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

ABRAMS MBU ENOW TAGEM

Abstract

A large amount of aid to recipients is given to the government, or goes through the budget, meaning it should have an impact on government fiscal behaviour (particularly on government spending). Existing empirical studies on the effects of aid on government spending neglect variable time-series properties, cross-country (recipient) heterogeneity and the potential for cross-country correlation. This paper examines the impact of foreign aid and taxes on government spending for a sample of 69 developing countries over 1980-2013, taking account of dynamics characterising fiscal data, cross-country heterogeneity and the distorting impact of cross-section dependence. Our econometric approach addresses these problems by applying the Pesaran (2006) CCE Mean Group estimator. We show that spending, net aid (as well as variants including grants, loans, and technical cooperation) and taxes comprise an equilibrium (cointegrated) relation. Our results provide robust evidence of a positive, long-run (as well as short-run) association between aid and spending. On average, the aid coefficients are positive but smaller than the tax coefficients, indicating that in the long-run and short-run taxes are a *more important* source of finance for expenditures than aid.

Keywords: Aid, tax revenue, common factor models, nonstationary panel econometrics

JEL classification: C23, E62, F35

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1. INTRODUCTION

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 spent in a country goes to the government, or finances services that would otherwise be a demand on the budget, it should impact on government fiscal behaviour; that is on government spending, tax revenue and domestic borrowing (all as shares of recipients' GDP). Much of the aid from donors to recipient countries does not actually go through the budget: aid may be in the form of donor-funded projects or in the form of technical assistance (Morrissey, 2012; Van de Sijpe, 2012) 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 this paper endeavours to answer, 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. These common factor models also 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.

Studies on the fiscal effects of aid (fiscal response models, FRMs hereafter), and aid effectiveness in general (i.e. the ability of aid to deliver economic growth and development) have mainly used cross-country data to provide empirical evidence of the effectiveness of aid, often yielding non-robust results. Early FRMs, and studies on the effects of aid on spending have been cross-country estimations in which the dynamics between aid and fiscal aggregates (tax/GDP and spending/GDP ratios) is assumed to be the *same* across countries (Franco-Rodiguez, McGillivray and Morrissey, 1998; Remmer, 2004; Morrissey, Isopi and Clist, 2011). The general pattern in these studies is that over time, aid increases total spending in recipient countries, albeit spending not increasing by the full amount of aid (Remmer, 2004; Morrissey, 2012). Nevertheless, we argue that these studies are restrictive in modelling the impact of aid on spending, and base our arguments on three key aspects.

First, these studies apply standard panel approaches which typically ignore the time-series properties of the data. 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 typically 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). Standard empirical approaches implicitly assume variable stationarity, thus ignoring potential long-run (levels) relationships between aid and fiscal variables. 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 (adjustment to equilibrium)

relationships between fiscal aggregates. Specifically, we test for the existence of a long-run equilibrium (cointegrating) relationship between aid, taxes and spending.

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 Proc*ess (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 in these countries. Incorporating such heterogeneity is fundamental in estimating any potential effects aid might have on government spending. Recently, however, recipient heterogeneity is being explicitly incorporated into fiscal response studies by estimating time series country-specific models (see *inter alia* Osei, Morrissey and Lloyd, 2005; Martins, 2010; Mascagni and Timmis, 2014). In this paper we extend the 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. This allows us to estimate the marginal impact of aid and taxes on spending, suggesting which of these two sources of finance is more important for spending plans.

Third, these cross-country approaches suffer from the potential endogeneity of aid. On the one hand, more aid may be disbursed to countries that have low expenditures as a result of external (economic) shocks or internal shocks (natural disasters, wars), which could explain a negative correlation between aid and government expenditures. On the other hand, to the extent that donors provide more aid to countries with higher expenditures, a positive correlation between aid and expenditures would be observed, which does not imply causality from aid to spending (Herzer and Morrissey, 2013). Standard instrumental variable methods can address this endogeneity problem. Nonetheless, Temple (1999) documents the difficulty in finding variables that qualify as instruments, besides the spuriousness of the estimates when the instruments are weak or invalid. 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 easily be tested.

Closely related to the issue of exogeneity and endogeneity is cross-section dependence. Internal and external factors that influence recipients' expenditures 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 country-specific regressions, will be correlated. Ignoring such correlations results in inconsistent and biased estimates (Chudik and Pesaran, 2015). Hence in this study 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 then 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 five-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 is robust to variable and residual correlation, outliers, and omitted variables. This long-run impact (hence the marginal effect) is quite large, although it is smaller than the average long-run impac of taxes. This suggests that in the long-run expenditure patterns are driven mainly by taxes, consistent with results in the fiscal effects literature (Martins,

2010; Mascagni and Timmis, 2014). Second, there is evidence of a cointegrating relationship between aid, taxes and the two components of total government spending. On average, aid has a significant long-run impact on capital spending with no observable impact on recurrent spending. Third, there is evidence of a cointegrating relationship between different aid flows (grants, loans and technical cooperation), taxes and total government expenditures. While grants have a positive long-run impact on total spending, loans and technical cooperation do not have any discernible impact on spending. Fourth, we find evidence of a cointegrating relationship between different aid flows, taxes and different components of government spending. While grants and loans have no long-run impact on recurrent spending, they both impact positively on capital spending in the long-run. Fifth, aid, taxes and spending are weakly exogenous, meaning there is no donor 'disbursement rule' that considers recipients' budget situation. The level of aid to recipients is independent of their fiscal situation. Regarding domestic fiscal variables, this result implies current tax revenue and expenditures are not determined by past imbalances (deficits/surpluses).

The rest of the paper is organised as follows. The next section provides a conceptual framework from which hypotheses will be tested; emphasising theoretical and econometric issues faced in empirical analysis, as well as the impact of cross-section dependence in econometric modelling and the importance of parameter heterogeneity. Section 3 provides a review of the literature on aid and expenditure; and fiscal response modelling in general. Section 4 presents a brief discussion on the data used for this analysis, and some charts. Section 5 sets out the empirical specification to estimate the impact of aid and taxes on spending; as well as the prevalence of cross-section dependence and unit roots Section 6 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. Section 7 contains the analysis of weak exogeneity and section 8 concludes.

2. CONCEPTUAL FRAMEWORK: DYNAMICS AND HYPOTHESES

2.1 Theoretical Issues

There has been growing interest in modelling the relationship between aid and domestic fiscal aggregates; studies referred to as fiscal response models (FRMs), which draw heavily on the work of Heller (1975). Basically, 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). Most FRMs have been cross-country estimates, imposing the impact of aid on fiscal aggregates (tax/GDP and spending/GDP ratios) to be the *same* across countries (Morrissey *et al.,* 2011; Clist and Morrissey, 2011; Morrissey and Torrance, 2015). More recently, the literature has evolved through country-specific studies (see *inter alia* Osei *et al.,* 2005; Martins, 2010). FRMs have been fundamental in providing the basic intuition on how aid should affect domestic fiscal behaviour. Nonetheless, they are fraught with theoretical and empirical limitations.

First, on theoretical grounds, there is no unanimous agreement 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.

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, FRMs are inherently static and make no attempt to distinguish long-run and short-run relationships involving aid and other 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); characteristics that influence the impact aid might have on other fiscal aggregates. Moreover, aid can play a dual role of relaxing the budget constraint in the short-run; while also forming part of the long-run budgetary planning process. Such distinguishable long-run and short-run effects are not accommodated in early FRMs.

Given the lack of detailed guidance from the aforementioned theory, 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 underlying budget identity all revenues must equal all expenditures:

$$Revenue + Aid + Borrowing = Expenditures \quad (1)$$

Where revenue includes tax and non-tax revenues (like receipts from central banks), borrowing includes domestic and foreign borrowing (i.e. from international private markets); aid includes grants and loans while expenditures consist of government capital and recurrent expenditures.[1] Equation (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 (1) is not a theory that states how expenditures are determined; just that all revenues and borrowing must equal all expenditures. We do not examine how expenditures are determined, but how aid and taxes influence expenditures.

This is in contrast to the Remmer (2004) analysis; which explicitly models the determinants of government size (measured by changes in government expenditures). In this paper we constantly make comparisons to Remmer (2004) because to date, it is one of the only studies that focus explicitly on the impact of aid on spending. She examines the factors determining government size; with aid being the variable of principal interest. She is guided by the literature on public finance in her choice of variables (demographic, economic and institutional variables); and explains the factors that are most important in determining government expenditures (hence government size) in developing countries. As her main hypothesis is testing whether aid is a significant determinant of government expenditures, she does not rely on a budget identity. In our study, a parsimonious approach is pursued by including just taxes and aid; and we test which of these sources of revenue is a more *important* determinant of the budget (expenditures) in recipient countries.

[1] We abstract from seigniorage in this analysis. Some countries in the sample have their exchange rates pegged to more developed countries, making them unable to print more money.

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. [2] Aid can have a direct financing impact on government spending, or an indirect policy impact through donors' policy conditions. Aid can also have an indirect impact on spending through taxes as some aid may be given for improving tax administration.[3] Taxes have a direct effect on spending, determined by changes in tax rates and the tax base (Lloyd *et al.,* 2009). Hence the structural relationship is of the form:

$$Exp_{it} = \alpha_i + \beta_{i1}(Aid)_{it} + \beta_{i2}(Tax)_{it} + u_{it} \quad (2)$$

Based on equation (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 (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 2.4. We consider equation (2) to be the long-run (equilibrium) relationship; the relationship of primary interest in most empirical studies. This equation can be made to include dynamics (for example the inclusion of a lagged dependent variable as well as lags of explanatory variables); and also 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 impact on the level and composition (allocation to different types of goods and services) of domestic government expenditures (Morrissey, 2012). As mentioned earlier, 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).

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. Expenditures might be very low in some recipient countries, which prompt donors to disburse more aid to such countries. The low expenditures, coupled with the increase in aid, may generate a negative association between aid and spending; resulting in endogeneity. In the fiscal response context this would mean donors adjust to fiscal imbalances (budget deficits/surpluses) in their disbursement of aid. That is, following a deviation from the equilibrium relationship (most likely caused by a deficit); the level of aid provided is in response to that fiscal imbalance. This relates to the issue of weak exogeneity, a fundamental issue we discuss in the next subsection. Using panel data, weak exogeneity can be tested for using tests for the direction of causality.

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 often promised to countries that cut (or at least made attempts to cut) their public sector; notwithstanding the fact that there was no unanimous agreement 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

[2] 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.

[3] The econometric implications of the inter-related effects of aid on taxes, and taxes on spending, are discussed in section 2.2.

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 by technical cooperation) into the analysis. Van de Sijpe (2012) finds that technical cooperation takes up a big share of education and health aid to developing countries (and is also a huge share of total aid). Much of the aid from donors to recipient countries does not actually go through the budget; aid may be in the form of donor-funded projects or in the form of technical assistance (Morrissey, 2012; Van de Sijpe, 2012) which does not even leave the donor country. Such aid does not go through recipients' budgets but can still generate fiscal responses from recipients.

