereby assisting a transition to increase domestic revenue.

The revenue choice between aid and taxes depends on domestic political economy factors which may also be influenced by donors through aid conditionality; though there are two innate limitations with modelling revenue conditionality in aid programs: (i) The measure of conditionality is too narrow since

it considers only IMF conditionality (see section 4.1 for an argument on why this is appropriate); and donor proliferation ensures that they have varying motivations for providing aid. (ii) Revenue conditionality changes over the years (over the years countries move across conditionality spectra, ranging from prior actions to structural benchmarks) and empirical specifications cannot easily account for these transitions. The importance of aid conditionality in improving revenue performance, however, is confirmed in this chapter. For countries with met revenue conditionality there is a positive association between aid and taxes. This positive relationship can be related to the political costs of autonomy; countries that meet donors' conditions have more leverage in negotiating future conditionality, if any, as well as the ability to make independent policy choices.

Using recently developed tests for the direction of long-run causality in panel time-series econometrics we can isolate the presence of an effect of aid (its components, as well as conditions and technical support associated with it) on taxes while simultaneously controlling for the reverse effect that taxes are likely to have on aid. Across different specifications, we find that causality between aid and taxes is uni-directional; with pervasive evidence for long-run causality from aid to taxes. This underscores the argument that previous research in the area tends to treat correlation as causation.

Understanding the characteristics of aid and taxation data, as well as the relationship between aid, donors and taxation informs the appropriate analytical method. Given that cross-country heterogeneity is pervasive and entrenched, aid and tax data are characterised by persistence, and the need to distinguish long-run (equilibrium) from short-run dynamics an error correction model representation is appropriate. An added advantage of the ECM is it controls for the contemporaneous correlation between aid (and policy 'favourite', grants) and taxes, while allowing for an agnostic, albeit long timeframe within which aid can influence taxes. Once these salient features are incorporated into econometric specifications, results are consistent across datasets. Average estimates differ across both datasets in this chapter, but the common result is a positive association between aid and taxes. This chapter does not make claims about robust results across datasets. However, there are unique features of aid and fiscal data which, in addition to the broader donor-recipient relationships, must be accounted for. When these features are incorporated, there might be a preponderance of a positive relationship between aid and taxes.

5. CONCLUSION

Aid, its composition, perceived and desired effects are characterised by heterogeneity. Morrissey and Torrance (2015 pg. 2) state that "*because aid is multifaceted and varied; each of the many donors give different types of aid in different amounts, with differing procedures and to serve varying motivations*". We can identify three key aspects of the above statement, and how they relate to the chapters of this thesis. First, aid is multifaceted and varied: it could be earmarked for specific sectors (for example, the health sector, the focus of chapter 2) or given as general budget support, in which case donors' and recipients' intentions are aligned. Second, donors give different types of aid in different amounts. This relates to on-budget aid (given directly to the recipient government), either in grants (which do not require repayment) or loans (which must be repaid, albeit typically on concessional terms); and off-budget aid (which is not given to the recipient government) such as technical assistance or donor-funded projects. The heterogeneous effects of on-budget and off-budget aid are emphasized in chapters 3 and 4. Third, aid is disbursed with differing procedures to serve varying motivations. This is related to the fact that aid can be disbursed through bilateral or multilateral agencies, through NGOs or Public-Private Partnerships (health aid allocation patterns of nine major donors are explored in chapter 2); aid disbursement can be in response to recipients' income and/or epidemiological needs or donors trying to strengthen their foreign policy (the dichotomy between recipients' needs and donors' interests also explored in chapter 2); donors providing aid for different expenditure headings (chapter 3); or the intended effects of aid on domestic revenue mobilisation, such as through tax policy reform and tax-related conditionality (chapter 4).

Chapter 2 of the thesis set out to address the multifaceted nature of aid, and assess the competing hypotheses underpinning the allocation of health aid in Sub-Saharan Africa. Focus on health aid is borne out of the fact that income trends in the region have only increased mildly, with some of countries in the SSA region still impoverished. In addition, there are pressing health demands which need to be addressed in the region, the recent scourge of HIV/AIDS being the most obvious. Hence, do donors give these pressing health needs and income levels the same weighting as their personal interests in disbursing health aid? That is the main question answered in chapter 2, with three main objectives: (1) Estimate the health aid allocation patterns of seven major international donors, (2) test for changed allocation behaviour after the Millennium Declaration, and (3) estimate the allocation

patterns of the two most influential Public-Private Partnerships and compare to the more traditional donors. To this end, health aid disbursement data was obtained from the Institute of Health Metrics and Evaluation (IHME) database, for 44 SSA countries and 9 donors (seven traditional donors and two PPPs) covering the period 1990 to 2011.

In the first part of the chapter, we estimate aid allocation patterns of seven major donors (five bilateral and two multilateral donors) using a Double-Hurdle estimator which allows for differences between the selection of potential recipients of health aid, and disbursement of health aid to said recipients. This allows for the possibility that variables determining selection may be different from those determining disbursement of funds. The main finding is large, pervasive heterogeneity amongst donors. Furthermore, donors do not necessarily place equal weights on recipients' needs or their own interests, but are influenced by both in their health aid allocation practice.

Next, we tested for changed allocation patterns post the Millennium Declaration. The Millennium Declaration brought into light the challenging health demands facing most LDCs and we sought to investigate if donors changed their health aid allocation patterns with respect to the health-related recipient need variables. To this end, we use Chow tests to evaluate changed importance of health-related variables. We find only modest changes over time: pre- and post the Millennium Declaration, the health-related need variables were consistently important in health aid allocation practice.

The last part of the chapter estimated the allocation patterns of the two biggest PPPs worldwide (the GAVI Alliance and the Global Fund to fight AIDS, Tuberculosis and Malaria), making use of recently available data on some key recipient need and merit variables used by PPPs, and modelling as closely as feasible the decision and allocation patterns of the PPPs based on their old funding models (see Ottersen *et al.,* 2014 for details). While we also find the PPPs to be heterogeneous among themselves, they are more homogeneous in their selection and allocation patterns in comparison with traditional donors. PPPs are more expansive in their selection practice, in part reflecting their purpose of inception (streamlining efforts to tackle some salient health deficiencies in LDCs).

Donor heterogeneity (fragmentation) and proliferation makes it difficult to estimate average donor behaviour, as a non-weighted average of different donors, in aid allocation practice. The variables determining selection of potential recipients and disbursement of funds differ fundamentally across donors: donors are influenced by the constellation of variables. Such fragmentation may impinge on the

expectations of aid's effectiveness; with efforts to harmonize health aid disbursement inadvertently limited in their success. A promising initiative, however, is to provide health aid through PPPs.[70] By their purposes of creation, they can have galvanising effects on improving social outcomes in developing countries. IHME (2013, p. 56) states that "*Public-Private Partnerships were established to streamline efforts to address a few key global areas, with a view to improving the effectiveness of each DAH dollar, and have grown substantially through their inception*". PPPs, in collaboration with NGOs, also play a salient role in delivering health services in developing countries (for example, vaccinating children, running public health campaigns, servicing health facilities). As sector aid typically includes financial and in-kind contributions, PPPs can easily monitor the disbursement and use of in-kind contributions since it will be administratively costly for bilateral or multilateral organisations to do so.

While chapter 2 considered donor heterogeneity in terms of determinants of their health aid allocation, chapters 3 and 4 focused on heterogeneity from the recipients' perspective, within a fiscal response context. Hence chapters 3 and 4 of the thesis contribute to the body of literature on the fiscal effects of aid.

Chapter 3 is premised on the difference in the impact of on-budget and off-budget aid on government spending in developing countries. The chapter posits that because much of the aid given to a recipient country goes to the government, or finances services that would otherwise be a demand on the budget, it is expected to have a direct effect on recipient countries' government expenditures. Additionally, substantial amounts of aid do not go to recipient countries but provide services (for example, consultancy services which enhance capacity building) and fund projects that still generate fiscal responses from recipients. Hence, we investigate if foreign aid (and its different components, loans and grants) and technical assistance (a proxy for off-budget aid) are related to total spending over time on average. The salient contribution of this chapter is methodological. Given that aid and fiscal data are characterised by high degrees of persistence, and the need to distinguish long-run (equilibrium) from short-run dynamics an error correction model (ECM) representation is most appropriate. We employ common factor models (heterogeneous panel techniques) developed by Pesaran (2006), robust to omitted variables and endogeneity created by unobserved common factors. The common factor approach allows for cross-section correlations in the data, created by global shocks that affect countries to varying degrees, and represented by unobserved common factors. Another advantage of the panel

[70] This also holds for aid to other sectors (for example, education aid) as well as general aid.

time-series techniques is they allow agnosticism about the endogeneity of variables; and simultaneity and endogeneity is addressed using recently developed tests for the direction of long-run causality (Canning and Pedroni, 2008). To this end, we estimate models on the impact of aid and taxes on spending in 69 developing countries, covering the period 1980 to 2013; within an underlying budgetary framework.

We show that aid (and its components) form a cointegrated (equilibrium) relationship with taxes and spending, and on average aid and taxes have a positive long-run and short-run impact on spending. The aid coefficients are positive but smaller than the tax coefficients, indicating that in the long-run and short-run taxes have a stronger association with expenditures than aid. The small effect of aid on spending points to a broader catalytic impact aid has on domestic revenue mobilization in developing countries, an analysis of which is carried out in chapter 4.

