Effect of Foreign Aid Dependency on Taxation Revenue in Sub-Saharan Africa

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List of Acronyms

ARDL	Auto Regressive Distribution of Lags
DRM	Domestic Revenue Mobilization
FE	Fixed Effects
GFS	Government Financial Statistics
GDP	Gross Domestic Product
HIPC	Heavily Indebted Poor Countries
EGLS	Estimated Generalized Least Square
IFS	International Financial Statistics
LICs	Low-Income Countries
LMICs	Lower-Middle Income Countries
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
RE	Random Effects
UMICs	Upper-Middle- Income Countries
WDI	World Development Indicators
2SLS	Two stage Least Squares

Abstract

There is an ongoing debate in the literature on the effect of foreign aid— concessional loans and grants—on fiscal tax revenues. Most scholars argue that loans have a positive effect on taxation revenue because of the obligation to repay them, whereas grants have a negative effect because the recipient treats them as 'free' money and as a substitute for taxation.

This study focuses on the impact of foreign loans and grants on tax revenues for 42 Sub-Saharan African countries for the period 1990-2014. We test the above hypothesis for these African countries, but divide them into different income groups to account for underlying structural differences.

Our results show that both concessional loans and grants have a negative effect on taxation revenue when all countries are pooled, and similarly for low-income and lower-middle income countries. As most of these countries received debt relief under the Highly Indebted Poor Country (HIPC) Initiative, we argue that recipient governments formulate an expectation of always receiving debt forgiveness and therefore treat both loans and grants as a "free" source of funds. This creates a disincentive to tax citizens who demand accountability for their taxes. However, upper-middle income countries (HICs) respond differently. Loans and grants have a positive effect on tax revenue in these countries. The effect of loans is a result of upper-income countries being ineligible for debt relief and therefore obligated to repay their loans, which creates an incentive to collect more taxes. The positive relationship between grants and tax revenue is explained by the fact that HICs have achieved a significant level of development, which translates to increased levels of efficiency and accountability in revenue systems from additional resources added to the fiscal.

As a policy recommendation to address the disincentive created by grants, we argue that grants should be channeled through Non-Governmental Organisations (NGOs) or the private sector, rather than given directly to the governments.

Key words: Foreign aid, Tax Revenue, Grants, Concessional loans,

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Chapter One

1 Introduction

To meet Millennium Development goals, and more recently, sustainable development goals, donor countries have been asked to rise their contribution towards official development assistance (ODA). There is an ongoing debate on the form which foreign aid to low-income and lower-middle income countries should take. That is, whether these should be loans or grants. This debate was necessitated by unsustainable debts in these countries as a result of receiving foreign aid in the form of loans. This led to the evolution of foreign aid towards grants.

This study analyses the effect of foreign aid, and more specifically, concessional loans and grants, on taxation revenue. Based on our literature review, we conclude that there is no consensus on the effect of foreign loans and grants on tax revenue. Scholars have found different responses of tax revenue as a result of changes in either foreign loans or grants to recipient countries. Many scholars argue that foreign loans have positive effects on tax revenue due to the obligation to repay these loans. In contrast, foreign grants tend to have a negative effect, since they are treated as "free" money by the recipient governments, and seen as in lieu of taxation (Gupta et al., 2004; Benedek et al., 2012). Although researchers have suggested that concessional loans are positively related to revenue performance, excessive reliance on foreign loans may lead to problems of debt sustainability in the long run.

Foreign aid is provided to recipient countries through governments' fiscal budgets, either as project support or budget support. Project support implies that the funds are earmarked for a particular project that is agreed upon by both the donor and the recipient country. Foreign aid requires a high level of accountability and achievement of deliverables, and may run for a few years. On the other hand, if given as budget support, funds are channeled into the national treasury. Decisions on spending are unrestricted by the donor and only depend on the country's list of priorities. In the past, most aid was provided in the form of project support. Currently, however, more aid is provided in the form of budget support, and the recipient countries are granted more autonomy in spending it.

The primary objective of donors in channeling foreign aid to African and other developing countries is to boost economic development. Statistics show that African countries receive the highest amount of foreign aid relative to GDP in the world, but the results appear to be dismal.

Something seems to be going wrong with donor aid, which raises numerous interesting questions. One of the questions we must ask in this regard is: Which are the critical sources of effective and sustainable development funding—foreign inflows or domestic revenue mobilization?

In 2002, the Monterrey Consensus highlighted the importance of mobilizing domestic resources to finance the Millennium Development Goals (MDGs), and since then, the donor community has increasingly acknowledged the importance of Domestic Revenue Mobilization (DRM), for example, through the support of African Tax Administration Forum (ATAF) initiatives. Increasing domestic revenue mobilization was emphasized again during the formulation of the Sustainable Development Goals (SDGs) which include an end to poverty, less inequality, and combatting injustice, as well as dealing with climate change, by 2030. World leaders of the UN endorsed the SDGs as the underlying development goals for the next generation. These goals can be achieved faster if developing countries receive the needed development financing. Increasing domestic revenue creates additional fiscal space for supporting country's important projects. It also allows a country to maintain spending levels consistent with its policy priorities when aid is phased out. Part of this strategy is improving tax system administration by developing a simple, fair and efficient tax system. As low-income countries in Africa transit into emerging market countries, they need to also strengthen their revenue collection to sustain higher tax burdens. At the same time, volatility and uncertainty of aid flows can adversely impact budgetary management in the recipient countries. Increasing domestic revenue is the best way to mitigate such effects and create a more stable and reliable revenue stream (Sanjeey Gupta and Shamsuddin Tareq, 2008).