2.2 Econometric Issues

In some countries, fiscal variables like government expenditures and tax revenue show high degrees of persistence, with positive and/or negative trends, meaning in the long-run they are nonstationary processes (Lloyd *et al.,* 2009; Eberhardt and Teal, 2011). Nonstationarity can be seen as an extreme form of variable persistence over time (Lütkepohl and Krätzig, 2004, p.11); with the mean, variance and covariance of the series changing over time. This concept 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 particular sample; not a *global* property (Pedroni, 2007). This simply 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 equally very important. Aid, for instance, can be seen to perform 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 (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). Hence, if aid is stationary then it simply relaxes the budget constraint; i.e. aid is used to finance budget deficits. 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 adjustment to equilibrium (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).[4] If the error terms from equation (2) turn out to be nonstationary as well we are left with a

[4] The long-run (cointegrating) relationship usually gets more attention in the aid literature as it fair to assume that any long-run impact of aid will be a permanent one. Short-run effects are transitory, and the interplay between variables in the short-run cannot easily be gauged as variables (especially aid) can be put to multiple uses in the short-run (Hansen and Heady, 2010, p. 878); none of which might still be important in the long-run.

spurious regression problem (Granger and Newbold, 1974).[5] It is noteworthy that despite omitting non-tax revenues and domestic borrowing (remember we do not want to estimate an identity), cointegration between aid, taxes and spending can be viewed as the statistical analogue of the domestic budgetary equilibrium (Osei *et al.,* 2005; Lloyd *et al.,* 2009).

Occasionally, the observed long-run evolution deviates from its path (fiscal disequilibrium resulting from a budget surplus or deficit) 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 hence *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. Insofar as dynamics are incorporated into equation (2), particularly the inclusion of a lagged dependent variable, the strict exogeneity assumption may no longer hold. This allows for the possibility of feedback between variables in the fiscal equilibrium; meaning past fiscal imbalances determines the amount of aid recipients receive and the amount of tax revenue they raise. In statistical terminology this translates to the concept of weak exogeneity; which is of great importance in the fiscal response literature. If a variable is weakly exogenous, then that variable does not adjust to maintain equilibrium following a disequilibrium.

It is intuitive to see which domestic fiscal variables, aid, taxes or spending adjust to maintain equilibrium in the system and which are exogenously determined for the fiscal equilibrium. When exogeneity tests are applied to domestic fiscal variables (taxes and expenditures) the results indicate which variables adjust to disequilibrium (Lloyd *et al.,* 2009). When applied to aid, the results give an indication of the behaviour of the donors in relation to fiscal disequilibrium. If aid is not weakly exogenous it will mean that donors consider past fiscal imbalances in deciding how much aid to give to recipients. If aid is weakly exogenous, then donors are *insensitive* to imbalances in recipient countries, and the level of aid disbursed is independent of the recipient country's fiscal situation.

Likewise, the (non)stationarity of tax revenues indicates its potential effects on expenditures. In spite of the important fiscal roles aid plays in developing countries, government expenditures are 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 revenues are the main determinant of government expenditures in developing countries (Osei *et al.,* 2005 for Ghana; Martins, 2010 for Ethiopia; Bwire *et al.,* 2013 for Uganda; Morrissey *et al.,* 2011 for 58 developing countries). Moreover, earlier studies on the determinants of government expenditures find that domestic revenue volatility is the main source of expenditure volatility in developing countries; as countries with volatile domestic revenues are unable to alter expenditures in the short-run (Fielding, 1997; Bleaney, Gemmell and Greenaway, 1995). As domestic revenues (represented solely by tax revenue in this study) are typically trending, they are expected to impact positively on domestic expenditures in the long-run. While nonstationarity is a necessary condition for tax revenues to have a long-term impact on

[5] 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 *et al.,* 2006). Thus the estimator does not converge to the true parameter value but to a random number (Coakley *et al.,* 2006).

spending, it is however, not a sufficient condition. Tax revenues are dependent on several recipient-specific factors[6] 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 government expenditures in recipient countries, aid also impacts tax revenues (and domestic revenue mobilisation in general); which, as emphasized, impact expenditures. Morrissey (2012) mentions the difficulty in linking aid and donor intentions. Some aid is given for tax administration and public sector management while some is given for physical capital ad human capital development. Data are now available on aid given for specific 'observable or quantifiable' purposes like human capital and physical capital development (obtainable from the OECD's Creditor Reporting System database). However, the amount of aid given for policy reform (conditional aid), like that for tax administration and public finance management is not easily known. There is a growing body of research on the impact of aid on tax revenues (Benedek *et al.,* 2012; Clist and Morrissey, 2011) which uncovers many channels through which aid can influence taxes (akin to the multiple channels through which aid influences spending, discussed above).

There may be a behavioural impact of aid on taxation; in which governments are less inclined to expend effort on tax collection as aid provides an alternative source of revenue. Besides this, policy conditions associated with aid (for example trade liberalisation or currency devaluation) may also influence the way aid impacts taxation. Generally, there are many ways through which aid can influence taxes and such 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 (2) will attribute all the effects on spending to aid, ignoring the effects of taxes. This justifies a parsimonious approach of including both aid and taxes. Moreover, domestic revenues have been found to be the main driver of expenditures so taxes should be included in any structural model of the form in equation (2). Besides taxes can act as a proxy for any observed or unobserved time-varying omitted variables that influence expenditures (for instance exports, imports and recipient policy) and if cointegration is found in equation (2), it will justify the inclusion of both aid and taxes in the model (implying no important nonstationary variables have been omitted).

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

[6] 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.

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 (De Hoyos and Sarafidis, 2006). 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 (SSA hereafter); 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.

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 spillover 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; and revenue instability has been found to be the main cause of expenditure instability in developing countries (Fielding, 1997). Indeed, Bleaney *et al.,* (1995) and Fielding (1997) find a close link between revenue and expenditure instability for samples of SSA countries.

Figure 1 highlights cross-section dependence in tax/GDP *slumps* 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 reach their minimum tax revenues in three years; 1984, 1994 and 1996. Closer inspection of the data revealed that the drop 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).

Guillamont *et al.,* (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 trade volumes. Murdoch and Sandler (2002) discuss spatial war spillovers, whereby civil wars in a particular 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).[7] 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 paper aims to further investigate. If the factors are nonstationary then they become part of the cointegrating relationship; 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.

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 particular 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 might 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 also its own short-run dynamics.

Figure 2 shows linear regression lines for the 10 highest recipients of net aid in the sample, separately. The objective of the diagram is strictly to show the importance of recipient heterogeneity. While we can draw some broad patterns on the relationship between aid and spending (i.e. a positive relationship between aid and spending for most of the countries as they are LDCs), the slopes of the linear regression lines are different for each country considered. Though these diagrams are basic and highly stylised (as they show patterns only for the countries in this analysis; and there are other domestic factors that influence spending that we cannot incorporate); they provide tacit evidence that pooling countries into a regression with *common* dynamics will have implications on inference if the true relationship (DGP) between aid, revenue and spending is indeed heterogeneous.

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

[7] See Ndulu *et al.,* (2008, ps. 253-261) for a thorough discussion of the immediate and lagged effects of state conflict.

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 (2) a pooled regression equation will have error terms that contain one or more of:[8]

$$(\beta_{i1} - \mu_1)Aid_{it} \qquad (\beta_{i2} - \mu_2)Tax_{it} \tag{3}$$

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) is a linear combination of nonstationary processes; hence the nonstationary errors themselves. Eberhardt and Teal (2011, p.140) state that even in cases where 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 *et al.,* 2009). We will formally introduce the concepts of stationarity, parameter heterogeneity and cross-section dependence into our econometric model in section 5.

3. LITERATURE REVIEW

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 basically 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. 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 remain some limitations to her study. First, 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.[9] Second, aid itself is included in government spending as a significant portion of aid given to a country is included in government spending (Morrissey, 2012). Her analysis does not attempt to account, econometrically, for such *double-counting*.

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

[9] 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.

Morrissey *et al.,* (2011) model the effect of aid on spending for a panel of 58 countries over 1990-2008. As the data they collect is 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.

Fiscal Response Models (FRMs)

These are studies that address the components of the budget over time by considering the relationship between aid, tax revenue, government spending and domestic borrowing. These studies consider the broader relationship between domestic fiscal variables and aid but don't estimate the magnitude of aid on government spending. As stated earlier, pristine FRMs have their shortcomings. In a bid to subdue the difficulties of pristine FRMs, 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 and 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 (revenue and expenditure) 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).

Osei, Morrissey and Lloyd (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, coupled with policies that lead to increases in taxes, are what lead to increased spending. There's no direct impact of aid on spending.

Morrissey, M'Amanja and Lloyd (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 were associated with increased spending and spending had a positive impact on growth (with grants also having a positive association with growth). Loans, on the other hand, were sought when expenditures exceeded revenues; i.e. to finance unanticipated deficits (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. Similar to Osei *et al.,* (2005) they do not provide estimates of the magnitude of the effect of aid on government spending.

Lloyd, McGillivray, Morrissey and Opoku-Afari (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. They find that aid does influence government budgetary behaviour; that is aid is a significant component of the fiscal relationship in recipient countries. Aid is also found to be positively associated with the different components of government spending; and it is weakly exogenous (i.e. donors do not respond to fiscal imbalances in determining their allocation of aid). 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. There is evidence of a long-run positive relationship between aid 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 provide more grants to Ethiopia and the level of development spending increases. The magnitude of the effect of aid on government spending, however, isn't estimated.

Bwire, Morrissey and Lloyd (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. They find that in the long-run, the budget is influenced more by tax revenue than aid; with aid and tax being negatively related to domestic borrowing while spending is positively related to domestic borrowing. In the disaggregated model, increases in capital spending lead to increases in deficits. Similar to 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. Most FRMs have been cross-country estimations in which the impact of aid on fiscal aggregates (tax/GDP and spending/GDP ratios) is assumed to be the *same* across countries (Morrissey *et al.,* 2011; Remmer, 2004). These cross-country estimates are based on the *homogeneity* assumption; that the effects of aid are the same for all countries in the respective samples. More recently, however, recipient heterogeneity is being explicitly incorporated into fiscal response studies by estimating time series country-specific models (see Morrissey, 2012 for a review of the country-specific studies).

In this study 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. To the best of our knowledge, no studies on aid and public expenditure explicitly account for the distorting impact of cross-sectional dependence, which arises from common shocks that affect units of data differently. Using annual data covering 1980-2013, this study will contribute 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.

4. DATA[10]

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 and net loans. As this database comprises aid data provided by the donors it tends to overstate the amount of aid that actually 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 measure of *net* grants which we then add to net loans to get net ODA figures for the econometric analysis. We also estimate variants of the main model with technical assistance (the proxy for off-budget aid), grants and loans 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 expenditure and domestic public investment (capital expenditure), we also collect data for these two expenditure headings (all 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 Global Revenue Dataset (GRD) of the International Centre for Tax and Development (ICTD). 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.

Figure 3 shows the distribution and evolution of net aid/GDP, tax/GDP and spending/GDP rates for all 69 countries in the sample. The lower and upper ends of each box plot show the 25^{th} and 75^{th} 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 increases consistently until 1988; then drops slightly in 1992 and continues falling until 2000. It picks up slightly from 2004 to 2008 then drops 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. Expenditures 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 4 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). 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 not because grants discourage tax efforts, but simply because tax/GDP rates are low in those countries. 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 the tax/GDP ratio increases and the aid/GDP ratio declines (with aid

[10] 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. They are only included to test the robustness of our results.