Chapter 4 builds on the analysis from chapter 3 by focusing on the impact of aid (on- and off-budget) on domestic revenue mobilization in developing countries. The chapter contributes to the cross-country literature on tax effort in two ways. First, given recipients' difficulties in raising revenue domestically, there is considerable heterogeneity in the way aid can shape tax performance in developing countries: through behavioural effects, technical assistance, donor conditionality, recipient policy reform, through the stability of donor-recipient relationships; and the effects are country-specific. These different mechanisms are explored in the chapter, permitting broader evidence and inference than has previously been available in the literature. Second, the chapter adds to the existing literature using a novel methodology. Empirical focus is on disentangling these mechanisms using econometric techniques that account for time-series properties of fiscal data, cross-country heterogeneity (created by domestic political and economic factors) and the distorting impact of cross-country correlation (induced by global shocks and/or spatial spill-overs). Thus, in the spirit of chapter 3, we estimate the long-run impact of aid (and its components) on the tax/GDP ratio across 84 developing countries covering the period 1980 to 2013 by applying the dynamic Common Correlated Effects Mean Group (CCEMG) estimator (Chudik and Pesaran, 2015). In this chapter we invoke the political calculus argument in discussing the results (Morrissey and Torrance, 2015; Morrissey, 2015b); stating that there are attendant political costs of aid and taxation (evaluated according to autonomy, accountability and bureaucratic costs) and the costs offset each other.

The overarching finding is a positive, robust long-run impact of aid on taxes; and the results provide insights to show that donors can support increasing tax revenue rather than allowing aid to substitute for domestic effort. Sole focus on the amount of aid, as is common in the cross-country literature, is inevitably fragile since the aid-tax link depends as mush on technical assistance (for example, capacity building) and the broader donor-recipient relationship. Nevertheless, donors can support increasing domestic revenue mobilization by providing technical assistance for the implementation of tax administration reform. A promising avenue for improving revenue administration is the Tax Administration Diagnostic Assessment Tool (TADAT); that allows institutional reforms to be structured according to administrative needs and characteristics of individual countries. A specific advantage of TADAT is that it identifies weaknesses in the taxation system (where the problems lie) and prioritises the order in which tax issues need to be addressed to improve administration and promote domestic revenue mobilization.

While the thesis contributes to the aid allocation and fiscal effects literatures, there is still scope for further research. In evaluating the determinants of health aid allocation in chapter 2, domestic government health expenditure as a source (GHE-s) was not included. This constitutes a serious omission as while aid is complementary in financing health expenditures, most of the expenditures are covered by recipient countries themselves. IHME (2013) shows that GHE-s is constantly bigger than DAH by a very large margin (GHE-s was at $613.5 billion in 2011) and GHE-s growth is constantly bigger than DAH growth. In addition, GHE-s represents an adequate measure of a recipient country's efforts towards increasing health conditions of its citizens. However, due to data unavailability GHE-s was not included in the analysis. The data, obtainable from the World Health Organization (WHO) Government Expenditure database, are available only from 1995 onwards for most countries, significantly reducing our sample size. With increased data availability, including government health expenditures as a source in future evaluations of determinants of DAH could potentially improve the model by controlling for a more encompassing measure of recipients' efforts in improving their health outcomes.

Chapters 3 and 4 of the thesis take a different dimension in discussing the fiscal effects of aid, emphasising the political calculus recipient governments make in deciding between aid and taxes as sources of revenue. While the cross-country empirical evidence presented in the chapters suggests that the political calculus may have shifted in favour of taxation (with the political costs of tax reducing over

the years), there is no explicit measure of political costs included in the analysis. Anecdotal evidence, using country-specific studies, will be a logical step in quantifying said political costs. For example, the taxation data for a single recipient (for example, Rwanda) can be matched to aid for DRM from its biggest donor(s); from which patterns between aid and taxation can easily be deciphered. In the case of one big donor to Rwanda, costs of autonomy, accountability and bureaucracy will easily be established.

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APPENDIX A

Appendix Table A 1: Variable Definitions, Sources and Expected Signs

S/N	Variable Name	Definition	Source	Expected sign with respect to DAH
		Health-Related Need Variables		
1.	Under-five mortality rate	This is the probability per 1,000 new births that a new born baby will die before the age of five, if subject to age-specific mortality rates of the specified year. It is a measure of severe deprivation in health.	World Development Indicators (WDI)	Positive
2.	HIV prevalence rate	This refers to the percentage of people aged 15-49 who are infected with HIV. Increases in this rate reflect the burden of HIV on the population.	WDI	Positive
3.	Tuberculosis prevalence rate	The number of cases of tuberculosis (all forms) in a population at a given point in time (the middle of the calendar year), expressed as the rate per 100 000 population. It is sometimes referred to as "point prevalence". Estimates include cases of TB in people with HIV. Published values are rounded to three significant figures. Uncertainty bounds are provided in addition to best estimates.	African Development Indicators (ADI)	Positive
4.	Infant Mortality Rate		WDI	Positive
		Broader Economic Need Variables		
5.	GDP *Per Capita* PPP	Gross domestic product divided by midyear population of the recipient country, converted to US dollars using purchasing power parity rates. It is a broad measure of development need by the recipients.	WDI	Negative
6.	GDP *Per Capita* Atlas Method	GNI per capita (formerly GNP per capita) is the gross national income, converted to U.S. dollars using the World Bank Atlas method, divided by the midyear population. GNI is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad.	WDI	Negative
7.	Population	Total population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship--except for refugees not permanently settled in the country of asylum, who are generally considered	WDI	positive

		part of the population of their country of origin. The values shown are midyear estimates.		
8.	Non-Health Aid	This is a measure of the amount of aid from a donor to a recipient (or group of recipients) which is not given for health-related purposes. It includes all measures of development aid (humanitarian aid inclusive). It is calculated by taking the difference of total ODA disbursements and DAH disbursements from specific donors to recipients.	OECD/DAC and IHME (2015)	Positive/Negative
Recipients' Merit Variables				
9.	GDP *Per Capita* growth	Annual average growth rates *Per Capita* GDP.	UNCTAD	Positive
10.	Trade (% of GDP) (Openness)	Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.	WDI	Positive
11.	Democracy	We have measured democracy using The Polity IV dataset. The Polity IV democracy measure ranges from 0 (least democratic) to 10 (most democratic).	Polity IV dataset	Positive
12.	Immunization of Measles	Child immunization measures the percentage of children ages 12-23 months who received vaccinations before 12 months or at any time before the survey. A child is considered adequately immunized against measles after receiving one dose of vaccine.	WDI	Positive
13.	IDA Resource Allocation Index (IRAI)	IDA Resource Allocation Index is obtained by calculating the average score for each cluster and then by averaging those scores. For each of 16 criteria countries are rated on a scale of 1 (low) to 6 (high).	WDI	Positive
Donors' Interest Variables				
14.	Exports	Amount of bilateral exports between a donor and recipient(s). It is actual exports, not exports as a percentage of GDP	OECD-DAC	Positive
Control Variables				
15.	Language	This is a dummy variable which takes on the value one if the recipient uses the donor's language as an official language in its country. Zero otherwise.	CIA World Factbook	Positive
16.	Colony	This is a dummy variable which takes the value of one if the country is a former colony of the donor and zero otherwise.	CIA World Factbook	Positive
Dependent Variable				

18.	Per capita health aid disbursements (DAH)	Financial and in-kind contributions made by channels of development assistance to improve health in developing countries. It includes all disease-specific contributions as well as general health sector support, and excludes support for allied sectors.	IHME (2015)	N/A

Appendix Table A 2: Descriptive Statistics

	Variable	Observations	Mean	Std. Dev.	Min	Max
	Log (GDPpc International $PPP)	956	7.62	0.95	5.00	10.57
	Log (HIV Prevalence)	946	0.87	1.45	-2.30	3.36
	Log (TB Prevalence)	968	5.68	0.75	3.37	7.46
	Log (Population)	968	15.54	1.58	11.16	18.92
	Log (Under-5 Mortality Rate)	968	4.76	0.53	2.65	5.79
	Log (Openness)	947	4.18	0.53	2.37	6.28
	Democracy	921	0.55	5.29	-10.00	9.00
	Immunization of Measles	946	67.70	19.13	12.00	99.00
	GDP *Per Capita* Growth	964	1.39	7.64	-50.24	91.97
	Log (Infant Mortality Rate)	968	81.21	29.89	12.20	165.8
	Log (GDPpc Atlas Method)	946	7.37	0.93	5.24	10.42
	IDA Resource Allocation Index	290	3.19	0.53	1.40	4.20
	Log (Total Bilateral Health Aid *Per Capita*)	352	11.50	7.67	0	20.10
	Log (Total Multilateral Health Aid *per capita*)	352	13.37	5.58	0	18.90
	Log (Total Health Aid *Per Capita*)	968	0.98	0.38	0	4.80
UK	Colony	968	0.34	-	0	1
	Language	968	0.48	-	0	1
	Log (Exports)	968	3.39	1.87	-4.61	8.55
	Log (Non-Health Aid)	843	15.45	2.47	9.78	21.94
	Log (Health Aid *Per Capita*)	968	0.13	0.28	0	0.22
Fra	Colony	968	0.36	-	0	1
	Language	968	0.41	-	0	1
	Log(Exports)	968	4.22	1.87	-4.61	8.04
	Log (Non-Health Aid)	932	16.61	1.87	10.07	21.51
	Log (Health Aid *Per capita*)	968	0.18	0.36	0	2.67
Germany	Log (Exports)	968	3.51	1.76	-4.61	9.38
	Log (Non-Health Aid)	915	16.50	1.83	9.22	21.34
	Log (Health Aid *Per Capita*)	968	0.88	0.17	0	1.91
USA	Language	968	0.48		0	1
	Log (Exports)	968	3.61	2.25	-4.61	8.86
	Log (Non-Health Aid)	935	16.46	1.98	7.71	21.23