The global financial crisis (2008-9) made it clear that Africa was overly dependent on external aid flows. Foreign aid was one of the first items to be cut in donors' budgets, which hit low-income African countries very hard. This made it increasingly clear that foreign aid was an undependable source of government revenue due to its uncertainty and volatility. Furthermore, over-dependence on grant aid leads developing countries to postpone reaching their full tax-collection potential (Gupta 2003).

Domestic revenue mobilization, mostly in the form of taxation, offers the potential for achieving greater independence and sustainable economic growth and development. Taxation reduces over-dependence on aid. It also reinforces social contracts between the state and its citizens, which foster accountability by the government. According to the African Economic Outlook (AEO, 2010), Africa's average tax revenue as a share of GDP has been increasing

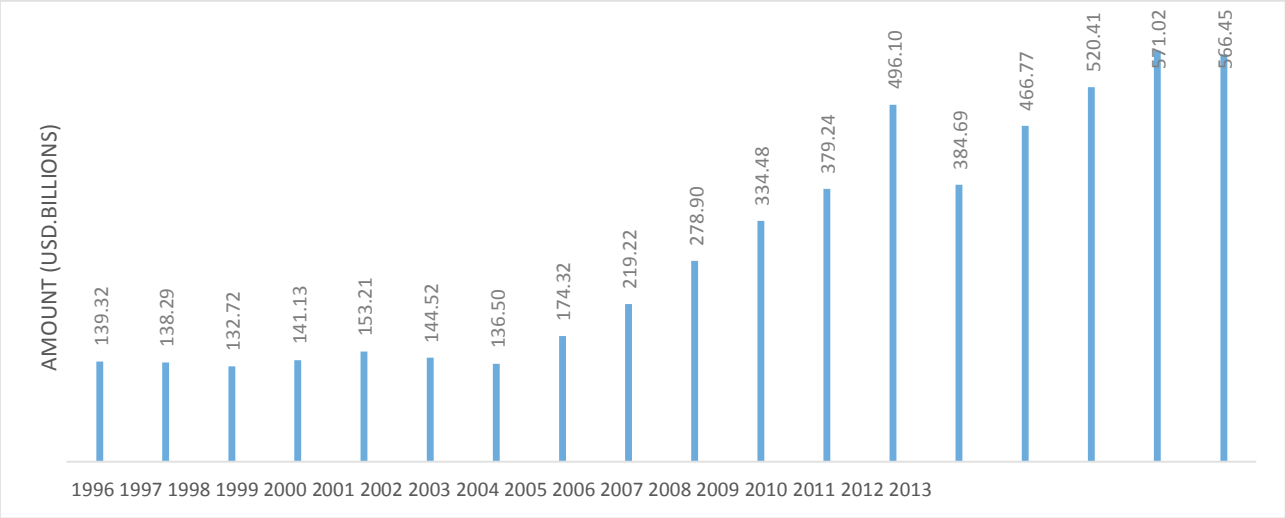
since the 1990s. However, this increase was mostly due to taxes on the extraction of natural resources, which does not require as much government accountability as other forms of taxes. Resource taxation has not appeared to offer a stable tax base to African countries. According to the IMF (IMF, 2007), countries that rely substantially on taxes from income, profit, and capital gains, expand revenue performance more than countries that depend on taxes from goods and services.

Many African countries are endowed with natural resources, but their governments have failed to use them to their advantage. This is largely because of poor governance and political instability. However, if foreign aid can be used to improve institutions, this could improve economic growth. , These improvements could include establishing efficient, effective and fair tax systems, and better government for its citizens.

1.1 Trends in African Taxation and Foreign Aid

Despite development challenges, most African countries have shown an improvement in DRM (excluding grants) since 2003, as shown in (Figure 1-1). This is constant, apart from a significant drop in 2009, which was a result of the Global financial crisis.

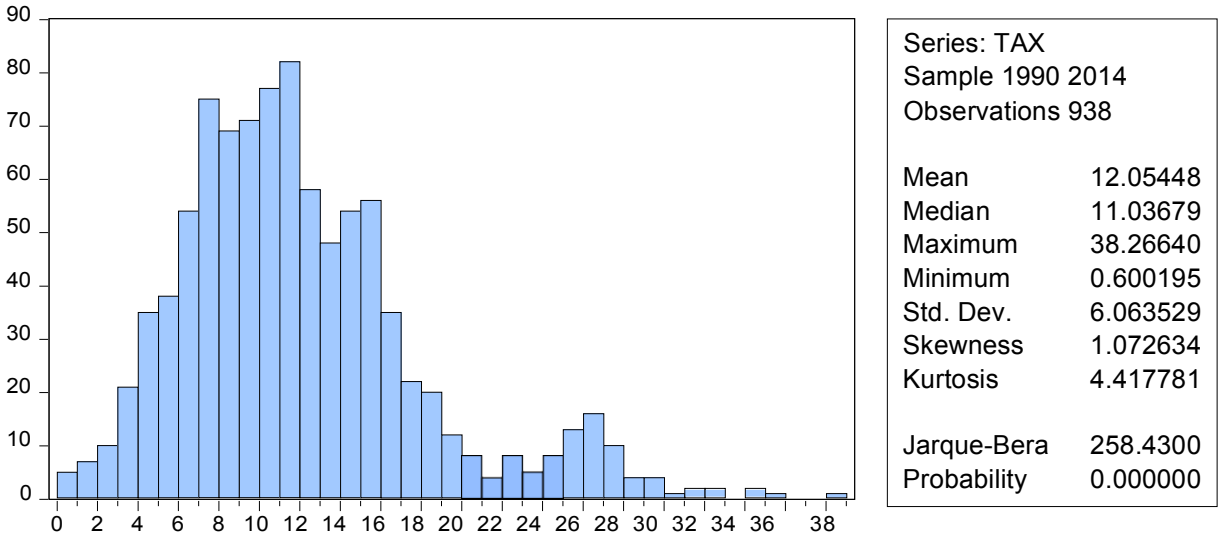
Figure 1-1: Trends in domestic revenue mobilization in Africa (1996-2013)



Source: AEO Database on African Fiscal Performance

The 42 Sub-Saharan Africa countries covered in our study show an average tax revenue of 12% of GDP (Figure 1-2) over the past 25 years. However, it is important to note that there are a large number of countries with tax levels above 20% of GDP. On the other hand, governments' final consumption expenditures averaged 15% of GDP (Figure 1-3 & Figure 1-4), which highlights the importance of foreign aid and domestic borrowing for them.