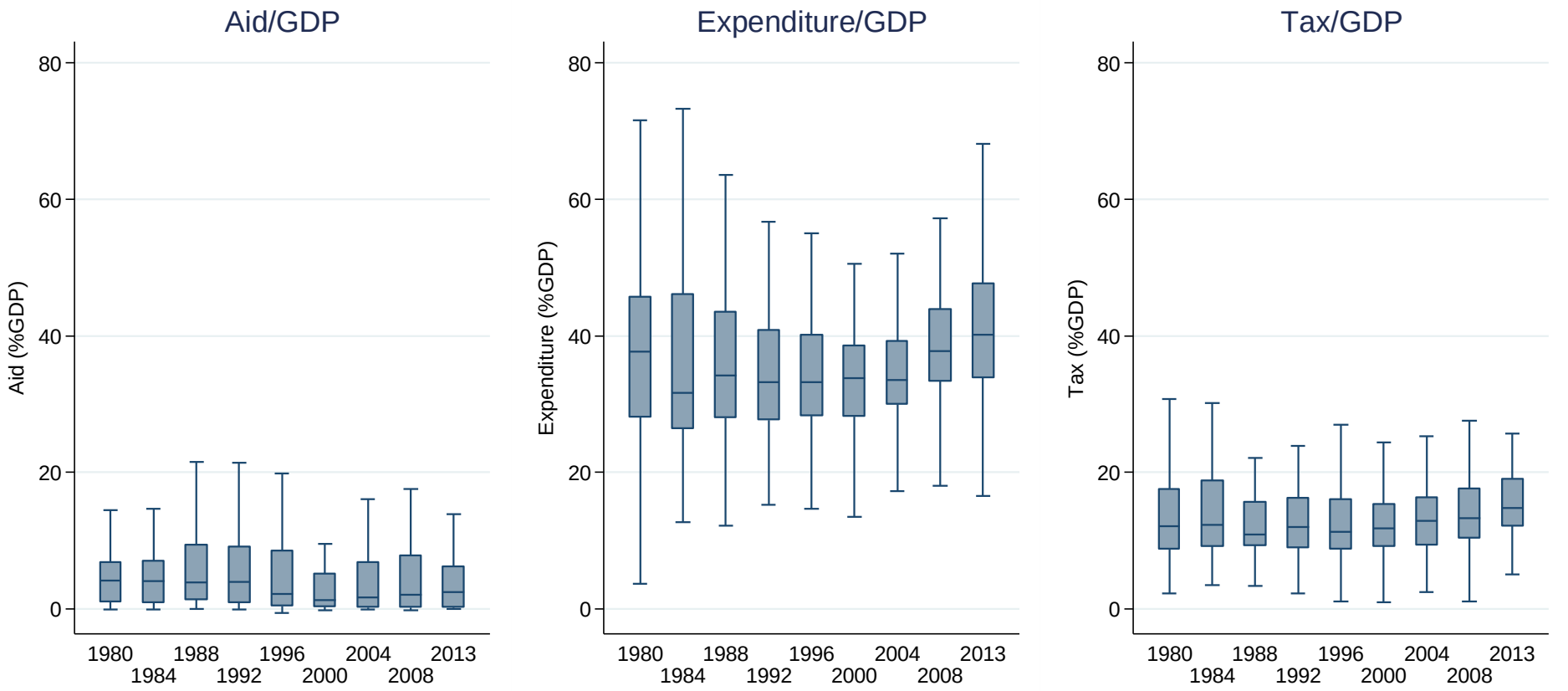
representing a lower share of government spending). Least developed countries are those with slow (sometimes stagnant) growth, low tax/GDP rates and for whom aid still represents a huge share of government spending. It follows then, that they would receive more aid in the form of grants; as their tax 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 5a shows that least developed countries have the lowest tax/GDP ratios. While this may indicate some kind of 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 that have better (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 2.1, Van de Sijpe (2012) 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 doesn't go through recipients' budgets but can still generate fiscal responses from recipients. Figure 5b 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 stock of human and physical capital to be able 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.

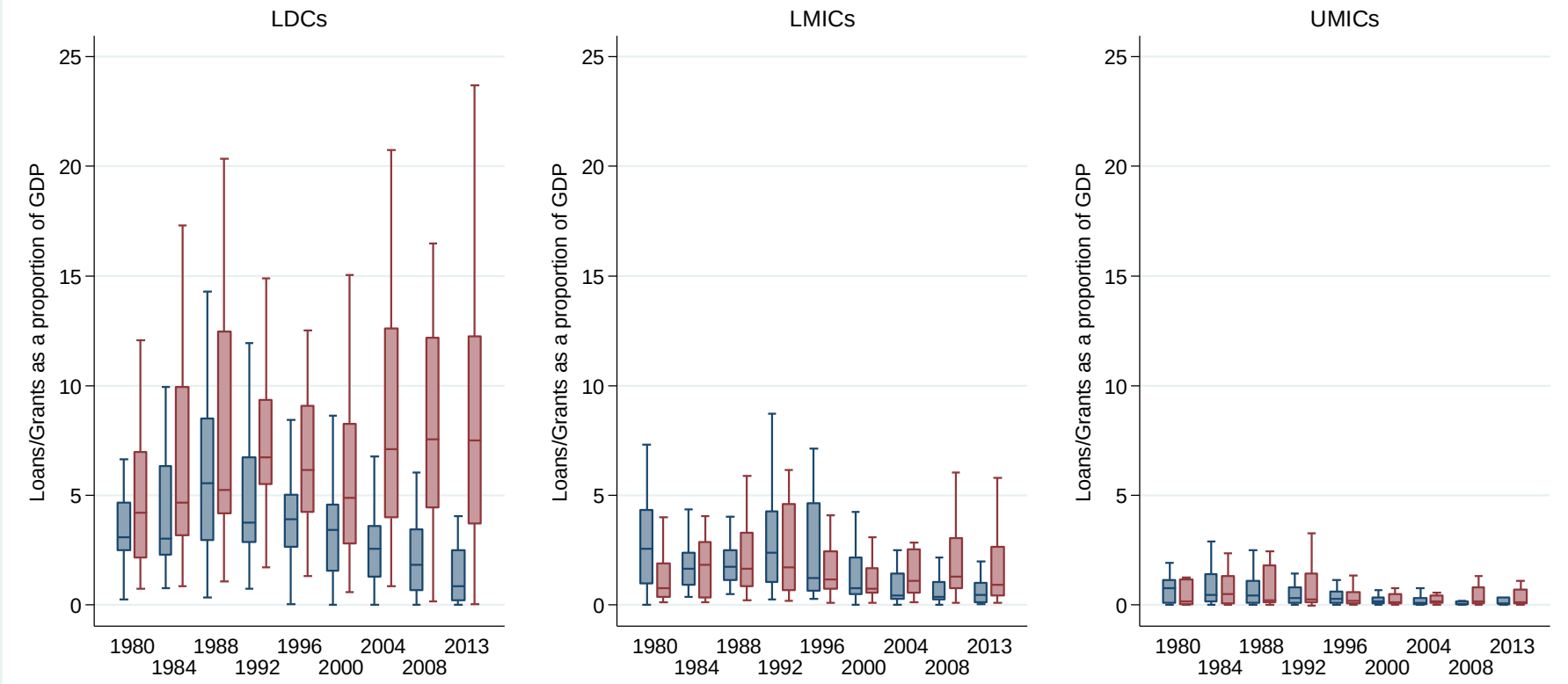
Figure 3: Distribution and Evolution of fiscal variables over time (1980-2013)



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)

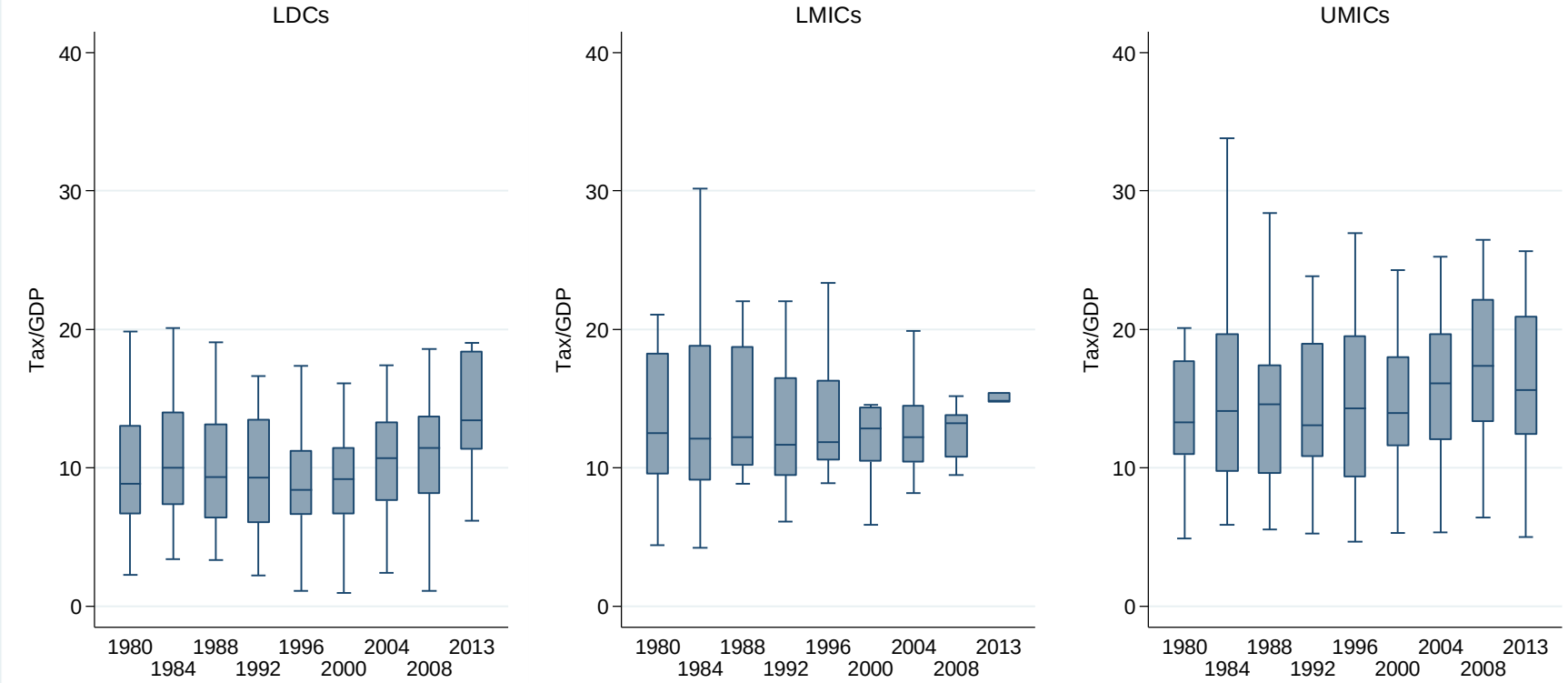
Figure 4: ODA Loans and Grants by Income Group (1980-2013)



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 2 for details of the sample for each income group.