	Log (Health Aid *Per Capita*)	968	0.38	0.59	0	4.80
Sweden	Log (Exports)	968	1.31	2.27	-8.11	7.37
	Log (Non-Health Aid)	813	14.92	2.18	9.29	19.31
	Log (Health Aid *Per Capita*)	968	0.06	0.15	0	1.29
EC	Log (Non-Health Aid)	949	17.32	1.28	11.62	19.93
	Log (Health Aid *Per Capita*)	968	0.15	0.24		2.22
IDA	Log (Non-Health Aid)	721	17.67	1.46	11.81	20.75
	Log (Health Aid *Per Capita*)	968	0.35	0.45	0	2.58
GAVI	Log (Health Aid *Per Capita*)	352	0.16	0.20	0	0.99
GFATM	Log (Health Aid *Per Capita*)	352	0.68	0.70	0	3.06

Appendix Table A 3: Determinants of Health Aid- Selection Stage (IV Probit)

	UK	France	Germany	USA	Sweden	EC	IDA
Recipients' Needs							
Under-five Mortality Rate	-0.891 (0.061)	-0.036 (0.041)	-0.074 (0.049)	0.103** (0.048)	0.084 (0.054)	-0.036 (0.047)	0.162*** (0.039)
HIV Prevalence Rate	0.034** (0.012)	0.003 (0.015)	0.031*** (0.011)	0.024** (0.010)	0.090*** (0.011)	0.035** (0.010)	-0.075*** (0.008)
Tuberculosis Prevalence Rate	0.013 (0.018)	0.127*** (0.027)	-0.044** (0.018)	0.034** (0.055)	0.034* (0.019)	-0.060*** (0.018)	-0.059*** (0.020)
GDP *Per Capita*	-0.198*** (0.023)	0.002 (0.026)	-0.068*** (0.020)	-0.011 (0.023)	-0.052** (0.024)	-0.056** (0.025)	-0.098*** (0.018)
Population	0.105*** (0.018)	-0.009 (0.024)	0.111*** (0.021)	0.154*** (0.015)	0.019 (0.020)	0.040*** (0.014)	0.096*** (0.010)
Recipients' Merits							
GDP *Per Capita* Growth	0.004* (0.002)	0.003* (0.002)	0.0004 (0.002)	0.002 (0.002)	-0.001 (0.002)	0.001 (0.002)	-0.001 (0.002)
Openness	0.170*** (0.033)	-0.038 (0.033)	0.044 (0.032)	0.012 (0.032)	-0.058 (0.039)	0.095*** (0.038)	-0.009 (0.031)
Democracy	0.003 (0.002)	-0.008*** (0.003)	-0.003 (0.003)	-0.001 (0.002)	0.005* (0.003)	0.004 (0.003)	0.003 (0.002)
Immunization	0.00002 (0.001)	-0.002** (0.001)	0.0004 (0.001)	0.003*** (0.001)	0.004*** (0.001)	-0.005*** (0.001)	0.006*** (0.001)
Donors' self-interest							
Exports	0.045*** (0.012)	0.038** (0.018)	-0.004 (0.015)	0.007 (0.007)	0.064*** (0.010)		
Control Variables							
Colony	0.247*** (0.049)	0.114* (0.063)					
Language	0.145*** (0.040)	0.363*** (0.056)		0.074** (0.031)			
Diagnostics							
Observations	736	736	736	736	736	736	820
Log-likelihood	1233.99	1222.68	1193.29	1277.58	1211.24	1188.47	1362.25
x^2	426.52	207.32	332.77	210.17	257.90	91.20	336.47

Notes:

(i) We estimate the selection probability (1 = receives health aid; 0 = does not receive health aid) based on an Instrumental Variable (IV) Probit maximum likelihood. All time-varying regressors except democracy, immunization and GDP per capita growth are logged. Heteroscedasticity and correlation-robust standard errors are reported in brackets. All equations include a constant term and a full set of time dummies (none of which are reported).

(ii) All time-varying explanatory variables are lagged one period.

(iii) ***, ** and * denote significance at 1, 5 and 10 per cent respectively.

(iv) The chi-squared statistic is for the test of joint significance of all regressors in the model. The p-values of the test have not been reported but for all donors, the test statistic is significant at 1 per cent.

Appendix Table A 4: Determinants of Health Aid- Allocation Stage (2SLS)

	UK	France	Germany	USA	Sweden	EC	IDA
Recipients' Needs							
Under-five Mortality Rate	-0.115 (0.091)	-0.036 (0.056)	-0.106** (0.046)	-0.087 (0.197)	0.225* (0.116)	0.013 (0.067)	-0.278*** (0.101)
HIV Prevalence Rate	0.051*** (0.019)	-0.044** (0.017)	0.038** (0.015)	0.198*** (0.048)	0.041* (0.020)	0.038*** (0.014)	-0.038* (0.022)
Tuberculosis Prevalence Rate	0.040 (0.032)	-0.011 (0.030)	0.012 (0.020)	0.029 (0.061)	-0.0001 (0.034)	0.049** (0.022)	-0.006 (0.038)
GDP *Per Capita*	-0.269*** (0.047)	0.032 (0.054)	-0.006 (0.038)	-0.016 (0.073)	0.048* (0.028)	0.057 (0.037)	0.030 (0.052)
Recipients' Merits							
Population	-0.076** (0.030)	-0.120*** (0.033)	-0.062** (0.027)	-0.079 (0.062)	-0.041 (0.029)	-0.074*** (0.015)	-0.134*** (0.024)
GDP *Per Capita* Growth	-0.006 (0.005)	-0.00004 (0.002)	0.003* (0.002)	0.010*** (0.003)	-0.0003 (0.003)	-0.002 (0.002)	0.004 (0.003)
Openness	0.138** (0.060)	-0.065 (0.057)	-0.038 (0.046)	0.026 (0.149)	-0.030 (0.041)	-0.013 (0.041)	-0.096 (0.078)
Democracy	0.009 (0.006)	0.001 (0.004)	0.002 (0.004)	0.023*** (0.009)	-0.001 (0.003)	0.0002 (0.004)	-0.002 (0.005)
Immunization	0.002 (0.002)	-0.0003 (0.001)	-0.001 (0.001)	0.003 (0.003)	0.002 (0.002)	-0.002** (0.001)	0.002 (0.002)
Donors' self-interest							
Exports	0.077** (0.030)	0.042 (0.030)	-0.009 (0.019)	0.047** (0.023)	0.007 (0.020)		
Control Variables							
Colony	0.228** (0.102)	0.074 (0.073)					
Language	-0.024 (0.068)	0.035 (0.060)		-0.076 (0.124)			
Diagnostics							
Observations	370	526	435	540	316	592	557
R-Squared	0.530	0.472	0.252	0.413	0.273	0.285	0.448

Notes:

(i) The dependent variable here is logged per capita health aid. The 2SLS estimator is conditional on receiving per capita health aid. Standard errors are reported in parentheses. All time-varying regressors except democracy, immunization, and GDP per capita growth are logged. All time-varying regressors are lagged one period.

(ii) Clustering is done at the country-year level. This is to purge the regressions of any heteroscedasticity and serial correlation. All equations include a constant term and a full set of time dummies.

(iii) ***, ** and * denote significance at 1, 5 and 10 per cent respectively.