Figure 1-2: Average Taxation Revenue as a share of GDP for 42 Countries (1990-2014)

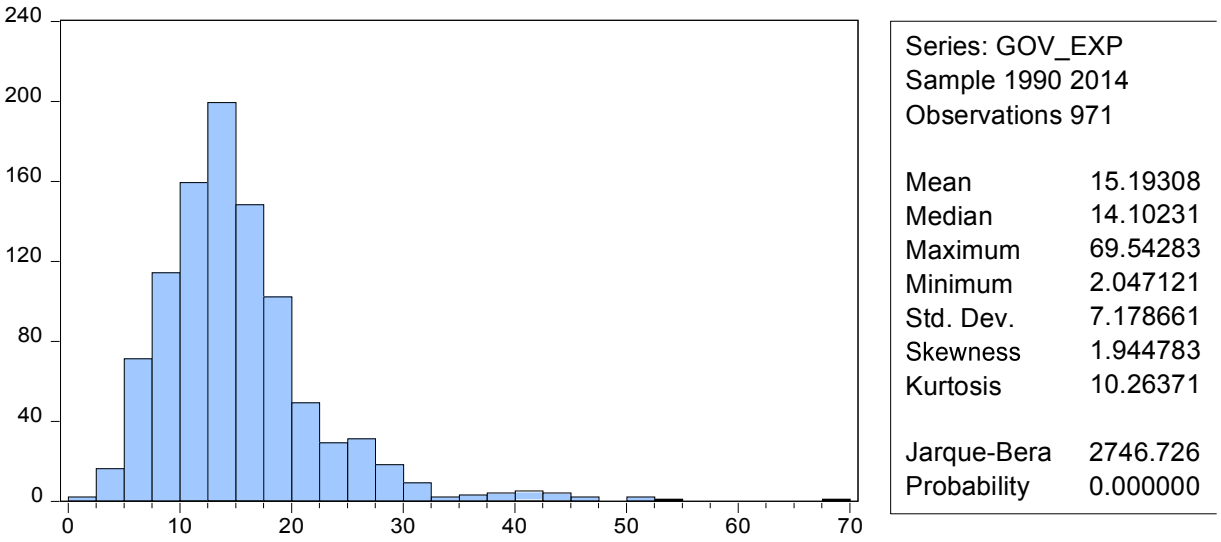


Source. GFS and IMF country reports

Average Central Government final consumption Expenditure in Sub-Saharan Africa

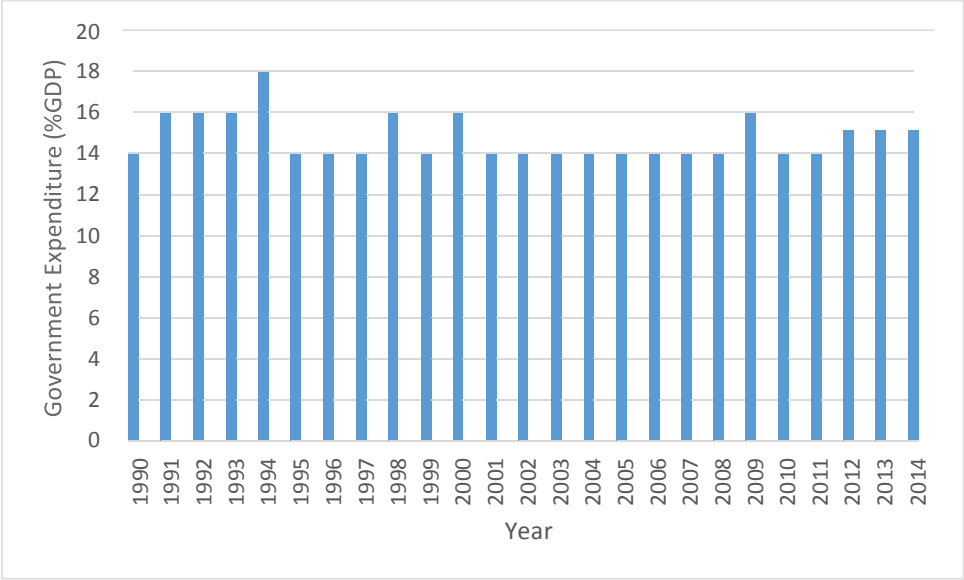
These expenditures are consumed within the current year and are mainly made up of recurrent expenditures which are essential in responding to community needs. They exclude military and capital expenditure, which are huge. Governments fund expenditure with revenue from taxes, seigniorage, borrowing, and foreign aid. We observe that average final consumption expenditures, 15% of GDP, are greater than the average tax revenue, 12% of GDP. Which indicates that tax collection in Sub-Saharan Africa is lower than expenditure demands.