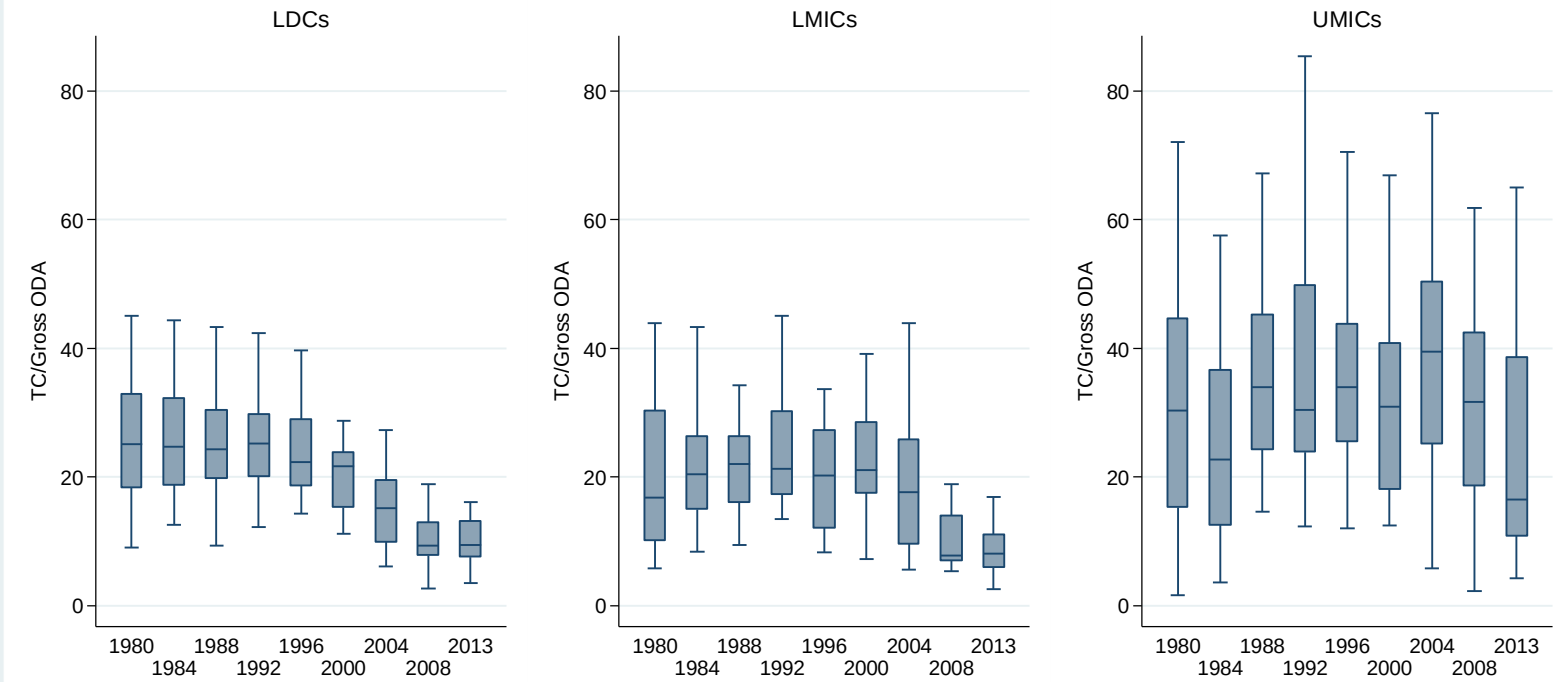
Source: OECD DAC (2015)

Figure 5a: Tax Revenue by Income Group (1980-2013)



Source: ICTD GRD (2014)

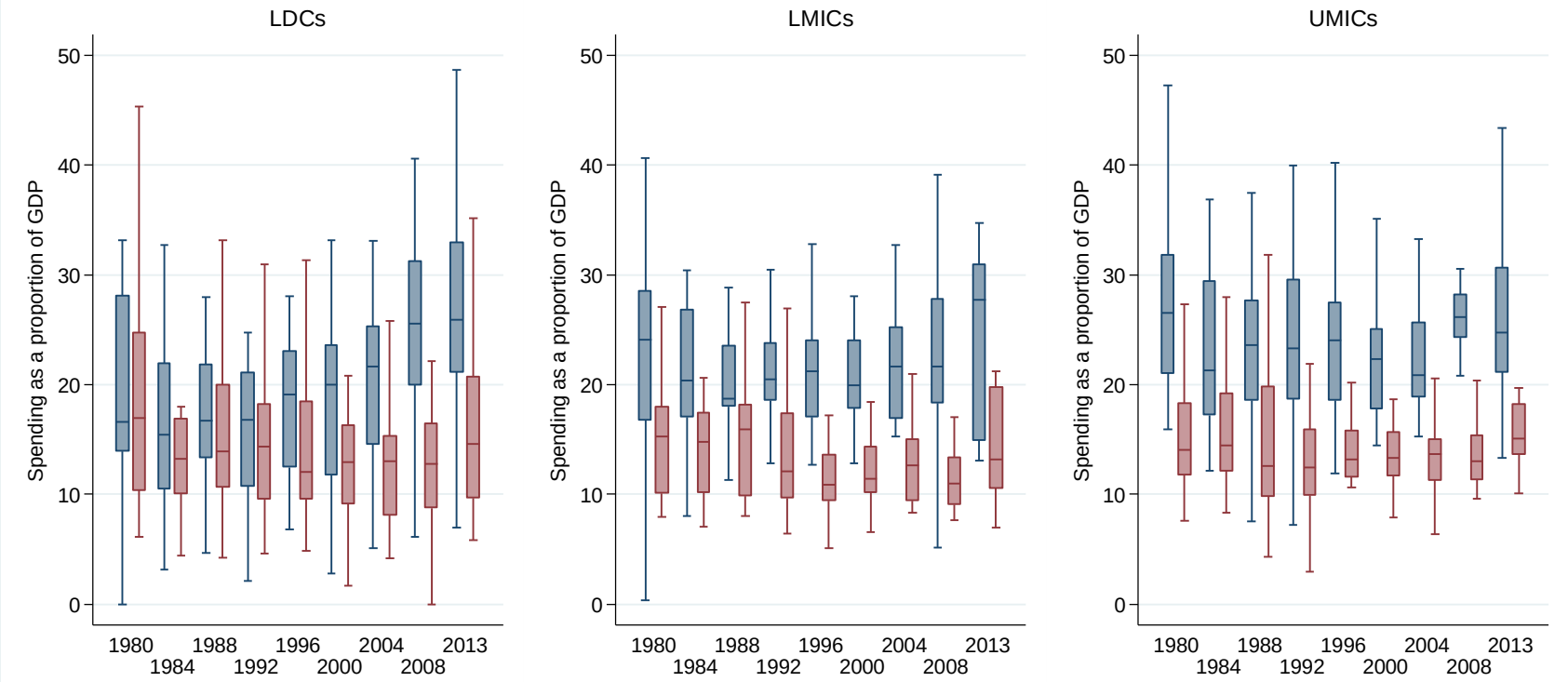
Figure 5b: Technical Cooperation by Income Group (1980-2013)



Note: TC/Gross ODA refers to technical cooperation as a share of gross aid disbursements.

Source: Author's calculations based OECD DAC (2015)

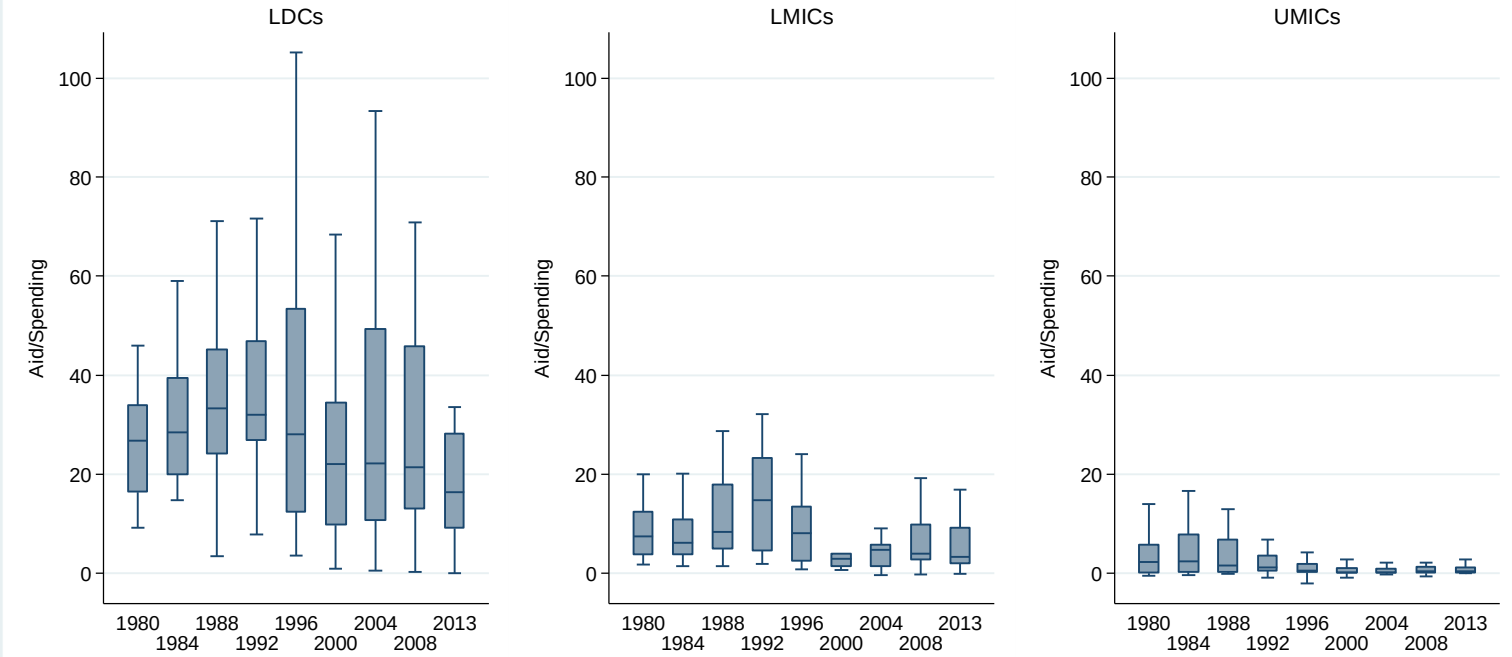
Figure 6: Capital and Recurrent Expenditures (1980-2013)



Note: The blue boxes represent capital expenditures while the red ones represent recurrent expenditures. 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 2 for details of the sample for each income group.

Source: *World Development Indicators* (2015)

Figure 7: Aid to Spending Ratio by Income Group (1980-2013)



Note: 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 2 for details of the sample for each income group.

Source: Author's calculations based on OECD DAC (2015) and *World Development Indicators* (2015)

The components of government spending have a more uniform evolution over time (figure 6). As development expenditures are essential for growth they are consistently higher than recurrent expenditures for all 69 countries in the sample. When the sample is disaggregated into the three different income groups there is considerable fluctuation over the years but capital expenditures are consistently higher than recurrent expenditures. Capital expenditures are also lower in least developed countries; perhaps indicative of their inabilities to raise taxes for development, or political factors constraining the ability for governments to invest.