Appendix Table A 5: Determinants of Health Aid-Selection Stage (Infant Mortality Rate)

	UK	France	Germany	USA	Sweden	EC	IDA
Recipients' Needs							
Infant Mortality Rate	-0.140**	-0.050	-0.132**	0.041	0.070	-0.035	0.174***
	(0.058)	(0.048)	(0.055)	(0.053)	(0.062)	(0.055)	(0.045)
HIV Prevalence Rate	0.031***	0.004	0.033***	0.023**	0.090***	0.034***	-0.073***
	(0.011)	(0.014)	(0.010)	(0.010)	(0.011)	(0.010)	(0.008)
Tuberculosis Prevalence Rate	0.022	0.125***	-0.039**	0.029*	0.029	-0.056***	-0.063***
	(0.017)	(0.026)	(0.018)	(0.016)	(0.019)	(0.018)	(0.020)
GDP *Per Capita*	-0.242***	-0.010	-0.077***	-0.028	-0.056**	-0.055**	-0.099***
	(0.022)	(0.026)	(0.020)	(0.025)	(0.024)	(0.025)	(0.018)
Population	0.108***	-0.021	0.112***	0.157***	0.011	0.040***	0.100***
	(0.017)	(0.024)	(0.020)	(0.015)	(0.020)	(0.014)	(0.010)
Recipients' Merits							
GDP *Per Capita* Growth	0.005***	0.003	0.001	0.003*	-0.001	0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Openness	0.181***	-0.031	0.060*	0.011	-0.066*	0.104***	-0.010
	(0.033)	(0.033)	(0.032)	(0.032)	(0.039)	(0.038)	(0.031)
Democracy	0.003	-0.007***	-0.003	-0.001	0.004*	0.003	0.002
	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)
Immunization	0.0002	-0.002**	0.0004	0.002**	0.003***	-0.005***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Donors' self-interest							
Exports	0.050***	0.043**	-0.006	0.005	0.070***		
	(0.011)	(0.018)	(0.014)	(0.007)	(0.010)		
Control Variables							
Colony	0.242***	0.106*					
	(0.045)	(0.062)					
Language	0.123***	0.360***		0.079**			
	(0.037)	(0.053)		(0.031)			
Diagnostics							
Observations	773	773	773	773	773	773	857
Log-likelihood	-281.25	-293.01	-326.18	-253.87	-307.70	-336.77	-321.35
x^2	461.33	217.56	355.05	222.98	274.84	93.53	354.34

Notes:

(i) We estimate the selection probability (1 = receives health aid; 0 = does not receive health aid) based on a pooled Probit maximum likelihood. All time-varying regressors except democracy, immunization and GDP per capita growth are logged. Heteroscedasticity and correlation-robust standard errors are reported in brackets. All equations include a constant term and a full set of time dummies (none of which are reported).

(ii) All time-varying explanatory variables are lagged one period.

(iii) ***, ** and * denote significance at 1, 5 and 10 per cent respectively.

(iv) The chi-squared statistic is for the test of joint significance of all regressors in the model. The p-values of the test have not been reported but for all donors, the test statistic is significant at 1 per cent.

Appendix Table A 6: Determinants of Health Aid- Allocation Stage (Infant Mortality Rate)

	UK	France	Germany	USA	Sweden	EC	IDA
Recipients' Needs							
Infant Mortality Rate	-0.283**	-0.047	-0.133**	-0.287	0.200	0.001	-0.354***
	(0.124)	(0.085)	(0.060)	(0.250)	(0.130)	(0.085)	(0.118)
HIV Prevalence Rate	0.046**	-0.043**	0.039**	0.190***	0.034	0.037**	-0.037*
	(0.018)	(0.017)	(0.016)	(0.047)	(0.022)	(0.014)	(0.022)
Tuberculosis Prevalence Rate	0.061**	-0.006	0.017	0.050	-0.013	0.047**	0.002
	(0.030)	(0.030)	(0.021)	(0.067)	(0.037)	(0.023)	(0.038)
GDP *Per Capita*	-0.304***	0.029	-0.011	-0.055	0.048	0.050	0.024
	(0.053)	(0.057)	(0.039)	(0.078)	(0.031)	(0.036)	(0.056)
Population	-0.066**	-0.120***	-0.061**	-0.068	-0.044	-0.072***	-0.136***
	(0.027)	(0.035)	(0.026)	(0.062)	(0.034)	(0.015)	(0.026)
Recipients' Merits							
GDP *Per Capita* Growth	-0.005	0.00003	0.003	0.010***	-0.0003	-0.002	0.004
	(0.004)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)
Openness	0.178**	-0.064	-0.030	0.059	-0.035	-0.007	-0.077
	(0.067)	(0.058)	(0.046)	(0.152)	(0.049)	(0.041)	(0.079)
Democracy	0.008	0.001	0.001	0.020**	-0.001	0.0003	-0.001
	(0.007)	(0.004)	(0.004)	(0.009)	(0.002)	(0.004)	(0.005)
Immunization	0.001	-0.001	-0.001	0.002	0.002	-0.002**	0.002
	(0.002)	(0.001)	(0.001)	(0.003)	(0.002)	(0.001)	(0.002)
Donors' self-interest							
Exports	0.076**	0.042	-0.008	0.044*	0.005		
	(0.030)	(0.031)	(0.019)	(0.023)	(0.020)		
Control Variables							
Colony	0.265**	0.090					
	(0.100)	(0.074)					
Language	-0.061	0.010		-0.076			
	(0.066)	(0.055)		(0.124)			
Diagnostics							
Observations	381	551	442	565	327	616	561
R-Squared	0.551	0.459	0.257	0.405	0.240	0.290	0.456

Notes:

(i) The dependent variable here is logged per capita health aid. The OLS estimator is conditional on receiving per capita health aid. Standard errors are reported in parentheses. All time-varying regressors except democracy, immunization, and GDP per capita growth are logged. All time-varying regressors are lagged one period.

(ii) Clustering is done at the country-year level. This is to purge the regressions of any heteroscedasticity and serial correlation. All equations include a constant term and a full set of time dummies.

(iii) ***, ** and * denote significance at 1, 5 and 10 per cent respectively.

Appendix Table A 7: Determinants of Health Aid-Selection Stage (Non-Health Aid)

	UK	France	Germany	USA	Sweden	EC	IDA
Recipients' Needs							
Under-five Mortality Rate	-0.036 (0.047)	-0.027 (0.038)	0.007 (0.044)	0.023 (0.044)	0.181*** (0.037)	-0.021 (0.046)	0.073 (0.047)
HIV Prevalence Rate	0.014 (0.012)	0.016 (0.015)	0.017 (0.011)	0.010 (0.010)	0.067*** (0.011)	0.031*** (0.010)	-0.031*** (0.010)
Tuberculosis Prevalence Rate	-0.020 (0.019)	0.111*** (0.026)	-0.069*** (0.017)	0.025 (0.016)	-0.007 (0.018)	-0.062*** (0.018)	-0.047*** (0.018)
GDP *Per Capita*	-0.184*** (0.025)	0.013 (0.023)	0.036 (0.026)	0.010 (0.021)	0.087*** (0.022)	-0.032 (0.025)	0.006 (0.018)
Population	0.013 (0.022)	-0.036* (0.024)	0.058*** (0.022)	0.172*** (0.017)	-0.006 (0.016)	0.026* (0.016)	0.086*** (0.018)
Recipients' Merits							
Non-Health Aid	0.073*** (0.009)	0.075*** (0.013)	0.109*** (0.013)	0.010 (0.012)	0.092*** (0.005)	0.047*** (0.014)	0.024* (0.013)
GDP *Per Capita* Growth	0.004* (0.002)	0.002 (0.002)	0.001 (0.002)	0.002 (0.002)	-0.003 (0.002)	0.001 (0.002)	-0.002 (0.002)
Openness	0.117*** (0.037)	-0.015 (0.030)	0.031 (0.032)	0.001 (0.033)	-0.052* (0.028)	0.112*** (0.036)	0.028 (0.033)
Democracy	0.006*** (0.002)	-0.008*** (0.003)	-0.009*** (0.003)	-0.001 (0.002)	0.003 (0.002)	0.002 (0.002)	0.003 (0.002)
Immunization	-0.002* (0.001)	-0.002** (0.001)	0.0004 (0.001)	0.002* (0.001)	0.002** (0.001)	-0.005*** (0.001)	0.004*** (0.001)
Donors' self-interest							
Exports	0.043*** (0.012)	0.012 (0.018)	-0.049*** (0.017)	0.005 (0.007)	0.014 (0.008)		
Control Variables							
Colony	0.183*** (0.047)	0.021 (0.060)					
Language	0.036 (0.040)	0.302*** (0.050)		0.104*** (0.030)			
Diagnostics							
Observations	686	747	740	752	664	757	565
Log-likelihood	-244.83	-260.34	-267.86	-221.27	-172.52	-308.64	-171.78
x^2	427.69	172.17	346.70	200.41	217.89	107.02	168.97

Notes:

(i) We estimate the selection probability (1 = receives health aid; 0 = does not receive health aid) based on a pooled Probit maximum likelihood. All time-varying regressors except democracy, immunization and GDP per capita growth are logged. Heteroscedasticity and correlation-robust standard errors are reported in brackets. All equations include a constant term and a full set of time dummies (none of which are reported).

(ii) All time-varying explanatory variables are lagged one period.

(iii) ***, ** and * denote significance at 1, 5 and 10 per cent respectively.

(iv) The chi-squared statistic is for the test of joint significance of all regressors in the model. The p-values of the test have not been reported but for all donors, the test statistic is significant at 1 per cent.