Figure 1-3: Average Central Government Expenditure as a share of GDP for 42 countries (1990-2014)



Source: World Bank national accounts, and OECD National Accounts data

Figure 1-4: Government Expenditure (% of GDP) in Sub-Saharan Africa



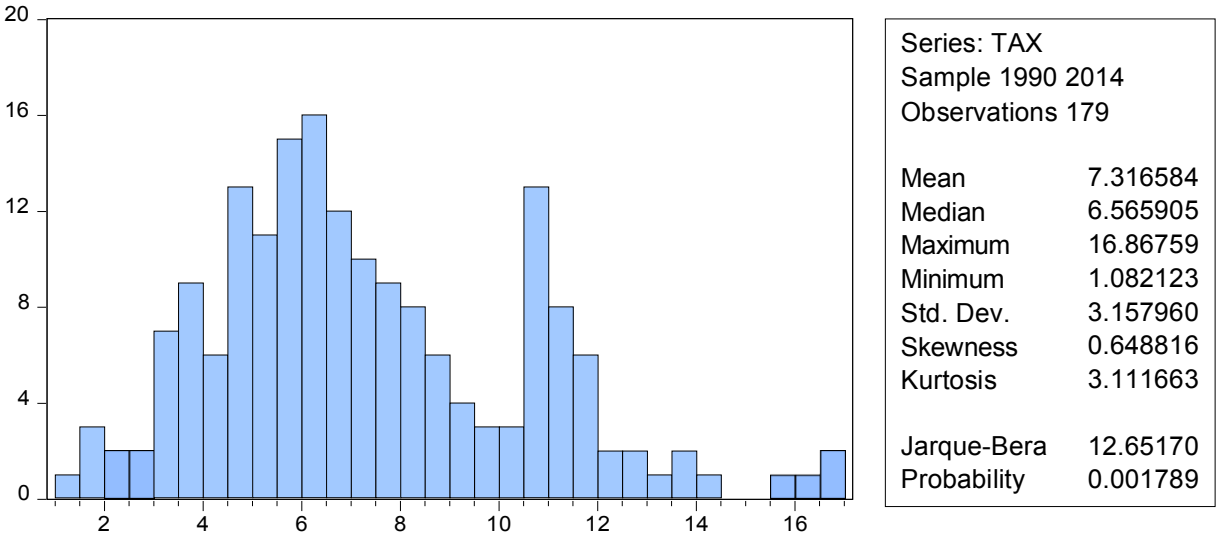
Source: World Bank national accounts, and OECD National Accounts data

Average Tax in Oil Exporting Countries in Sub-Saharan Africa

According to the literature, oil-rich countries pay less attention to tax collection because of an overemphasis on oil-related sources of revenue, which is linked to less accountability to

citizens who demand social developments in exchange for their money. Some of these countries are upper-middle income countries such as Gabon, and Equatorial Guinea, which have an average tax revenue of 7% of GDP (Figure 1-5), which is lower than the average tax revenue in both low-income (10% of GDP) and lower-middle income countries (12% of GDP).[1] This demonstrates the resource curse, since more developed countries are expected to collect more tax, which is not the case with oil-rich countries.

Figure 1-5: Oil Exporting Countries Average Tax Revenue for 7 Countries (1990-2014)



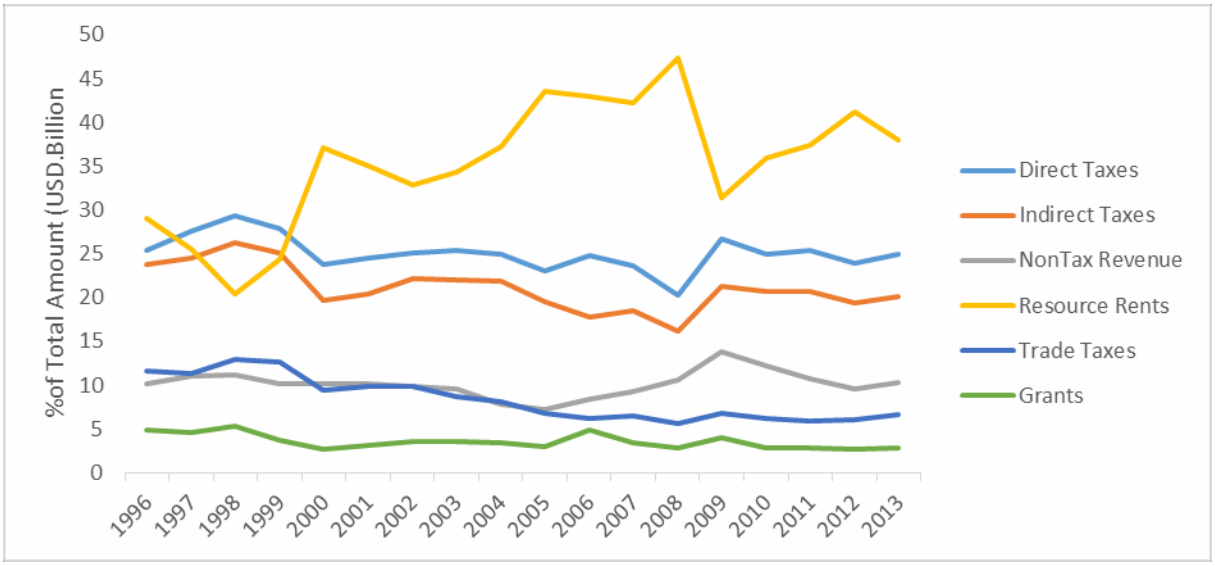
Source. GFS and IMF country reports

Performance of different taxes

Studies confirm that Africa's largest source of revenue is resource rents, obviously from resource-rich countries. Thomas (2013), analyzes the relationship between non-resource tax revenue and resource revenue in Sub-Saharan Africa. They determine that a higher resource revenue-to-GDP ratio has a negative effect on non-resource revenue, implying low tax efforts. They argue that most of these resource-rich countries have weak institutions, which encourages tax evasion and high levels of corruption. (Figure 1-6) shows that resource revenue is high in Africa, implying that tax efforts are relatively low. Resource-rich countries in this group could perform much better economically if other forms of taxes are given more attention in the collection of taxes.