Figure 7 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, 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 maintained based solely on either revenue package. Hence aid and taxes must be complementary, and the *observable* impact of aid and taxes on spending can only be determined empirically.

5. EMPIRICAL MODEL SPECIFICATION

5.1 Cross-Section Dependence and Unit Roots

As mentioned in section 2.3, rising economic integration across countries makes interdependencies between them palpable. It is then imperative to investigate the potential 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 for the other $N-1$ countries. Doing that for all other countries, 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 correlation coefficients can be used to obtain a more formal test statistic (for example, the Pesaran CD statistic). The CD test of Pesaran (2004) 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; Holly and Raissi, 2009). For a balanced panel, the statistic can be defined as:

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right) \qquad (4)$$

Where $\hat{\rho}_{ij}$ is the average pairwise correlation of the variable series (or residuals) and under of null of 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:

$$\Delta y_{it} = \mu_i + \beta_i t + (\rho_i - 1) y_{it-1} + \sum_{j=1}^{p} \delta_{ij} \Delta y_{it-j} + u_{it} \quad (5)$$

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 u_{it} from equation (9) does not have a common factor (i.e. the tests assume cross-section independence); and the tests were developed to increase power from pooling low-powered[11] country-specific unit root tests (Eberhardt and Teal, 2010). 'Second generation' tests, on the other hand, assume that u_{it} has a *single* factor creating the cross-section dependence. The null hypothesis for the unit root tests is:

$$H_0: \rho_i - 1 = 0, i = 1, \dots, N \quad (6)$$

Against the alternative that:

$$H_1: \rho_i - 1 < 0, i = 1, \dots, N_1;\ \rho_i - 1 = 0, i = N_1 + 1, \dots, N \quad (7)$$

Where N is the number of countries in the sample, $N_1 < N$ and N_1/N is nonzero and fixed as $N \to \infty$ (Baltagi and Moscone, 2010). In words, the null hypothesis is the variable series (or regression residual) is nonstationary for *all* countries in the sample; with the alternative of stationarity in *at least* some countries. Rejection of the unit root null hypothesis does not imply panel stationarity, but rather nonstationarity in *all* countries (Eberhardt and Teal, 2011). Smith and Fuertes (2007, p. 39) state 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. Basically, ADF tests akin to equation (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 (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 (5), augmented with cross-section averages of the observables will be:

$$\Delta y_{it} = \mu_i + \beta_i t + (\rho_i - 1) y_{it-1} + \sum_{j=1}^{p} \delta_{ij} \Delta y_{it-j} + \theta_{1i}^{CA} \overline{\Delta y}_{it} + \theta_{2i}^{CA} \bar{y}_{it-1} + \theta_{3i}^{CA} \Delta y_{it-p} + u_{it} \quad (8)$$

where in addition to the terms in equation (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. Moreover, Baltagi and Moscone (2010) state that the test is also robust to other forms of cross-section dependence such as

[11] 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).

spatial autoregressive processes. Nonetheless, the test can only accommodate one single factor as the source of cross-section dependence.

5.2 The Econometric Model: Common Factor Representation

The equation of primary interest in this analysis is a static structural equation akin to equation (2), modelling the effects of aid and taxes on spending. Building on a common factor approach, the equation will be of the form:

$$y_{it} = \alpha_i + \beta_{i1}(Aid)_{it} + \beta_{i2}(Tax)_{it} + \varepsilon_{it} \qquad \varepsilon_{it} = \gamma_i'\Gamma_t + \mu_{it} \tag{9}$$

where y is total government spending, aid is net ODA and tax is tax revenue – all in logarithms. The vector of slope coefficients β_i differs across countries, but is constant over time. Unobserved, time-invariant recipient heterogeneity is represented by country-specific "fixed effects" α_i. In addition a vector of common factors Γ_t (that affect the error term) with country-specific factor loadings (γ_i) is also included to account for the evolution of time-varying unobservables. These common factors can be a combination of *weak* factors, representing local spillover effects like the devaluation of the CFA Franc in 1994; and *strong* factors like the great depression of the early 1980s and the recent financial crisis (see section 2.3). Furthermore, these unobservable common factors may not only drive expenditures but also the other independent variables (aid and taxes) in the model, leading to endogeneity. To elucidate this point, assume any independent variable from equation (9), x, evolves in the form:

$$X_{it} = \pi_i + \tau_i X_{it-1} + \Phi_{1i}\Gamma_{1t} + \cdots + \Phi_{ni}\Gamma_{nt} + \delta_i\Psi_t + \upsilon_{it} \tag{10}$$

$$\Gamma_t = \eta\Gamma_{t-1} + \epsilon_{\Gamma t} \qquad \Phi_t = \theta\Phi_{t-1} + \epsilon_{\Phi t} \tag{11}$$

for $i = 1, \dots, N$, and $t = 1, \dots, T$. As seen in equation (10) the independent variables (aid and tax revenue) are driven by a set of common factors (Γ_{nt} and Ψ_t)[12], some of which influence expenditures in equation (9). Hence if $\gamma_i \neq 0$ and $\Phi_i \neq 0$ the error term and the regressors from equation (9) are correlated, creating serious problems for estimation (Kapetanios *et al.,* 2011). Empirical estimators that address this kind of endogeneity should be used. In addition, equation (11) indicates that the factors can be nonstationary ($\eta = 1,\ \theta = 1$), again with important implications for estimation and inference. Based on equations (9), (10), and (11); and guided by the conceptual discussions in section 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:

$$\Delta y_{it} = \alpha_i + \rho_i[y_{it-1} - \beta_{i1}(Aid)_{it-1} - \beta_{i2}(Tax)_{it-1}] + \gamma_{i1}\Delta(Aid)_{it} + \gamma_{i2}\Delta(Tax)_{it} + \varepsilon_{it} \tag{12}$$

Where the β_i's represent the long-run relationship between spending, aid and taxes in the model (a potential cointegrating relationship, from which we're interested in getting the average value of β_i) and γ_i's represent the short-run relations. 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 from short-run dynamics, the theoretical premise from which ECMs are derived. Second, the error correction term ρ_i and the long-run coefficients ($\beta_{i,s}$) can be 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

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

the error correction term in the ECM (Eberhardt and Presbitero, 2014). A negative and significant error correction coefficient represents cointegration, indicating that the economy returns to its long-run equilibrium following a deviation from equilibrium (Bleaney *et al.,* 2016).

A few comments on this specification and how it relates to Remmer (2004) are noteworthy. Although both studies draw on insights from political economy and public finance theory, they are different in two aspects. First, the main hypothesis of interest in this study differs from that of Remmer (2004). Guided by the literature on growth in government size, she models the determinants of government size (measured by changes in the expenditure/GDP ratio), including aid as the variable of principal interest. As this is primarily a public finance model, she includes other variables (economic, institutional and demographic) that may affect government size. These control variables include trade openness, central government total revenue, government debts, *per capita* GDP, population and the dependency ratio.

The main hypothesis in our study, however, is different. We investigate if aid forms part of the long-run budgetary equilibrium (i.e. the presence of a cointegrating relationship between aid, taxes and expenditures) and test which of the sources of finance, aid or taxes, is more *responsible* for changes in expenditures. We posit that the relative importance of each of these sources of finance is attributed to how recipients perceive their respective political costs (based on accountability, autonomy and bureaucracy), which offset each other (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) analysis are themselves determinants of tax effort (see section 2). Hence in our analysis tax revenue will act as a proxy for all the control variables included in the Remmer (2004) analysis, 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, 2014). Lütkepohl (2007) also states that the cointegration property is invariant to model extensions. This means when other sources of finance 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 now raises the possibility that there may be more than one cointegrating relationship, as there are other sources of finance that influence recipients' expenditures. 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 study we treat the sole long-run relationship as a statistical analogue to the domestic budgetary equilibrium. Besides, including other nonstationary variables into the system may result in spurious relations (Herzer, 2014). 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 included variable will not converge to zero as expected of irrelevant variables in regression (Herzer, 2014). These considerations, then, justify a parsimonious model such as equation (9).

Second, the dynamic ECM Remmer (2004) estimates is more restrictive as the model imposes parameter homogeneity. She tests for unit roots in her analysis, and finds evidence of homogenous cointegration (judged by a negative and significant lagged dependent variable). However, if the true coefficients determining how the control variables affect expenditure growth (DGP) differs across countries; imposing

homogeneity results in the breakdown of the cointegrating relationship. Long-run homogeneity was not tested for. Moreover, no attempts are made to accommodate cross-section dependence into her analysis. Common shocks generate unobserved common factors that are potentially nonstationary, with implications for estimation (Coakley *et al.,* 2006). Cross-section dependence is a recurrent feature in macro data and should always be accounted for in analysis. Thus in this paper, 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 also accommodating 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 (Coakley *et al.,* 2006; Eberhardt, 2012). Basically, 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:

$$\hat{\beta}^{CCEMG} = \frac{\sum_{i=1}^{N} \hat{\beta}_i}{N} \tag{13}$$

Where $\hat{\beta}^{CCEMG}$ is the country-specific estimate from the CCEMG estimator. Coakley *et al.,* (2006) and Bond and Eberhardt (2013) prove that the estimator is consistent in the presence of multiple common factors (Γ_t and Ψ_t in equations (9) and (10)), factor loading dependence ($\gamma_i = \Phi_i$) and also in the presence of regressor-specific common factors (for instance, Ψ_t in equation (10)). Additionally, the estimator is robust to nonstationary common factors ($\eta = 1,\ \theta = 1$). However, Chudik and Pesaran (2015) find that the CCEMG estimator is subject to small sample bias; especially in samples with moderate time series dimensions (Chudik and Pesaran, 2015). Furthermore, they relax the strict exogeneity assumption, instead allowing for *feedback* between variables in the system which poses a challenge for inference. Allowing for feedback in the system raises the issue of weak exogeneity, which is of particular importance in the fiscal response context (see section 2.2). To solve these two aforementioned problems the authors 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 (12) with cross-section averages (and lags of the cross-section averages) of the dependent and independent variables we get:

$$\begin{aligned}\Delta y_{it} = {} & \pi_{0i} + \pi_i^{EC} y_{it-1} + \pi_i^{Aid} Aid_{it-1} + \pi_i^{Tax} Tax_{it-1} + \pi_i^{Aid} \Delta(Aid)_{it} + \pi_i^{Tax} \Delta(Tax)_{it} + \pi_{1i}^{CA} \overline{\Delta y}_t \\ & + \pi_{2i}^{CA} \bar{y}_{t-1} + \pi_{3i}^{CA} \overline{\text{Aid}}_{t-1} + \pi_{4i}^{CA} \overline{\text{Tax}}_{t-1} + \pi_{5i}^{CA} \overline{\Delta Aid}_t + \pi_{6i}^{CA} \overline{\Delta Tax}_t + \sum_{l=1}^{p} \pi_{7i}^{CA} \overline{\Delta y}_{t-p} \\ & + \sum_{l=1}^{p} \pi_{8i}^{CA} \overline{\Delta Aid}_{t-p} + \sum_{l=1}^{p} \pi_{9i}^{CA} \overline{\Delta Tax}_{t-p} + \varepsilon_{it}\end{aligned} \tag{14}$$

where in addition to the terms from equation (12), the coefficients $\pi^{CA}{}_s$ represent the coefficients of the cross-section averages of the dependent and independent variables (which yield the standard CCEMG estimator); and the coefficients $\sum_{l=1}^{p} \pi^{CA}{}_s$ represent the additional lags of cross-section averages which Chudik and Pesaran (2015) suggest be added to the standard CCEMG estimator (which yield 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 on the basis of $p = T^{\frac{1}{3}}$ (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 (lagged dependent variable), and also in the presence of weakly exogenous regressors. We then estimate equation (14) and obtain the long-run coefficients of aid and taxes in the form:

$$\beta_i^{Aid} = -\frac{\pi_i^{Aid}}{\pi_i^{EC}} \qquad \beta_i^{Tax} = -\frac{\pi_i^{Tax}}{\pi_i^{EC}}$$

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, and therefore there exists a cointegrating relationship between aid, taxes and spending.