Appendix Table A 8: Determinants of Health Aid- Allocation Stage (Non-Health Aid)

	UK	France	Germany	USA	Sweden	EC	IDA
Recipients' Needs							
Under-five Mortality Rate	-0.121 (0.092)	-0.040 (0.062)	-0.100** (0.043)	-0.083 (0.207)	0.220** (0.107)	0.004 (0.068)	-0.263*** (0.079)
HIV Prevalence Rate	0.043* (0.022)	-0.044** (0.017)	0.039** (0.015)	0.194*** (0.047)	0.032* (0.018)	0.040** (0.015)	-0.026 (0.023)
Tuberculosis Prevalence Rate	0.034 (0.036)	-0.014 (0.030)	0.013 (0.021)	0.029 (0.058)	-0.025 (0.035)	0.044* (0.022)	-0.008 (0.036)
GDP *Per Capita*	-0.253*** (0.053)	0.035 (0.051)	-0.012 (0.044)	0.015 (0.078)	0.084** (0.032)	0.050 (0.035)	0.028 (0.052)
Population	-0.084** (0.034)	-0.116*** (0.035)	-0.080** (0.033)	-0.128** (0.057)	-0.070*** (0.029)	-0.078*** (0.018)	-0.200*** (0.031)
Recipients' Merits							
Non-Health Aid	0.013 (0.017)	0.019 (0.015)	0.021 (0.018)	0.070* (0.036)	0.049*** (0.010)	0.014 (0.015)	0.071*** (0.020)
GDP *Per Capita* Growth	-0.006 (0.005)	-0.0003 (0.002)	0.003 (0.002)	0.009*** (0.003)	-0.002 (0.003)	-0.002 (0.002)	0.001 (0.003)
Openness	0.146** (0.066)	-0.063 (0.055)	-0.026 (0.047)	-0.0002 (0.146)	-0.033 (0.039)	-0.007 (0.040)	-0.097 (0.074)
Democracy	0.008 (0.007)	0.001 (0.004)	-0.001 (0.004)	0.019** (0.008)	-0.0005 (0.003)	0.0002 (0.004)	-0.003 (0.004)
Immunization	0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	0.001 (0.003)	0.001 (0.002)	-0.003** (0.001)	0.001 (0.002)
Donors' self-interest							
Exports	0.072** (0.032)	0.030 (0.029)	-0.004 (0.022)	0.041* (0.024)	-0.005 (0.013)		
Control Variables							
Colony	0.229** (0.112)	0.079 (0.072)					
Language	-0.028 (0.061)	-0.005 (0.053)		-0.085 (0.123)			
Diagnostics							
Observations	372	545	433	558	325	612	535
R-Squared	0.531	0.453	0.267	0.410	0.361	0.290	0.489

Notes:

(i) The dependent variable here is logged per capita health aid. The OLS estimator is conditional on receiving per capita health aid. Standard errors are reported in parentheses. All time-varying regressors except democracy, immunization, and GDP per capita growth are logged. All time-varying regressors are lagged one period.

(ii) Clustering is done at the country-year level. This is to purge the regressions of any heteroscedasticity and serial correlation. All equations include a constant term and a full set of time dummies.

(iii) ***, ** and * denote significance at 1, 5 and 10 per cent respectively.

Appendix Table A 9: Selection Stage (GNI *Per Capita* Atlas Method)

	UK	France	Germany	USA	Sweden	EC	IDA
Recipients' Needs							
Under-five Mortality Rate	0.061 (0.047)	-0.035 (0.043)	-0.072 (0.051)	0.090* (0.047)	0.031 (0.049)	-0.017 (0.049)	0.088*** (0.190)
HIV Prevalence Rate	0.023** (0.012)	0.005 (0.016)	0.024*** (0.011)	0.023** (0.010)	0.096*** (0.011)	0.035*** (0.010)	-0.065*** (0.008)
Tuberculosis Prevalence Rate	0.005 (0.019)	0.126*** (0.027)	-0.041** (0.018)	0.028* (0.016)	0.041** (0.019)	-0.059*** (0.018)	-0.048** (0.019)
GNI *Per Capita* Atlas	-0.111*** (0.023)	-0.007 (0.026)	-0.036* (0.021)	-0.010 (0.022)	-0.102*** (0.022)	-0.038 (0.024)	-0.124*** (0.019)
Population	0.116*** (0.019)	-0.008 (0.027)	0.119*** (0.022)	0.156*** (0.016)	-0.010 (0.020)	0.037*** (0.014)	0.099*** (0.010)
Recipients' Merits							
GDP *Per Capita* Growth	0.004** (0.002)	0.003 (0.002)	-0.0001 (0.002)	0.002 (0.002)	-0.0002 (0.002)	0.001 (0.002)	-0.001 (0.002)
Openness	0.101*** (0.031)	-0.036 (0.031)	0.018 (0.032)	0.007 (0.030)	-0.061* (0.035)	0.086*** (0.034)	-0.023 (0.028)
Democracy	0.005** (0.002)	-0.007*** (0.003)	-0.002 (0.003)	-0.001 (0.002)	0.006* (0.002)	0.004 (0.003)	0.004* (0.002)
Immunization	0.001 (0.001)	-0.002** (0.001)	0.001 (0.001)	0.002** (0.001)	0.003*** (0.001)	-0.005*** (0.001)	0.005*** (0.001)
Donors' self-interest							
Exports	0.025** (0.012)	0.043** (0.020)	-0.016 (0.015)	0.005 (0.007)	0.076*** (0.010)		
Control Variables							
Colony	0.269*** (0.050)	0.116* (0.063)					
Language	0.141*** (0.042)	0.358*** (0.055)		0.083*** (0.032)			
Diagnostics							
Observations	768	768	768	768	768	768	852
Log-likelihood	-303.37	-292.75	-328.51	-252.55	-295.48	-331.40	-310.59
x^2	432.06	214.00	352.30	222.26	290.90	102.00	362.97

Notes:

(i) We estimate the selection probability (1 = receives health aid; 0 = does not receive health aid) based on a pooled Probit maximum likelihood. All time-varying regressors except democracy, immunization and GDP per capita growth are logged. Heteroscedasticity and correlation-robust standard errors are reported in brackets. All equations include a constant term and a full set of time dummies (none of which are reported).

(ii) All time-varying explanatory variables are lagged one period.

(iii) ***, ** and * denote significance at 1, 5 and 10 per cent respectively.

(iv) The chi-squared statistic is for the test of joint significance of all regressors in the model. The p-values of the test have not been reported but for all donors, the test statistic is significant at 1 per cent.

Appendix Table A 10: Allocation Stage (GNI *Per Capita* Atlas Method)

	UK	France	Germany	USA	Sweden	EC	IDA
Recipients' Needs							
Under-five Mortality Rate	-0.115 (0.091)	-0.036 (0.056)	-0.106** (0.046)	-0.087 (0.197)	0.225* (0.116)	0.013 (0.067)	-0.278*** (0.101)
HIV Prevalence Rate	0.051*** (0.019)	-0.044** (0.017)	0.038** (0.015)	0.198*** (0.048)	0.041* (0.020)	0.038*** (0.014)	-0.038 (0.022)
Tuberculosis Prevalence Rate	0.040 (0.032)	-0.011 (0.030)	0.012 (0.020)	0.029 (0.061)	-0.0001 (0.034)	0.049** (0.022)	-0.006 (0.038)
GNI *Per Capita* Atlas	-0.269*** (0.047)	0.032 (0.054)	-0.006 (0.038)	-0.016 (0.073)	0.048* (0.028)	0.057 (0.037)	0.030 (0.052)
Population	-0.076** (0.030)	-0.120*** (0.033)	-0.062** (0.027)	-0.079 (0.062)	-0.041 (0.029)	-0.074*** (0.015)	-0.134*** (0.024)
Recipients Merits							
GDP *Per Capita* Growth	-0.006 (0.005)	-0.00004 (0.002)	0.003 (0.002)	0.010*** (0.003)	-0.0003 (0.003)	-0.002 (0.002)	0.004 (0.003)
Openness	0.138** (0.060)	-0.065 (0.057)	-0.038 (0.046)	0.026 (0.149)	-0.030 (0.041)	-0.013 (0.041)	-0.096 (0.078)
Democracy	0.009 (0.006)	0.001 (0.004)	0.002 (0.004)	0.023*** (0.009)	-0.001 (0.003)	0.0002 (0.004)	-0.002 (0.005)
Immunization	0.002 (0.002)	-0.0003 (0.001)	-0.001 (0.001)	0.003 (0.003)	0.002 (0.002)	-0.002** (0.001)	0.002 (0.002)
Donors' self-interest							
Exports	0.077** (0.030)	0.042 (0.030)	-0.009 (0.019)	0.047* (0.023)	0.007 (0.020)		
Control Variables							
Colony	0.228** (0.102)	0.074 (0.073)					
Language	-0.024 (0.068)	0.035 (0.060)		-0.076 (0.124)			
Diagnostics							
Observations	370	526	435	540	316	592	557
R-Squared	0.530	0.472	0.252	0.413	0.273	0.285	0.448

Notes:

(i) The dependent variable here is logged per capita health aid. The OLS estimator is conditional on receiving per capita health aid. Standard errors are reported in parentheses. All time-varying regressors except democracy, immunization, and GDP per capita growth are logged. All time-varying regressors are lagged one period.

(ii) Clustering is done at the country-year level. This is to purge the regressions of any heteroscedasticity and serial correlation. All equations include a constant term and a full set of time dummies.

(iii) ***, ** and * denote significance at 1, 5 and 10 per cent respectively.