[1] These countries collect non-tax revenue in the form of royalties and dividends

Figure 1-6: Performance of Different Taxes

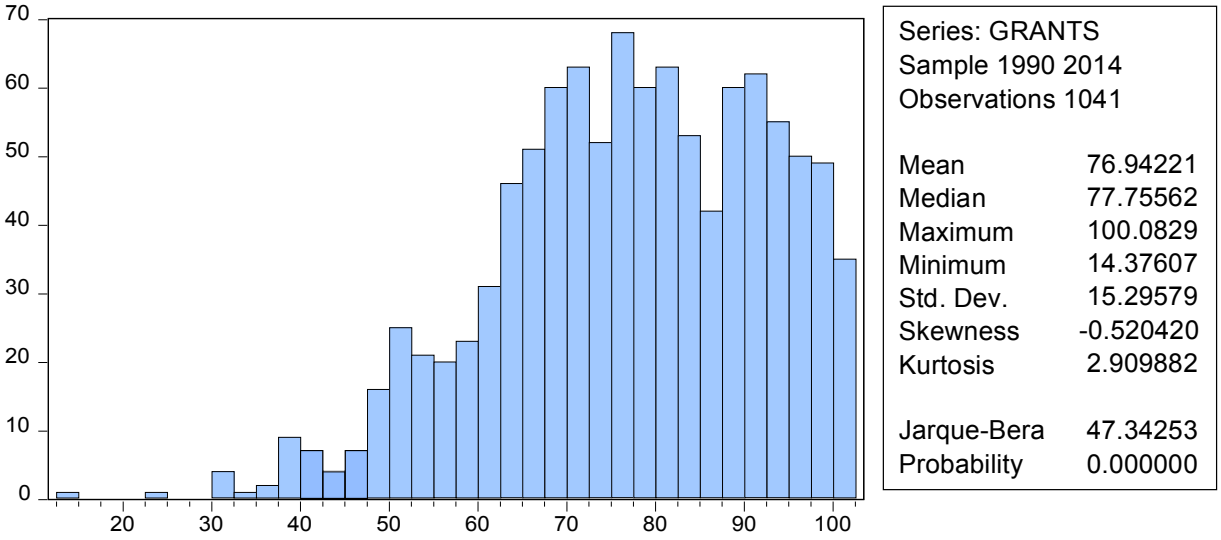


Source: AEO Database on African Fiscal Performance

1.2 Disaggregation of Foreign Aid into Concessional Loans and Grants

The high average levels of grants (Figure 1-7), 77% of GDP, for the 42 Sub-Saharan countries we examine can be explained by the fact that most of the poor countries receive foreign aid in the form of grants, since they are not eligible for loans, which need repayment. Additionally, some of the Sub-Saharan countries are classified under fragile countries and they frequently receive humanitarian grants, especially during civil wars and severe droughts.

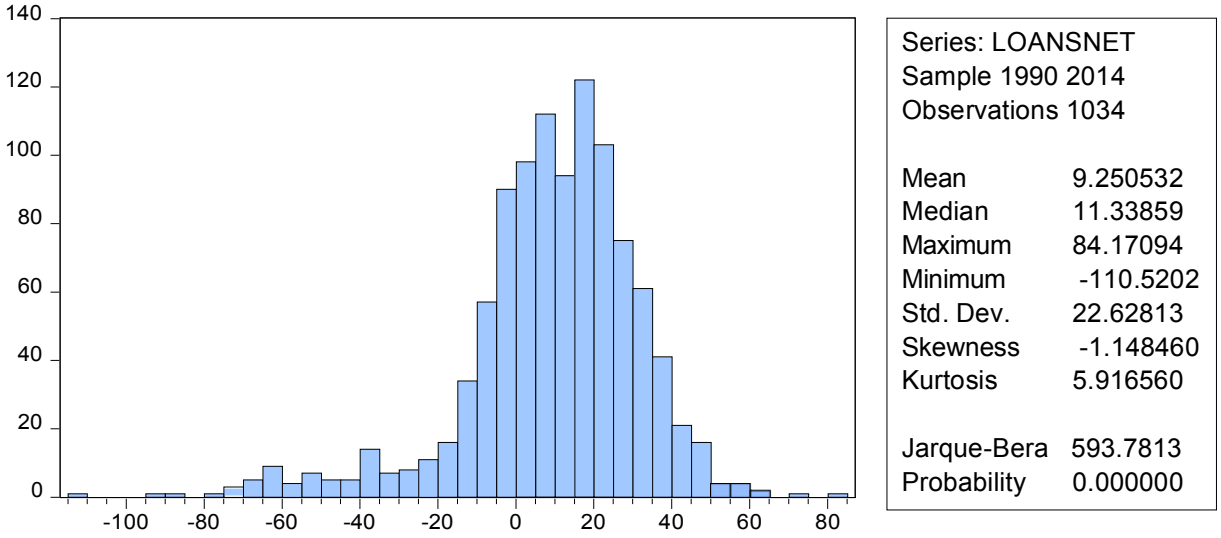
Figure 1-7: Distribution of Grants as a share of percent GDP in Sub-Saharan Africa



Source: OECD Geographical Distribution of Financial Flows to Aid Recipients

Net concessional loans constitute an average of 9.3 percent of GDP per annum for the 42 Sub-Saharan countries over the 25-year period. (Figure 1-8)

Figure 1-8: Distribution of net Loans as a share of percent GDP in Sub-Saharan Africa



Source. OECD's Geographical Distribution of Financial Flows to Aid Recipients

1.3 Challenges Facing Developing Countries

Developing countries have weak systems of financial management. Thus, the challenges for increasing revenue collection include such things as tax avoidance, tax evasion, out-dated tax systems, unskilled tax collectors, and high rates of corruption. Moreover, there is a lack of

oversight on how the collected revenue is spent for sustainable development. In short, there is lack of accountability from governments.