6. Empirical Results

6.1 Cross-Section Dependence and Unit Roots

Results for cross-section dependence (table I) provide evidence of the pervasiveness of cross-section dependence in the sample, based on the cross-country correlation coefficients and the Pesaran (2004) *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.

Table I: 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 $\lvert\hat{\rho}_{ij}\rvert$) coefficients of the $N(N-1)$ sets of correlations. CD is the Pesaran (2004) 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. Net ODA (Aid), technical cooperation (TC), tax revenue (Rev) and government expenditure (Exp) all in logs

Cross-section dependence (CSD) leads to standard panel unit root suffering from significant size distortions, resulting in them over-rejecting the null of nonstationarity (Eberhardt and Presbitero, 2014). Thus panel unit root tests that accommodate such

dependence are more appropriate. To that end, we use the CIPS test of Pesaran (2007). Table II 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 and H_1 = stationarity in some countries' variable series. This is obtained by normalising the individual country t-statistics using simulated values of the mean and variance (Söderbom *et al.,* 2014). This makes the Ztbar statistic distributed $N(0,1)$.

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. On the other hand, nonstationarity is rejected for all variables in first differences. Nonstationarity of these fiscal variables implies the interplay between them potentially forms a cointegrating relationship (the statistical analogue of a domestic budgetary equilibrium). We now formally test for the presence of this budgetary equilibrium.[13]

Table II: Pesaran (2007) Unit Root Test

Levels: CIPS with intercept only								
Variable	Aid		TC		Rev		Exp	
Lags	*Zt*bar	*p*	*Zt*bar	*p*	*Zt*bar	*p*	*Zt*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	*Zt*bar	*p*	*Zt*bar	*p*	*Zt*bar	*p*	*Zt*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	*Zt*bar	*p*	*Zt*bar	*p*	*Zt*bar	*p*	*Zt*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.

6.2 Heterogeneous Baseline Estimates

Having confirmed the prevalence of cross-section dependence, and also established that all the variables are nonstationary we proceed to estimate the heterogeneous dynamic ECM using a dynamic CCEMG estimator; results of which are reported in Table III. 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.

[13] Panel unit root tests results, as well as tests for cross-section dependence for variables used in exploratory analysis can be found in Appendix 5.

Table III: 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
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: These results are based on an error correction model for all 69 countries in the sample with the first difference of log expenditures as dependent variable. *Aid1* refers to net ODA excluding technical cooperation while *Aid2* refers to net ODA including technical cooperation. Standard CCEMG indicates the Pesaran (2006) common correlated effects mean group (CCEMG) estimator while one-lag and two-lag CCEMG indicate the standard CCEMG augmented with one and two lags of the cross-section averages respectively. The *long-run* averages are computed from the robust mean estimates of the CCEMG models (with standard errors computed through the Delta method). The *short-run* coefficients are read off directly from estimation. All models are augmented with country-specific linear trend terms. The t-statistic of 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 while CD test is the Pesaran (2004) test distributed $N(0,1)$ under the null of cross-section independence (p-value in parantheses below). *, ** and *** indicate significance at 1%, 5% and 10% 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 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 will 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 III. 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 (Cavalcanti *et al.,* 2011). In addition, the t-statistic[14] is *sufficiently* greater than 10 in the model, providing 'solid' evidence of a long-run equilibrium (cointegrating) relationship between aid, taxes and expenditures. 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.

Tests for panel cointegration have been proposed in the econometric literature, each with their own 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 account for 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. Given the difficulties in carrying out 'solid' inference on the existence of cointegration, 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.,* 2013; Mascagni and Timmis, 2014). 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. A $1 increase in aid is associated with a $0.241 increase in government spending. This is a fairly large effect, emphasising the perceived importance of aid to developing countries[15], and provides insight into the *general tendency* in the sample that on average, there is a positive association between aid and expenditures. Expenditures, however, do not increase by the amount of aid (i.e. aid is not additional). Domestic resources previously allocated may be redirected to other uses once recipients receive more aid. The positive association between aid and expenditures is consistent with the findings in Remmer (2004) though as mentioned earlier, her main hypothesis is different. She interprets her positive association between aid and spending as increased aid permitting an expansion in government size in the long-run. We interpret our results as aid being a part of the long-run budgetary equilibrium, representing an important source of finance for expenditures of recipient countries.

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 0.83% increase in government expenditures in the long-run. A $1 increase in taxes is associated with a $0.25 increase in recipients' expenditures. This coefficient (and marginal effect) is large (and larger than that of aid) indicating that on average, long-run spending plans are driven mainly by tax revenues (or domestic revenue in general). This is a recurrent finding in the fiscal effects literature (Lloyd *et al.,* 2009; Mascagni and Timmis, 2014), suggesting that while developing countries still maintain high shares of aid their spending patterns are determined mainly by their domestic sources of revenue. This is plausible as domestic expenditures driven by domestic revenue reduce the risk of fiscal vulnerability as a result of aid unpredictability (Bwire, 2012).

[14] This t-statistic on the lagged dependent variable does not follow a t-distribution; but a large value of, say 10, is 'solid' evidence of cointegration.

[15] Using sample data to illustrate, aid accounted for about 16 per cent of government spending on average 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.

Turning to the short-run coefficients; again aid and taxes are positively associated with spending. The short-run coefficient of 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 means aid substitutes for private sources of finance in the short-run. This short run impact may also reflect the volatility of aid flows to some countries, with this volatility making aid it impossible for aid to be used for planning in those countries. Hence it merely relaxes the budget constraint. With regard to taxes, a one percentage-point increase in taxes is associated with a 0.59% increase in expenditures in the short-run. This indicates that even in the short-run, domestic sources of revenue are the main driving force of government expenditures. Like aid, this short-run impact of taxes may also be a result of tax instability. Fluctuating tax revenue mimics a stationary process; meaning any such volatility in taxes will be translated to revenue volatility.

Overall the results indicate 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. Expenditures in recipient countries are driven mainly by tax revenues 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. This choice between tax and aid also relates to the political costs associated with tax and aid; based on 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). Hence any government that can make independent policy choices is an autonomous one. The desire for greater autonomy encourages governments to expend effort on 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. He also states 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 cost of accountability refers to whom and the extent to which a government has to account for its uses of revenue, and these accountability costs are likely to be higher for aid than for taxes (Morrissey, 2015b). The donor agencies themselves have to account to their own government and parliament, so they implement measures to monitor the use of aid and minimise fungibility. Donors often provide aid with policy reform conditions (relating to public finance management), and exert considerable effort in monitoring the use of their aid. This means effort has to be expended by recipients 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. Hence the costs of accountability are higher for aid, especially in these countries with weak institutions and revenues are comparatively low.

Besides 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 lead to the bureaucratic costs of aid being very high. Even if donors coordinate and form a donor group, 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 sum, the political 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.

6.3 Exploratory Analysis

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

6.3.1 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 actually funding. Thus we re-estimate equation (14) with capital expenditures and recurrent expenditures as dependent variable, respectively. Results for the disaggregated spending impact are reported in table IV.

Table IV: Heterogeneity of 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
CD *test*	0.54	-0.20
(p-value)	(0.592)	(0.839)
Observations	1954	1962

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 III.

Investigation of the lagged dependent variable indicates that aid, capital expenditures and taxes form an equilibrium (cointegrating) relationship. This implies that every year, recipients rely on aid receipts in financing their physical capital projects. 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 recipient's development prospects (i.e. some 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).

Taxes have a larger coefficient than aid which, again, suggests that decision makers 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 also 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.

As regards recurrent spending, there is evidence of a long-run cointegrating relationship between aid, taxes and recurrent spending. However, aid does not have any significant long-run impact on recurrent spending; while taxes impact on recurrent spending in the long-run and short-run. Martins (2010) also finds no long-run relationship between aid and recurrent spending. As the proportion of aid intended for capital and recurrent spending is unknown this result should not be treated evidence of no aid fungibility; but as absence of evidence of fungibility. The results differ from Osei et al., (2005), who find that aid impacts more on recurrent spending than capital spending in Ghana. However, much of the aid given to Ghana over their sample period was conditional aid (in the form of structural adjustment lending), which was not necessarily given for investment. Hence their results.

6.3.2 Disaggregated Aid Flows

Here we model the heterogeneous effects of aid loans, aid grants and technical cooperation. From section 4, 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 may have different effects on spending. Accordingly we re-estimate equation (14) with, respectively, grants, loans and technical cooperation as the measure of aid. Results are reported in table V. As regards 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.

As seen from table V, the long-run average of technical cooperation has the appropriate sign, but is statistically insignificant. This negative sign and 'absence' of evidence of a long-run effect is plausible both empirically and theoretically. 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).

Table V: Heterogeneous Aid Flows

	Grants	Loans	TC
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
CD test	-1.19	-0.28	-1.28
(p-value)	(0.234)	(0.780)	(0.202)
Observations	1987	1865	1987

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 III.

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.

6.3.3 Domestic Revenues

Royalties and other revenue from natural resources are important in countries endowed with natural resources. Thus we re-estimate equation (14) with two new measures of revenue; total tax revenue (column 2) and total government revenue (column 3). The former comprises revenue from non-resource taxes and resources taxes (both direct and indirect tax components), while the latter is a composite of tax and non-tax revenues. Results are reported in table VI. Regarding total tax revenue, the results are broadly unchanged relative to those with non-resource taxes as the measure of domestic revenue. 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 (hence, the dollar amount of total taxes) on total taxes higher than those on aid. When total government revenue is used the results are failry similar, except now there is no significant long-run impact of aid on spending. Besides, the coefficients on all variables are now smaller.

Table VI: 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
CD *test*	-0.22	1.63
(p-value)	(0.826)	(0.104)
Observations	1961	1940

Notes: 'Total Tax Revenue' and 'Total Domestic Revenue' refer to error correction models for all 69 countries first with total tax revenue (including natural resource taxes) as the measure of domestic revenue (column 2), then total government revenue as the measure of domestic revenue (column 3). The CCEMG with two lags of cross-section averages is used. For all other details see Table III.

6.3.4 Disaggregated Aid Flows and Expenditures

We estimate the heterogeneous effects of aid grants and loans on the different components of government spending. Thus equation (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 VII. 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. Mascagni and Timmis (2014) and Martins (2010) also find a positive relationship between grants and capital expenditures, with the latter finding that grants adjust to changes in development expenditure. Mascagni and Timmis (2014) 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 impact on 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 certainty of recipients servicing and repaying their loans. The long-run average is 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 when loans are largely concessional, making repayment a trivial issue in time with no direct policy implications (Mascagni and Timmis, 2014).