APPENDIX B

Appendix Table B 1: Countries in Sample

Sub-Saharan Africa (SSA)	Middle East and North Africa (MENA)	Asia and the Pacific (AsiaPAC)	Latin America and the Caribbean (LAC)
1. Angola	1. Algeria	1. Bangladesh	1. Argentina
2. Benin	2. Egypt	2. China	2. Barbados
3. Botswana	3. Iran, Islamic Republic	3. Fiji	3. Belize
4. Burkina Faso	4. Jordan	4. India	4. Chile
5. Burundi	5. Morocco	5. Indonesia	5. Colombia
6. Central African Republic	6. Turkey	6. Nepal	6. Costa Rica
7. Chad		7. Pakistan	7. Dominica
8. Comoros		8. Philippines	8. Dominican Republic
9. Congo, Dem Rep		9. Sri Lanka	9. Ecuador
10. Congo Rep		10. Thailand	10. El Salvador
11. Cote D'Ivoire		11. Vanuatu	11. Guatemala
12. Equatorial Guinea			12. Honduras
13. Gabon			13. Jamaica
14. Gambia, The			14. Mexico
15. Ghana			15. Nicaragua
16. Guinea			16. Panama
17. Guinea-Bissau			17. Peru
18. Kenya			18. Uruguay
19. Lesotho			19. Venezuela
20. Madagascar			
21. Malawi			
22. Mauritania			
23. Mauritius			
24. Mozambique			
25. Niger			
26. Rwanda			
27. Senegal			
28. Seychelles			
29. Sudan			
30. Swaziland			
31. Togo			
32. Uganda			
33. Zimbabwe			

Appendix Table B 2: Classification of Countries according to Income Groups

Least Developed Countries (LDCs)	Other Low-Income Countries: (GNIpc <= $1,045 in 2013)	Lower Middle-Income Countries (LMICs): (GNI*pc* $1,046 - $4,125 in 2013)	Upper Middle-Income Countries (UMICs): (GNIpc $4,126 - $12,745 in 2013)
1. Angola 2. Bangladesh 3. Benin 4. Burkina Faso 5. Burundi 6. Central African Republic 7. Chad 8. Comoros 9. Congo, Dem Rep 10. Equatorial Guinea 11. Gambia, The 12. Guinea 13. Guinea-Bissau 14. Lesotho 15. Madagascar 16. Malawi 17. Mauritania 18. Mozambique 19. Nepal 20. Niger 21. Rwanda 22. Senegal 23. Sudan 24. Togo 25. Uganda 26. Vanuatu	1. Kenya 2. Zimbabwe	1. Congo Rep 2. Cote D'Ivoire 3. Egypt 4. El Salvador 5. Ghana 6. Guatemala 7. Honduras 8. India 9. Indonesia 10. Morocco 11. Nicaragua 12. Pakistan 13. Philippines 14. Sri Lanka 15. Swaziland	1. Algeria 2. Argentina 3. Barbados 4. Belize 5. Botswana 6. Chile 7. China 8. Colombia 9. Costa Rica 10. Dominica 11. Dominican Republic 12. Ecuador 13. Fiji 14. Gabon 15. Iran 16. Jamaica 17. Jordan 18. Mauritius 19. Mexico 20. Panama 21. Peru 22. Seychelles 23. Thailand 24. Turkey 25. Uruguay 26. Venezuela

Notes: GNIpc refers to per capita GNI. For estimation purposes, 'other low-income countries', 'lower middle-income countries' and 'upper middle-income countries' are grouped into 'low income countries' (see table 3.5 of sub-section 3.5.3.2).

Appendix Table B 3: Variables, descriptions and data sources

Variable Name	Variable Description	Data Source
Aid	Net aid (net of repayments)	OECD-DAC
Grants	Gross ODA grants	OECD-DAC
Loans	Gross ODA loans	OECD-DAC
Technical Cooperation	Technical cooperation	OECD-DAC
Tax Revenue	Non-resource tax revenue	ICTD Database
Total Tax Revenue	Resource + Non-resource tax revenue	ICTD Database
Total Government Revenue	Government revenue excluding grants	ITCD Database
Spending	Total government spending	World Development Indicators
Capital Spending	Public investment	World Development Indicators
Recurrent (Consumption) Spending	Government consumption spending	World Development Indicators

Appendix Table B 4: Summary Statistics

Panel A: Raw (Non-Logged) Variables

Variable	Mean	S.D.	Min.	Max.
Aid	4.69e+08	7.14e+08	-1.40e+09	8.77e+09
Tax Revenue	1.25e+10	6.52e+10	5982453	1.69e+12
Spending	4.20e+10	2.34e+11	5.05e+07	5.44e+12
Gross Loans	3.18e+08	6.01e+08	0.000	9.44e+09
Gross Grants	3.23e+08	5.35e+08	-582187	8.08e+09
TC	1.35e+08	1.63e+08	1357134	1.46e+09
Cap. Spending	3.00e+10	1.81e+11	0.000	4.24e+12
Cons. Spending	1.21e+10	5.43e+10	0.000	1.21e+12

Panel B: Regression Variables (In Logs or First Differences of Logs)

Variable	Mean	S.D.	Min.	Max.
y_{it-1}	22.113	2.013	17.738	29.107
Aid_{it-1}	18.020	4.663	0.000	22.895
Tax_{it-1}	21.034	2.031	15.604	27.952
Cap_{it-1}	21.577	2.137	16.598	28.862
$Cons_{it-1}$	21.150	1.913	16.872	27.577
$Loans_{it-1}$	18.260	1.937	9.321	22.969
$Grants_{it-1}$	18.686	1.471	12.313	22.812
TC_{it-1}	18.172	1.134	14.121	21.105
Δy_{it}	0.037	0.224	-1.421	1.974
ΔAid_{it}	-0.035	3.611	-21.143	21.566
ΔTax_{it}	0.040	0.213	-1.682	2.232
ΔCap_{it}	0.038	0.287	-2.380	2.914
$\Delta Cons_{it}$	0.031	0.209	-1.894	2.314
$\Delta Loans_{it}$	-0.034	0.904	-8.028	5.166
$\Delta Grants_{it}$	0.029	0.548	-3.293	3.181
ΔTC_{it}	-0.014	0.238	-1.281	1.095

Notes: Descriptive statistics are presented for the full sample of 2346 observations from N= 69 countries (average T=34). In Panel A the variables are non-logged. In Panel B we report descriptive statistics for the main ECM regression variables (as well as those used for exploratory analysis), namely Δy_{it}- expenditure growth rate, y_{it-1} – lagged level of government expenditure, Aid_{it-1} – lagged level of net aid, Tax_{it-1} – lagged level of taxes, ΔAid_{it} – growth rate of net aid, ΔTax_{it} – growth rate of taxes. All other variables used for exploratory analysis follow the same interpretation.

Appendix Table B 5: Cross-section Dependence

Panel A	Variables in Levels			
	$Grants_{it}$	$Loans_{it}$	$Cons_{it}$	Cap_{it}
avg $\hat{\rho}_{ij}$	0.247	0.133	0.446	0.485
avg $\lvert\hat{\rho}_{ij}\rvert$	0.333	0.260	0.542	0.555
CD	66.10	34.39	116.41	126.84
p-value	0.00	0.00	0.00	0.00
Panel B	Variables in First Differences			
	$\Delta Grants_{it}$	$\Delta Loans_{it}$	$\Delta Cons_{it}$	ΔCap_{it}
avg $\hat{\rho}_{ij}$	0.046	0.015	0.086	0.097
avg $\lvert\hat{\rho}_{ij}\rvert$	0.175	0.176	0.182	0.176
CD	11.94	4.01	22.32	25.25
p-value	0.00	0.00	0.00	0.00

Notes: Grants, loans, Recurrent Expenditures (Cons), Capital Expenditures (Cap). See table 3.1 for other details.

Appendix Table B 6: Panel Unit Root Tests

Levels: CIPS with intercept only								
Variable	Grants		Loans		Cons		Cap	
Lags	Ztbar	*p*	Ztbar	*p*	Ztbar	*p*	Ztbar	*p*
0	-12.46	0.00	-11.43	0.00	0.37	0.64	-3.78	0.00
1	-7.18	0.00	-5.22	0.00	-1.68	0.05	-4.06	0.00
2	-3.60	0.00	-3.65	0.00	-0.81	0.21	-1.72	0.04
3	-2.30	0.01	-3.55	0.00	-0.84	0.20	-1.21	0.11
4	0.94	0.83	-0.60	0.28	-0.42	0.34	0.30	0.62
Levels: CIPS with intercept & trend								
Variable	Grants		Loans		Cons		Cap	
Lags	Ztbar	*p*	Ztbar	*p*	Ztbar	*p*	Ztbar	*p*
0	-11.29	0.00	-9.68	0.00	-0.20	0.42	-2.95	0.00
1	-5.58	0.00	-1.96	0.03	-1.67	-1.66	-3.84	0.00
2	-1.32	0.09	-0.87	0.19	-0.04	0.49	-0.88	0.19
3	0.65	0.74	0.48	0.69	0.40	0.66	-0.04	0.48
4	4.47	1.00	3.82	1.00	-0.33	0.37	1.58	0.94
Differences: CIPS test with drift								
Variable	Grants		Loans		Cons		Cap	
Lags	Ztbar	*p*	Ztbar	*p*	Ztbar	*p*	Ztbar	*p*
0	-36.83	0.00	-35.86	0.00	-27.10	0.00	-31.96	0.00
1	-27.47	0.00	-23.46	0.00	-16.75	0.00	-21.02	0.00
2	-16.98	0.00	-13.44	0.00	-8.92	0.00	-12.89	0.00
3	-12.93	0.00	-7.63	0.00	-5.73	0.00	-8.04	0.00
4	-8.47	0.00	-4.11	0.00	-4.51	0.00	-4.46	0.00

Notes: Grants, loans, Recurrent Expenditures (Cons), Capital Expenditures (Cap). See table 3.2 for other details.