African countries often face problems of poor governance and political instability. Although most African countries are endowed with natural resources, they may fail to garner the full benefits under such circumstances. If foreign aid can be channelled towards upgrading institutions, this can revitalize domestic revenue mobilization and improve governance and political accountability. In this case, foreign aid to Africa would have a long-term positive impact on DRM.

1.4 Research Focus

Objective of the Thesis

This study focuses on the impact of foreign loans and grants on tax revenues of 42 Sub-Saharan African countries for the period 1990-2014. Using this panel, we test the hypothesis that loans have a positive effect on taxation revenue because of the obligation to repay them, whereas grants have a negative effect because the recipient treats them as free money, and as a substitute for taxation.

We begin with a basic model for predicting taxation revenue, and then consider the role of loans and grants. We try to account for underlying structural differences among countries by analyzing countries classified in different income levels separately.

Contribution to Literature

The findings of our research contribute to the existing literature by, firstly, making use of the most recent data. Secondly, we control for structural differences. Lastly, we control for tax collection ability using tertiary school enrolment (% gross) as a proxy for skilled tax collectors.

Organization of the Thesis

The rest of the study is organized as follows: Section 2 reviews the literature on the relationship of foreign aid compositions, concessional loans, and grants, to tax revenue. In this section, we further review the effect of foreign aid on institutions, fiscal behavior and economic growth. Section 3 outlines the methodology and data sources. Section 4 presents empirical results and interpretation, and finally, Section 5 includes our conclusion and policy recommendations.

Chapter Two

2 Review of the Literature

Government expenditures are financed through three key sources of revenue; foreign aid (grants and concessional loans), tax revenue and not-tax revenue for resource-rich countries, and borrowing (both domestic and foreign). In our literature review, we examine studies on the impact of foreign aid on taxation, institutions, and fiscal and overall economic growth. The literature on the impact of foreign aid on institutions, fiscal behavior and economic growth is covered, since any shock on taxation revenue has leakages effects on these sectors.

2.1 Impact of Foreign Aid on Taxation

For sustainable development to be attained, especially in developing countries, governments should invest heavily in improving tax administration systems to increase revenue from taxation. Heavy dependence on foreign aid tends to hinder the development of major projects because of the volatile nature of this aid. Domestic revenue is more stable, however, and possible to predict, and therefore allows for appropriate planning. It is therefore of paramount importance that developing countries attain sustainable and stable levels of taxation to fund their growing government expenditure.

Inflow of Foreign aid to developing countries have increased in recently to finance the growing share of recurrent expenditures. Although recipient countries are expected to supplement the inflows by increasing domestic tax revenues, the record shows that this has not been the case with most African countries. Some theoretical and empirical evidence suggests that an increase in foreign aid inflow might reduce effort in revenue collection.

Gupta et al. (2004) analyzes the impact of foreign aid on tax revenue in 107 countries in the period 1970 to 2000. They investigate the impact of grants and loans on domestic revenue mobilization, alongside other structural variables. They find out that concessional loans are positively related to tax revenue, while grants are negatively related. Furthermore, total foreign aid is found to impact domestic revenue mobilization negatively. This implies that the negative effect from grants outweighs the positive effect from loans, and the overall effect becomes negative.

Gupta et al. (2004) further argue that the effects of foreign aid on domestic revenue are country specific. The reduction of revenue in some countries arises as a result of increases in foreign

aid through the tendency of recipient governments to return resources to the private sector by reducing the tax burden on citizens, to accelerate economic growth. Corruption is used as a proxy for institutional development, whereby, governments in countries with high levels of corruption will respond to an increase in foreign aid by offsetting tax revenue fully. Gupta et al. (2004) estimate the following model:

$$\log[{}^{Tax}/_{GDP}] = \beta_0 + \beta_1 \text{AGR} + \beta_2 \text{IND} + \beta_3 \text{TRADE} + \beta_4 \text{INCOME} + \beta_5 \text{Grants} + \beta_6 \text{Grants}^2 + \beta_7 \text{Loans} + \beta_8 \text{Loans}^2 + \varepsilon \quad (2\text{-}1)$$

*** Time and country subscripts omitted*

Where Tax (% of GDP) represents tax revenue, AGR (% of GDP) represents agricultural sector, IND (% of GDP) represents the industrial sector, Trade (% of GDP) represents trade openness, INCOME represents real GDP per capita, which is a proxy for level of development, and, finally Grants and Loans, which make up foreign aid flows. The squared terms are included to capture nonlinear effects. The study further finds that agriculture has statistically significant negative effects on tax revenue. Gupta et al. (2004) argue that it's difficult to tax agricultural activities since most of the transactions are carried out informally and mostly practiced at subsistence level especially in low-income and lower-middle income countries. The impact of industry on tax revenue was positive. This is supported by the fact that it's easy to levy tax due existence of well-kept books of accounts. Increase in GDP per capita has a negative impact on tax revenue which is an unexpected outcome. Income per person was used as a proxy for level of development, and more developed countries are expected to raise more revenue through taxation. Trade impacts tax collection positively, since transactions take place at a specific point making it easier to levy taxes. There is also an argument that shortages in mobilization of domestic revenue my trigger foreign aid inflows, suggesting the presence of reverse causality between tax revenue and foreign aid. Gupta, et al used one period lags for loans and grants as instrument variables in the study, to solve endogeneity problem.