Table VII: Heterogeneity in Aid 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
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

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 III.

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.

6.3.5 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).[16] We re-estimate equation (14) for each region, results for which are presented in table VIII. Aid has a positive long-run (in addition to a short-run) impact in two of the four sub-regions (SSA and MENA), with the long-run average considerably larger for the SSA subsample. This is mainly because countries in SSA still 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 institutions in those countries they are aid dependent, with political costs of aid not as high as in other 'more developed' developing regions. These countries may be taxing as much as they can but is still not sufficient to finance the level of expenditure required, hence their reliance on aid. MENA countries have been subject to economic embargos (for example Iran) and civil unrest (for example Algeria) hence it is possible that more aid is provided to them to 'boost' their economies.

Taxes have a positive long-run and short-run impact on spending in all four regions. The long-run average of taxes is 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.

[16] Details of the countries comprising each region can be found in appendix 1.

Table VIII: 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
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 stands for Sub-Saharan Africa, MENA for Middle East and North Africa, Asia for Asia and the Pacific, and SAM for 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 III.

Lloyd *et al.,* (2009) posit that the fiscal impact of aid will depend on the level of development of the recipient country, with less developed economies having lower tax volumes and receiving more aid. As most SSA countries in this sample are least developed countries, the large (relative to other regions in the study) coefficient on aid and low (still relative to other regions in the study) coefficient on taxes confirm the assertion that less developed countries have more significant fiscal effects of aid.

6.3.6 Level of Development

Here the sample is split into three income groups-least developed countries (LDCs), lower middle income countries (LMICs) and upper middle income countries (UMICs)-based on the World Bank's classification. We thus re-estimate equation (14) for each income group, results for which are presented in table IX. After re-estimating equation (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 (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, 2014). Hence in the disaggregated model we include;

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

for each covariate Υ 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. Remmer (2004) argues that international exposure generates pressures for recipient governments to increase spending, making exports a good candidate for inclusion here. Results are reported in table IX.

Table IX: Heterogeneity in Levels of Development

	LDCs	**LMICs**	**UMICs**
Long-Run			
Tax	0.675***	0.571***	0.1.022***
	[0.064]	[0.185]	[0.207]
Aid	0.199***	-0.010	0.002
	[0.145]	[0.042]	[0.004]
Short-Run			
Tax	0.603***	0.512***	0.642***
	[0.079]	[0.094]	[0.114]
Aid	0.092**	0.004	0.001
	[0.035]	[0.013]	[0.002]
EC Coefficient			
y_{it-1}	-0.872***	-0.719***	-0.783***
	[0.078]	[0.073]	[0.086]
t-statistic	-11.15	-9.87	-9.11
Diagnostics			
RMSE	0.086	0.049	0.054
CD test	0.11	0.94	2.67
(p-value)	(0.914)	(0.348)	(0.007)
Observations	764	481	744
Countries	26	17	26

Notes: The sample is disaggregated by income level (based on the World Bank's classification). LDC refers to least developed countries, LMICs to lower middle income countries, and UMICs to upper middle 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 III.

Results indicate that aid has a positive long-run (and short-run) impact in least developed countries, with no discernible impact in middle 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 VIII). As mentioned earlier, these LDCs are aid dependent and as such their political costs of aid are lower than their political costs of taxation. These countries are constrained in their ability to raise revenue so they may be collecting as much tax as is possible, which still is not enough for expenditures. Furthermore, LDCs lack the human capital development, financial market development and infrastructure necessary 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 middle income countries. Moreover, some of these low income countries 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, 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.

7. 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 reverse causality. While the levels of aid may affect government expenditures, it is possible that the level of expenditures in recipient countries determines aid flows. We are interested in investigating if donors respond to recipients' fiscal imbalances when disbursing aid, or if they just have fixed amounts of aid to be disbursed to recipients irrespective of the recipients' fiscal situations. In a simplified version we can express equations (9) and (10) as follows:

$$y_{it} = \beta_i x_{it} + u_{it} \qquad u_{it} = \alpha_i + \gamma_i \Gamma_t + \varepsilon_{it} \tag{15}$$

$$x_{it} = \pi_i + \lambda_i g_t + \rho_i \Gamma_t + \phi_i \varepsilon_{it} + \nu_{it} \tag{16}$$

for any independent variable x and a single common factor Γ driving both y and x in equations (15) and (16) respectively. Baseline estimates from table III 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 (16), we are uncertain whether x 'causes' y or y 'causes' x or both. In the aid literature, this reverse causality arises because of the non-random allocation of aid (Temple and Van de Sijpe, 2015). That is, in disbursing aid donors respond to changing conditions in recipient countries, some of which are not easily measured (they are unobservable). Thus any model that controls for country and time fixed effects, or even a model that employs a systematic approach to the choice of control variables, still would not be sufficient for identification as aid and macroeconomic outcomes are determined by these unobservables (Temple, 2010; Temple and Van de Sijpe, 2015).

A standard instrumental variable approach can address this 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). 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, Temple (2010) argues that 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. Temple and Van de Sijpe (2015) 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 use 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 of time (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. This is reasonable as the largest donors provide aid on an average to many recipients. Hence it is impossible for donors' aid budgets to be responsive to country-specific circumstances in all recipients. The instrument is informative $[E(x,z)\neq 0]$ as there are multiple donors considered in the analysis, and their budget shares differ. Hence the instrument has huge explanatory power in the first stage.

In this study, 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 Teal, 2014). This is of particular importance in the fiscal response framework, as it offers insight to which variables adjust to maintain the budgetary equilibrium.

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. When weak exogeneity tests are applied to domestic fiscal variables, the tests indicate which of the fiscal variables adjust in light of fiscal disequilibria (deficit/surplus) to restore equilibrium. When such tests are applied to 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 endogenous. 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; Gemmell *et al.,* 2012).

As long as 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:

$$\Delta y_{it}=\rho_{1i}+\theta_{1i}\hat{e}_{it-1}+\sum_{j=1}^{K}\lambda_{11ij}\Delta \mathrm{y}_{it-j}+\sum_{j=1}^{K}\lambda_{12ij}\Delta x_{it-j}+\epsilon_{1it} \quad (17)$$

$$\Delta x_{1it}=\rho_{2i}+\theta_{2i}\hat{e}_{it-1}+\sum_{j=1}^{K}\lambda_{21ij}\Delta y_{it-j}+\sum_{j=1}^{K}\lambda_{22ij}\Delta x_{it-j}+\epsilon_{2it} \quad (18)$$

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 from the cointegrating relationship between the variables (d represents deterministic terms like a constant and a country-specific trend). 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 also adjust to such fiscal disequilibria as well). If 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 (17) and (18) are stationary. This means once ECMs are estimated for each country, estimates for θ_i can be investigated using standard t-ratios (Eberhatrdt and Teal, 2014; Canning and Pedroni, 2008). Following Canning and Pedroni (2008) we will 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 (17) and (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 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 χ^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 numerical value of θ_i is 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-sided test that only takes positive values in both the null and alternative. If these two tests fail to agree on the direction of causation 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 Teal, 2014). 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 X: 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: Expenditure equations (1), (2) and (3) refer to the ECM regression (augmented with cross-section averages) with expenditure as the 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 as independent variable and recurrent spending and capital spending as dependent variables, respectively. 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 $N(0,1)$. 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$\chi^2(2N)$. 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.

We present results for weak exogeneity tests in table X; using specifications of equations (17) and (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). In the rows for the 'expenditure equation' we report results for tests whether taxes and net aid (as well as grants and loans) have a causal impact on expenditures, with the null hypothesis of "no causal" impact. The other variables in the subsequent rows are tested analogously. We then report the two aforementioned statistics developed by Canning and Pedroni (2008); that is 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, 2014).

For the expenditure equations the GM test fails to reject the null of 'no causal impact' from aid (as well as 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 causation 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 provide an explanation that is more plausible theoretically. Expenditure policies are often prepared for the medium to long-term, meaning expenditures (especially legislative expenditures and public payroll) are not easily reversed once implemented (Bwire, 2012). In the fiscal response context this implies that expenditures do not adjust to maintain the budgetary equilibrium. Once expenditures are set, whether or not the government incurs a deficit, the expenditure targets must be met. Even when imbalance is a result of a budget surplus, expenditures do not adjust to maintain equilibrium as the sustainability of such surpluses is not guaranteed in developing countries. This pattern of results is largely replicated when expenditures are disaggregated into capital and consumption expenditures. The former includes physical capital development expenditures while the latter usually includes public payroll. These expenditures are not easily reversed once implemented.

In the first two tax equations, again 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. 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'. Following Canning and Pedroni (2008), this can be interpreted as taxes being weakly exogenous on average; but not *pervasively* weakly exogenous in the sample. 83% of the countries in the sample cannot reject the null of 'no causal impact' and the t-statistic on the robust mean $\hat{\theta}_i$ coefficients is less than 1.96 (evidence 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. This provides tentative evidence that tax revenues are also 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. 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, grants and technical cooperation both test statistics, as well as the robust mean θ_i coefficient agree that the three aforementioned 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 on table III 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). For 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. From the results we can conclude that there is 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.

8. CONCLUSION

This paper investigated the nature of the relationship between aid, taxes and spending using novel panel time series methods to address the problems of cross-country heterogeneity, cross-section dependence, and variable nonstationarity. 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. Estimates show that on average, aid has both a positive long-run and short-run impact on spending. This average, positive long-run relationship is quite large; indicating that increases in aid are positively correlated with huge increases in spending. Aid also has a short-run impact on spending. The weak effect may arise because aid just relaxes recipients' budget constraints (i.e. aid is used as a substitute for private sector borrowing). It may also reflect the volatility of aid, with aid being too unpredictable to be used for long-run fiscal planning. In addition, we find that the coefficient on taxes (hence the marginal effect of taxes on spending) is higher than the coefficient on aid (and its corresponding marginal effect). 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 *important* for recipients' expenditures.

Delving further into the relationship between aid, taxes and spending we can draw three important conclusions. First, we find evidence of a long-run equilibrium relationship between aid, taxes and different components of spending. Aid influences development spending, but not recurrent (consumption) spending, with patterns in recurrent spending driven solely by taxes. This result does not imply that all aid was given for investment, hence it was invested. Neither does it imply that aid is not generally fungible. The measure of aid used in this study does not permit us determine the amount of aid given for investment, and that given for recurrent expenditures. Nonetheless, the result is just consistent with the idea that donors have a preference for their aid to be spent on development expenditures, with the hope that increased public investment will crowd in private investment which is essential for growth (Herzer and Morrissey, 2013).

Second, there is also evidence of an equilibrium relationship between heterogeneous aid flows, taxes and total government expenditures. Grants have a positive long-run (but no short-run) impact on spending while loans and technical cooperation do not have any impact on spending, whatsoever. This result is consistent with the notion that donors can

easily force recipients to spend grants on more productive capital expenditures, rather than on consumption expenditures. Third, there is evidence of an equilibrium relationship between heterogeneous aid flows and different components of spending. Grants and loans impact positively on capital spending, with neither having any impact on recurrent spending.