APPENDIX C

Appendix Table C 1: Cross-Section Dependence

Panel A	Variables in Levels	
	Tax_{it}	Aid_{it}
avg $\hat{\rho}_{ij}$	0.077	0.247
avg $\lvert\hat{\rho}_{ij}\rvert$	0.405	0.418
CD	12.29	40.29
p-value	0.000	0.000
Panel B	**Variables in First Differences**	
	ΔTax_{it}	ΔAid_{it}
avg $\hat{\rho}_{ij}$	0.003	0.055
avg $\lvert\hat{\rho}_{ij}\rvert$	0.178	0.179
CD	0.27	9.22
p-value	0.784	0.000

Notes: Tax revenue (Tax), Net ODA (Aid): all as percentages of GDP. See table 3.1 for other details.

Appendix Table C 2: Pesaran (2007) Unit Root Test

Levels: CIPS with intercept only				
Variable	Tax_{it}		Aid_{it}	
Lags	Z*t*bar	*p*	Z*t*bar	*p*
0	-4.58	0.00	-3.89	0.00
1	-3.22	0.00	-1.19	0.12
2	-0.97	0.17	1.03	0.85
3	1.30	0.90	-0.10	0.46
4	2.47	0.99	1.96	0.98
Levels: CIPS with intercept & trend				
Variable	Tax_{it}		Aid_{it}	
Lags	Z*t*bar	*p*	Z*t*bar	*p*
0	-5.27	0.00	-4.561	0.00
1	-3.97	0.00	-1.84	0.03
2	-2.29	0.01	1.22	0.89
3	1.00	0.84	-0.03	0.49
4	2.46	0.99	1.19	0.88
Differences: CIPS test with drift				
Variable	ΔTax_{it}		ΔAid_{it}	
Lags	Z*t*bar	*p*	Z*t*bar	*p*
0	-24.63	0.00	-26.48	0.00
1	-15.76	0.00	-16.29	0.00
2	-10.75	0.00	-7.89	0.00
3	-4.99	0.00	-5.95	0.00
4	-2.91	0.00	-4.14	0.00

Notes: Tax revenue (Tax), Net ODA (Aid): all as percentages of GDP. See table 3.2 for other details.

Appendix Table C 3: Cross-Section Dependence

Panel A	Variables in Levels				
	Tax_{it}	Aid_{it}	$Grants_{it}$	$Loans_{it}$	TA_{it}
avg $\hat{\rho}_{ij}$	0.121	0.133	0.139	0.268	0.522
avg $\lvert\hat{\rho}_{ij}\rvert$	0.401	0.335	0.354	0.359	0.602
CD	37.71	40.35	43.83	82.15	160.69
p-value	0.000	0.000	0.000	0.000	0.000
Panel B	Variables in First Differences				
	ΔTax_{it}	ΔAid_{it}	$\Delta Grants_{it}$	$\Delta Loans_{it}$	ΔTA_{it}
avg $\hat{\rho}_{ij}$	0.003	0.042	0.036	0.016	0.152
avg $\lvert\hat{\rho}_{ij}\rvert$	0.181	0.178	0.193	0.183	0.223
CD	0.88	13.02	10.95	4.61	45.36
p-value	0.381	0.000	0.000	0.000	0.000

Notes: Tax revenue (Tax), Net ODA (Aid), Grants, Loans and Technical Assistance (TA); all as percentages of GDP. See table 3.1 for other details.

Appendix Table C 4: Pesaran (2007) Unit Root Test

Levels: CIPS with intercept only										
Variable	Tax		Aid		Grants		Loans		TA	
Lags	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*p*
0	-4.80	0.00	-8.32	0.00	-11.35	0.00	-12.55	0.00	-4.10	0.00
1	-3.30	0.00	-3.88	0.00	-6.13	0.00	-6.52	0.00	-0.41	0.34
2	-0.90	0.18	-0.74	0.23	-2.71	0.00	-5.34	0.00	-0.08	0.47
3	-0.86	0.20	-0.94	0.17	-1.79	0.04	-4.17	0.00	-0.32	0.38
4	-1.03	0.15	2.00	0.98	2.55	1.00	-2.03	0.02	1.65	0.95
Levels: CIPS with intercept & trend										
Variable	Tax		Aid		Grants		Loans		TA	
Lags	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*p*
0	-6.46	0.00	-8.22	0.00	-10.73	0.00	-11.81	0.00	-6.18	0.00
1	-4.79	0.00	-3.70	0.00	-4.72	0.00	-3.56	0.00	-1.66	0.05
2	-1.51	0.07	-0.47	0.32	-1.24	0.11	-1.28	0.10	0.10	0.54
3	0.16	0.56	0.59	0.72	-0.64	0.26	0.40	0.65	0.75	0.77
4	2.19	0.99	4.88	1.00	4.68	1.00	2.10	0.98	3.18	1.00
Differences: CIPS test with drift										
Variable	Tax		Aid		Grants		Loans		TA	
Lags	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*p*
0	-34.41	0.00	-37.85	0.00	-40.27	0.00	-39.82	0.00	-39.44	0.00
1	-23.15	0.00	-25.74	0.00	-28.69	0.00	-25.70	0.00	-23.61	0.00
2	-14.45	0.00	-15.57	0.00	-17.11	0.00	-15.08	0.00	-13.54	0.00
3	-8.59	0.00	-11.86	0.00	-14.33	0.00	-10.16	0.00	-11.29	0.00
4	-3.90	0.00	-7.23	0.00	-10.61	0.00	-7.05	0.00	-4.65	0.00

Notes: Tax revenue (Tax), Net ODA (Aid), Grants, Loans and Technical Assistance (TA); all as percentages of GDP. See table 3.2 for other details.

Appendix Table C 5: Supplementary summary statistics

	Grants/GDP	Loans/GDP	TA/GDP		Grants /GDP	Loans/GDP	TA/GDP
Algeria	0.08	0.21	0.16	Madagascar	5.58	4.18	1.96
Angola	1.24	0.56	0.50	Malawi	8.90	3.82	2.47
Argentina	0.01	0.03	0.03	Maldives	1.95	3.34	1.85
Bangladesh	1.11	1.81	0.47	Mali	5.93	4.66	2.93
Belize	1.24	1.72	1.56	Mauritania	8.05	5.83	2.35
Benin	0.21	0.13	0.09	Mauritius	0.46	0.98	0.53
Bhutan	5.22	2.69	4.86	Mexico	0.01	0.03	0.02
Botswana	1.19	0.46	1.31	Morocco	0.56	1.37	0.53
Burkina Faso	6.14	3.56	3.06	Mozambique	11.77	5.98	3.20
Burundi	13.36	5.16	3.82	Nepal	2.65	2.79	2.08
Cameroon	2.08	1.57	0.88	Nicaragua	6.44	3.53	2.14
Cape Verde	8.45	5.07	5.78	Niger	7.46	3.41	3.16
CAR	6.65	2.27	3.01	Pakistan	0.51	1.33	0.27
Chad	4.05	2.66	2.02	Panama	0.20	0.24	0.23
Chile	0.04	0.04	0.11	Papua New Guinea	2.29	0.66	1.44
China	0.02	0.19	0.05	Paraguay	0.24	0.68	0.53
Colombia	0.08	0.08	0.17	Peru	0.26	0.38	0.29
Comoros	6.74	4.77	5.33	Philippines	0.23	0.82	0.31
Congo Rep.	2.78	2.13	1.25	Rwanda	10.73	3.32	3.71
Costa Rica	0.42	0.75	0.46	Sao Tome & Principe	16.23	10.38	10.65
Cote D'Ivoire	2.28	2.25	0.72	Senegal	4.28	3.98	2.73
Dominica	3.18	3.71	1.26	Seychelles	1.50	1.76	1.94
Dom. Republic	0.22	0.43	0.23	Sierra Leone	8.42	4.39	1.96
DRC	5.64	1.22	0.56	Solomon Islands	6.86	2.62	12.77
Ecuador	0.19	0.35	0.32	Sri Lanka	1.06	3.37	0.71
Egypt	0.99	1.48	0.75	St. Vincent	1.91	2.03	0.74
El Salvador	1.71	1.41	1.26	Sudan	3.30	1.66	1.25
Eq. Guinea	3.89	3.97	5.25	Swaziland	0.94	0.71	1.21
Ethiopia	5.71	2.33	1.26	Tanzania	6.60	3.83	2.42
Fiji	0.74	0.11	1.55	Thailand	0.07	0.42	0.18
Gabon	0.49	0.55	0.62	Togo	4.78	3.57	2.30
Gambia	6.79	5.87	3.60	Tonga	5.28	1.81	6.60
Ghana	2.77	2.75	0.65	Turkey	0.09	0.23	0.05
Guatemala	0.60	0.40	0.49	Uganda	5.50	3.51	1.57
Guinea	4.22	3.79	1.54	Uruguay	0.06	0.07	0.12
Guinea-Bissau	10.60	6.30	5.66	Vanuatu	5.02	1.29	9.46
Honduras	2.59	2.69	1.11	Venezuela	0.01	0.01	0.03
India	0.10	0.44	0.07	Zambia	6.86	5.43	2.38
Indonesia	0.11	0.68	0.19				
Iran	0.12	0.01	0.04				
Jamaica	0.94	2.00	0.54				
Jordan	4.51	2.35	1.06				
Kenya	1.94	2.12	1.22				
Kiribati	12.24	0.68	12.73				
Laos	3.65	4.16	2.80				
Lesotho	5.66	3.79	4.45				

Notes: TA/GDP = technical assistance to GDP ratio.