Benedek et al. (2012), responded to critiques of Gupta et al. (2004) by re-examining the relationship between aid and domestic tax revenue in 118 countries for the period 1980-2009, with a focus on the countries' income levels: low-income, lower middle income, and upper middle income. They estimated the Two-way Error Correction Model in the equation (2-2).

$$\log[{}^{\text{Tax}}/_{\text{GDP}}] = \beta_0 + \beta_1 \text{AGR}_{it} + \beta_2 \text{IND}_{it} + \beta_3 \text{TRADE}_{it} + \beta_4 \text{INCOME}_{it} + \beta_5 \text{ODA\_Grants} + \beta_6 (\text{ODA}_{\text{Grants}_{it}})^2 + \beta_7 \text{ODA}_{\text{Loans}_{it}} + \beta_8 (\text{ODA\_Loans}_{it})^2 + a_i + \mu_t + \varepsilon_{it} \quad (2\text{-}2)$$

These variables are the same as those used by Gupta, et al. (2004). a_i and μ_t represent country and time specific effects respectively.

The findings of their research support the results presented by Gupta, et al. (2004) of a negative effect on tax revenue from grants and total aid, as well as a positive relationship between concessional loans and tax revenue. The negative correlation was stronger in low-income countries. They further disaggregate tax data into VAT, income, excise, and trade taxes and establish that trade taxes have a positive relationship with ODA grants, whereas other taxes maintained a negative correlation. The positive effect from trade taxes is explained by increased imports, which accompany a rise in external grants. The negative impact on other forms of taxes such as VAT can be explained by the fact that increased imports are not taxed VAT which is added at the production stage and final sale of goods and services produced locally. Countries with weak institutions, that is, more corrupt, are more affected by a rise in grants which drastically lower levels of tax revenue. Benedek, et al. (2012) also note that the impact of grants on tax revenue has been weakening over time. Gupta et al. (2004) finds an offset of the total revenue of about 28 cents for every additional dollar of grants, whereas they find an offset of 9 cents for every additional dollar in grants.

Clist and Morrissey (2011) build on the model of Gupta et al. (2004) by examining the impact of foreign aid (loans and grants) on tax efforts in 82 developing countries during 1970-2005. Their study analyzes two sets of data, from 1970-1984 and 1985-2005 separately. They further classify countries into two income groups: Lower-middle income and low-income. The findings for the first set of data show that loans are positively related to tax revenue, while grants have a negative relationship with tax revenue. The second set of data, 1985-2005, indicate that grants are positively related to tax revenue, but this is only significant in middle-income countries. The argument supporting a positive relationship is attached to conditional lending, which became popular in the mid-1980s and only significant in middle-income countries. This is because middle-income countries had better fiscal systems than low-income countries, which had a limited tax base and weak fiscal systems. The study examined the effect of import taxes separately from that of export taxes. It was evident that import taxes were

positively related to tax revenue, as most of the countries, and especially the low-income countries depend heavily on imports, which are taxed at the border. Export taxes had a negative relationship to tax revenue, which the paper indicated was an unexpected outcome. This might be a result of the reduction or elimination of export taxes in the 1980s in most countries. It could also result from the establishment of Export Processing Zones (EPZ), where investors are given long tax holidays, especially in developing countries, to attract investors for industrialization visions. It is clear that poor countries have limited ability to expand tax revenue and therefore they receive more aid, mostly in the form of grants, since they are fiscally constrained and the donor community may not wish to expose them to enormous debt burdens. This implies that, for poor countries with low levels of tax revenue, any increase in aid flow will impact negatively on tax revenue, because the more grants they receive, the more they lower taxes. There is thus an automatic-negative contemporaneous effect between grants and tax revenue. Clist and Morrissey (2009) estimated the following model in their analysis.

$$\log[{}^{Tax}/_{GDP}] = \beta_0 + \beta_1 \mathrm{AGR} + \beta_2 \mathrm{IND} + \beta_3 \mathrm{M} + \beta_4 \mathrm{X} + \beta_5 \mathrm{GDP} + \beta_6 \mathrm{GDP}^2 + \beta_7 \mathrm{Grants} + \beta_8 \mathrm{Grants}^2 + \beta_9 \mathrm{Loans} + \beta_{10} \mathrm{Loans}^2 + \varepsilon \quad (2\text{-}3)$$

*** Time and country subscripts omitted*

However, the findings of Benedek et al. (2012) have been challenged by Clist (2016), who attempted to reproduce the model unsuccessfully. Clist (2016) failed to replicate Benedek's results, even using the same data and attributes this to the use of different data in constructing variables, mainly dependent variables, without checking data compatibility. Clist, P. (2016) blames these inconsistencies on the different datasets used by Benedek, et al, and states that coefficient estimates are not robust to different sources of data.

Patrick Carter (2013) criticizes studies which suggest that foreign aid in the form of grants has a negative impact on revenue mobilization. He claims that these studies use simple, static models and strong econometric assumptions. He states that the results found in these studies disappear or become insignificance when more general econometric methods are used to analyze the same data. Carter estimates the relationship between foreign aid and tax revenue using data from Gupta et al. (2004) and Remmer (2004). He applies panel time series estimators in his analysis and finds no evidence to support the taxation and foreign aid relationship. He argues that the increased positive impact of grants on tax revenue is a result of increased awareness of and emphasis by the donor community on the importance of domestic revenue mobilization for sustainable economic development.

Hisali & Ddumba-Ssentamu, (2013) find that grants have a negative effect on tax revenue in Uganda, which is offset by the positive impact of loans. This is unlike Benedek, et al. (2012) and Gupta, et al. (2004) who find the positive effect of loans being offset by the negative effect of grants, and hence the overall negative effect of total foreign aid. As a result, total aid leads to a modest increase in tax revenue in the long-run. According to theory, a higher GDP per capita should translate to more tax collection. However, a study by Hisali & Ddumba-Ssentamu (2013) argues that the negative relationship between GDP per capita and tax revenue is a result of noncompliance from taxpayers. These results suggest that the wealthy individuals practice tax avoidance and evasion. There is therefore a need for development in tax systems.