Using the long-run equilibrium relationship, we do not find evidence of a donor 'disbursement rule', as donor allocation is independent of the fiscal situation of the recipient (irrespective of the measure of aid used). Aid, as well its components, is weakly exogenous. This implies donors have a fixed amount of aid they intend to disburse, and this amount does not change in light of the fiscal situation of recipients. Domestic fiscal variables (taxes) are weakly exogenous to spending as well, reflecting the difficulty in reversing taxation policies once they have been implemented.

Aid data used in this paper are taken from a donor source, which overstates the amount of aid. In a panel context, it is infeasible to collect aid data from all national sources. Our results, then, can only be interpreted based on this donor measure of aid. Nonetheless, we suggest some policy implications for donors and recipients in design of their aid policies and conditions. The way in which aid is disbursed should be a reflection of the broader institutional set up of the recipient countries. The small average impact of aid on spending may reflect the general institutional quality (poor expenditure management, bad public finance management, corruption, poor governance) of the recipients. In recipient countries with such weak institutions, donors should give more aid through specific (donor-monitored) projects and give less to the government. In recipients with strong institutions more aid should be given directly to the government, as these are most likely the countries where the specific purpose for which the aid was disbursed would be met.

In the same vain selectivity over the aid modality is important, with the characteristics of recipients influencing how aid is delivered. Donors provide aid for different purposes like education, infrastructural development, and health; and finance those purposes through donor projects or government budgets. The former relates to project aid while the latter relates to general budget support, most likely given to countries where the budget and expenditure are managed well (Morrissey, 2015b). There are political costs of project aid and budget support, relating to the amount of influence donors have over the way their aid is used. Clist, Isopi and Morrissey (2012) find that the World Bank and the European Commission (EC) provide more budget support to countries where government spending allocation is in accordance with their (World Bank and EC) objectives, otherwise they provide aid through donor projects. They also provide more budget support to countries with better government policies; usually countries with a poverty reduction strategy in place. We provided evidence that the level of total aid to recipients is independent of their fiscal situation (aid is weakly exogenous), but the way in which the aid is delivered may be a reflection of recipients' institutions. If we assume that the strength of institutions is gauged by the management of the budget and expenditures, then countries with stronger institutions are those that manage their budget and expenditures well, and practice better public finance management. More budget support (which goes to the government) should be given to such countries.

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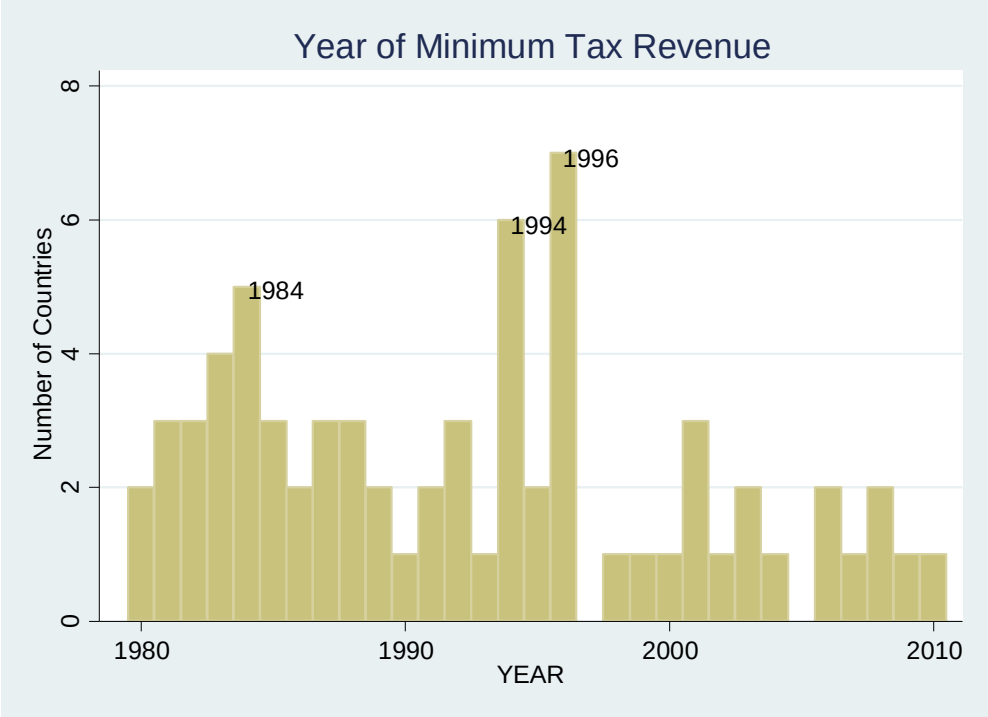
FIGURES FOR MAIN TEXT

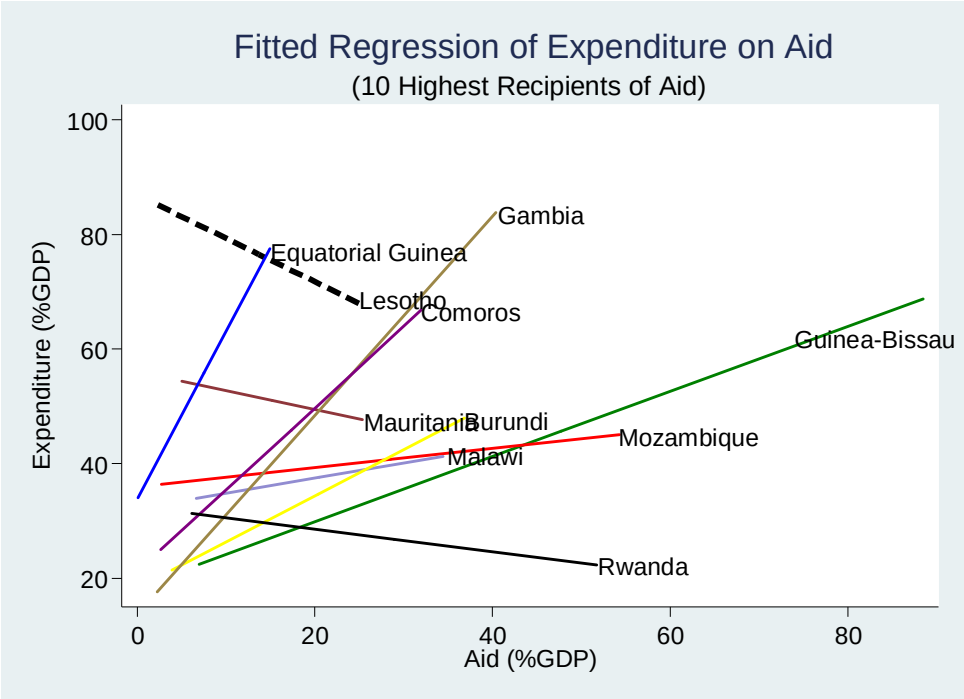
Figure 1: Minimum tax/GDP distribution (1980-2013)



Note: The histogram indicates the number of the countries that recorded their lowest tax/GDP rates in a given 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)

Figure 2: Regression Plots of Aid on Spending for the 10 highest recipients.



Source: Author's calculations based on OECD DAC (2015) and *World Development Indicators* (2015)

APPENDICES

Appendix 1: Countries in Sample

Sub-Saharan Africa (SSA)	Middle East and North Africa (MENA)	Asia and the Pacific	Latin America and the Caribbean (LAC)
1. Angola 2. Benin 3. Botswana 4. Burkina Faso 5. Burundi 6. Central African Republic 7. Chad 8. Comoros 9. Congo, Dem Rep 10. Congo Rep 11. Cote D'Ivoire 12. Equatorial Guinea 13. Gabon 14. Gambia, The 15. Ghana 16. Guinea 17. Guinea-Bissau 18. Kenya 19. Lesotho 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	1. Algeria 2. Egypt 3. Iran, Islamic Republic 4. Jordan 5. Morocco 6. Turkey	1. Bangladesh 2. China 3. Fiji 4. India 5. Indonesia 6. Nepal 7. Pakistan 8. Philippines 9. Sri Lanka 10. Thailand 11. Vanuatu	1. Argentina 2. Barbados 3. Belize 4. Chile 5. Colombia 6. Costa Rica 7. Dominica 8. Dominican Republic 9. Ecuador 10. El Salvador 11. Guatemala 12. Honduras 13. Jamaica 14. Mexico 15. Nicaragua 16. Panama 17. Peru 18. Uruguay 19. Venezuela

Appendix 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: GNI*pc* refers to *per capita* GNI

Appendix 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 4: Summary Statistics

Panel A: Log-transformed Variables

Variable	Mean	S.D.	Min.	Max.
Aid	18.048	4.645	0.000	22.895
Tax Revenue	21.071	2.034	15.604	28.153
Spending	22.176	2.028	17.729	29.325
Gross Loans	18.286	1.935	9.321	22.969
Gross Grants	18.697	1.480	12.313	22.812
TC/Net ODA	18.156	1.154	14.121	21.105
Cap. Spending	21.643	2.152	16.598	29.075
Cons. Spending	21.206	1.923	16.872	27.820

Panel B: Regression Variables

Variable	Mean	S.D.	Min.	Max.
y_{it-1}	22.151	2.017	17.738	29.216
Aid_{it-1}	18.062	4.608	0.000	22.895
Tax_{it-1}	21.062	2.032	15.604	28.153
Cap_{it-1}	21.616	2.143	16.598	28.967
$Cons_{it-1}$	21.183	1.913	16.872	27.703
$Loans_{it-1}$	18.290	1.931	9.321	22.969
$Grants_{it-1}$	18.682	1.478	12.313	22.812
TC_{it-1}	18.168	1.149	14.121	21.105
Δy_{it}	0.032	0.222	-1.421	1.974
ΔAid_{it}	-0.024	3.592	-21.143	21.566
ΔTax_{it}	0.040	0.213	-1.682	2.232
ΔCap_{it}	0.034	0.287	-2.380	2.914
$\Delta Cons_{it}$	0.027	0.207	-1.894	2.314
$\Delta Loans_{it}$	-0.034	0.894	-8.028	5.166
$\Delta Grants_{it}$	0.030	0.544	-3.293	3.181
ΔTC_{it}	-0.015	0.238	-1.434	1.095

Notes: Descriptive statistics are presented in logarithms for the full sample from 69 countries (2346 observations). In Panel A the variables are in logarithms. 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 5: Supplementary Data Analysis

Table A1: 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: We use the stata routine 'xtcd' developed by Markus Eberhardt. We report the average correlation and average absolute correlation coefficients of the $N(N-1)$ sets of correlations. CD is the Pesaran (2004) 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. Grants, loans, Recurrent Expenditures (Cons), Capital Expenditures (Cap)

Table A2: Panel Unit Root Tests

Levels: CIPS with intercept only								
Variable	Grants		Loans		Cons		Cap	
Lags	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*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	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*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	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*p*	Z*t*bar	*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 Spending (Cons) and Capital Spending (Cap) all in logs. 'Lags' denote the number of lags of the differenced dependent variable included to wipe out serial correlation. H_0 = nonstationarity in all countries' variable series; H_1 = stationarity in some countries' variable series.