Appendix Table C 6: Classification of countries by income groups

Least Developed Countries (LDCs)	Other Low-Income Countries (LICs)
1. Angola	1. Algeria
2. Bangladesh	2. Argentina
3. Benin	3. Belize
4. Bhutan	4. Botswana
5. Burkina Faso	5. Cameroon
6. Burundi	6. Cape Verde
7. Central African Republic	7. Chile
8. Chad	8. China
9. Comoros	9. Colombia
10. Democratic Republic of Congo	10. Costa Rica
11. Congo Republic	11. Cote D'Ivoire
12. Equatorial Guinea	12. Dominica
13. Ethiopia	13. Dominican Republic
14. Gambia	14. Ecuador
15. Guinea	15. Egypt
16. Guinea-Bissau	16. El Salvador
17. Kenya	17. Fiji
18. Kiribati	18. Gabon
19. Laos	19. Ghana
20. Lesotho	20. Guatemala
21. Madagascar	21. Honduras
22. Malawi	22. India
23. Mali	23. Indonesia
24. Mauritania	24. Iran
25. Mozambique	25. Jamaica
26. Nepal	26. Jordan
27. Niger	27. Maldives
28. Rwanda	28. Mauritius
29. Sao Tome and Principe	29. Mexico
30. Senegal	30. Morocco
31. Sierra Leone	31. Nicaragua
32. Solomon Islands	32. Pakistan
33. Sudan	33. Panama
34. Tanzania	34. Papua New Guinea
35. Togo	35. Paraguay
36. Uganda	36. Peru
37. Vanuatu	37. Philippines
38. Zambia	38. Seychelles
	39. Sri Lanka
	40. St Vincent and the Grenadines
	41. Swaziland
	42. Thailand
	43. Tonga
	44. Turkey
	45. Uruguay
	46. Venezuela

Appendix Table C 7: CCEMG Estimates

	CCEMG	One-Lag CCEMG	Two-Lag CCEMG
Country trends ƒ			
Long-Run			
Aid/GDP	0.084**	0.091**	0.084**
	[0.033]	[0.037]	[0.039]
Short-Run			
Aid/GDP	-0.007	-0.004	0.004
	[0.010]	[0.017]	[0.017]
EC Coefficient			
y_{it-1}	-0.615***	-0.603***	-0.606***
	[0.049]	[0.051]	[0.052]
t-statistic	-12.63	-11.83	-11.61
Diagnostics			
RMSE	0.100	0.087	0.081
Stationarity ϒ	I(0)	I(0)	I(0)
CD test	-0.91	-1.21	-0.93
(p-value)	(0.365)	(0.228)	(0.353)
Observations (N)	1245 (47)	1212 (47)	1166 (46)

Notes: The results are based on an error correction model for all 47 countries in the sample with the first difference of log (tax/GDP) as dependent variable. ƒ The models are augmented with country-specific linear trend terms. For all other details see Table 4.3.

Appendix Table C 8: Heterogeneity in Levels of Development

	LDCs	LICs
Long-Run		
Aid/GDP	0.164***	0.006
	[0.055]	[0.051]
Short-Run		
Aid/GDP	0.015	-0.011
	[0.029]	[0.017]
EC Coefficient		
y_{it-1}	-0.561***	-0.674***
	[0.056]	[0.100]
t-statistic	-10.00	-6.70
Diagnostics		
RMSE	0.090	0.069
Stationarity ϒ	I(0)	I(0)
CD test	-0.68	-0.67
(p-value)	(0.500)	(0.500)
Observations (N)	658 (25)	58 (21)

Appendix Table C 9: Heterogeneity across regions

	SSA	LAC	MENA	AsiaPAC
Long-Run				
Aid/GDP	0.122***	-0.136	0.123	0.105***
	[0.051]	[0.112]	[0.101]	[0.047]
Short-Run				
Aid/GDP	0.005	-0.012	0.011	-0.002
	[0.026]	[0.027]	[0.056]	[0.007]
EC Coefficient				
y_{it-1}	-0.578***	-0.527***	-0.766***	-0.826***
	[0.051]	[0.144]	[0.252]	[0.243]
t-statistic	-11.42	-3.67	-3.04	-3.40
Diagnostics				
RMSE	0.093	0.050	0.055	0.046
Stationarity ϯ	I(0)	I(0)	I(0)	I(0)
CD test	-0.93	0.56	0.43	0.21
(p-value)	(0.353)	(0.575)	(0.668)	(0.831)
Observations (N)	778 (29)	123 (6)	138 (6)	127 (5)

Notes: For all other details see Table 4.3.

Appendix Table C 10: Revenue Conditionality

	Revenue Conditionality	No Revenue Conditionality
Additional Covariates ϱ	*exports*	
Long-Run		
Aid/GDP	0.108**	0.011
	[0.052]	[0.059]
Short-Run		
Aid/GDP	0.003	-0.005
	[0.021]	[0.031]
EC Coefficient		
y_{it-1}	-0.540***	-0.856***
	[0.049]	[0.158]
t-statistic	-11.03	-5.40
Diagnostics		
RMSE	0.077	0.071
Stationarity ϯ	I(0)	I(0)
CD test	-1.54	-1.90
(p-value)	(0.125)	(0.058)
Observations (N)	912 (35)	254 (11)

Notes: ϱ The CCEMG is estimated with lags of cross-section averages and cross-section averages of other variables (see main text for details). For all other details see Table 4.3.

Appendix Table C 11: Recipient Policy Reform

	Revenue Authority	No Revenue Authority
Long-Run		
Aid/GDP	0.117	0.071
	[0.087]	[0.046]
Short-Run		
Aid/GDP	-0.0009	0.003
	[0.037]	[0.020]
EC Coefficient		
y_{it-1}	-0.493***	-0.619***
	[0.029]	[0.071]
t-statistic	-16.99	-8.70
Diagnostics		
RMSE	0.093	0.074
Stationarity ד	I(0)	I(0)
CD test	-1.18	0.64
(p-value)	(0.239)	(0.519)
Observations (N)	415 (16)	751 (30)

Notes: 'For all other details see Table 4.3.

Appendix Table C 12: Heterogeneity by Natural Resource Wealth

	Natural Resources	No Natural Resources
Long-Run		
Aid/GDP	0.079	0.083**
	[0.105]	[0.041]
Short-Run		
Aid/GDP	0.003	0.007
	[0.043]	[0.019]
EC Coefficient		
y_{it-1}	-0.615***	-0.601***
	[0.137]	[0.056]
t-statistic	-4.50	-10.67
Diagnostics		
RMSE	0.088	0.079
Stationarity ד	I(0)	I(0)
CD test	-0.66	-1.12
(p-value)	(0.511)	(0.263)
Observations (N)	327 (13)	839 (33)

Notes: 'Natural Resources' includes resource-rich countries with active extractive industries; oil, gas and mining as classified in IMF (2012) while 'No Natural Resources' includes non-resource-rich countries. For all other details see Table 4.3.

Appendix Table C 13: Heterogeneity by Aid Uncertainty

	High Aid Uncertainty	Low Aid Uncertainty
Long-Run		
Aid/GDP	0.069	0.099*
	[0.052]	[0.056]
Short-Run		
Aid/GDP	0.019	-0.005
	[0.020]	[0.025]
EC Coefficient		
y_{it-1}	-0.624***	-0.585***
	[0.093]	[0.065]
t-statistic	-6.75	-9.07
Diagnostics		
RMSE	0.089	0.077
Stationarity ד	I(0)	I(0)
CD test	-0.52	-0.80
(p-value)	(0.606)	(0.423)
Observations (N)	428 (17)	738 (29)

Notes: For all other details see table 4.3.

Appendix Table C 14: Heterogeneity by Aid Instability

	High Aid Instability	Low Aid Instability
Long-Run		
Aid/GDP	0.076	0.087
	[0.056]	[0.056]
Short-Run		
Aid/GDP	0.005	0.009
	[0.017]	[0.028]
EC Coefficient		
y_{it-1}	-0.567***	-0.620***
	[0.056]	[0.074]
t-statistic	-10.10	-8.37
Diagnostics		
RMSE	0.073	0.087
Stationarity ד	I(0)	I(0)
CD test	-1.38	-0.88
(p-value)	(0.167)	(0.380)
Observations (N)	480 (19)	686 (27)

Notes: For all other details see Table 4.3.