Chaudhry & Munir (2010) research factors contributing to low levels of tax revenue in Pakistan. Their fiscal model incorporates income, economic policies, external, and social factors. Foreign aid is one of the external variables, along with external debts and foreign remittances. Their study finds out that foreign aid has a negative relationship to tax collection in Pakistan, but the variable was statistically insignificant. Their baseline model uses a lagged variable of tax-to-GDP ratio to capture dynamic effects in the country, and to solve autocorrelation problems in the model.

Thornton (2014) critiques findings in the literature by claiming that that the presence of endogeneity and heterogeneity problems might have biased the results of these studies. Thornton (2014) uses distance between the recipient and the donor, former colony, and religion as instrumental variables to solve identified problems. The findings of the study are similar to those in other studies, but his research shows that OLS estimates are biased downwards due to the presence of endogeneity. This shows that the literature has generally underreported the effect of foreign aid on tax revenue.

2.2 Impact of Foreign Aid on Institutions

Africa, as a continent, is one of the largest recipient of foreign aid in the world, and the least democratic. This leads us to question of foreign aid hurts Africa and if the receipt of foreign aid is a curse. Djankov et al. (2008) study 108 foreign aid recipient countries from 1960 to 1999. Their study focuses on establishing the impact of foreign aid on institutions in the beneficiary countries. Democracy is used as a proxy for institutional development. Their results show that countries which receive more foreign aid have lower levels of democracy than counterparts who receive less foreign aid. Increased aid to these countries leads to worse

political institutions, which further results in rent-seeking by corrupt government officials, as observed in resource-rich countries. This is similar to the role of natural resources which fuel rent-seeking behavior. This only comes into play when institutions are weak. Djankov, et al. (2008) conclude that foreign aid has a negative impact on institutions and suggests the need for further probe investigation of this negative correlation.

In addition to determinants of tax efforts used in the literature, Antonio and Carlos (2011) add income distribution into their regression. They used the Gini index as a proxy for income distribution in countries where they identify a zero effect of foreign aid on tax revenue. They discover a statistically significant negative effect of aid on tax revenue whenever the Gini index is excluded from the model using IV and RE, and a positive impact using sys-GMM. This shows that omission of the income distribution variable can lead to biased results. Scholars have argued that the impact of foreign aid on tax revenue is pegged on the quality of institutions, where aid fuels tax collection in countries with good institutions and induces tax-cuts where institutions are weak. Antonio and Carlos (2011) control for institutional quality and still find that aid does not seem to have any effect on tax revenue. They therefore conclude that, irrespective of the quality of a country's institutions , aid does not affect tax revenue. This is contrary to Gupta, et al. (2003), Brun, et al. (2007) and Azam, et al. (1999) who find that in more corrupt countries (those with weak institutions) foreign aid results in tax-cuts.

Bräutigam & Knack, (2004) review the impact of large amounts of aid on African countries with poor governance records, and how they are delivered. The outcome of their study shows the link between foreign aid and governance in sub-Saharan African countries. Their research provides evidence of deterioration in governance in African countries as a result of increased aid. They conclude that improvement in governance results in increased GDP per capita, and that there is a strong relationship between increase in foreign aid and lower tax revenue. Their suggestions for solutions to these problems include, firstly, that disbursement of foreign aid should be targeted to governments with proven records of developmental governance. Secondly, they suggest that programs which involve huge levels of aid, should be provided only as a short-term development tool.

2.3 Impact of Foreign Aid on Fiscal Components

Osei, et al. (2005) use Vector Autoregressive (VAR) methods to establish cointegration among nonstationary fiscal variables to investigate the impact of foreign aid on the national budget of Ghana. The fiscal response model includes variables for government spending, tax revenue,

aid finance, and domestic borrowing. Impulse response analysis shows fiscal variables are cointegrated, and further shows that, in Ghana, aid leads to an increase in government spending, an increase in tax effort, and reduced domestic borrowing. Franco-Rodriguez, et al. (1998) find that, in Pakistan, the total impact of aid on consumption was negative, despite the allocation of almost half of total aid to government consumption. The impact of aid on governance was slightly positive, but there was a negative effect on total public expenditure and taxation.

Studies on aid and government fiscal behavior by Oliver Morrissey (2014) show that aid did not have a significant effect on tax revenue until the 1980s when a positive relationship was observed. This led, to reductions in domestic borrowing which is a requirement of the IMF. Bazoumana Ouattara (2006) find that almost 41% of aid flows to Senegal is used to finance the country's debt. The research further establishes the existence of a negative relationship between aid and government revenue, and an insignificant effect on domestic expenditure and borrowing. Batten, (2010) analyze the interplay between foreign aid and fiscal behavior in Papua New Guinea, where aid grants lead to lower tax revenue and reduced domestic borrowing.

Ghura, (1998) carry out a study on the determinants of tax revenue by focusing on the effect of economic policies and corruption in Sub-Saharan Africa. They find that the implementation of structural reforms is positively correlated to tax revenue, and an increase in grants results in a reduction in tax revenue. Corruption is also captured in their model, among other variables, and the analysis reveals that the presence of corruption reduced tax revenue.

Bhushan & Samy (2014) undertake a case study of four countries: Bolivia, Uganda, Guatemala, and Zimbabwe, to examine the impact of fiscal capacity and performance on aid allocation. It is evident from their research that both bilateral and multilateral donors, despite endless emphasis on domestic revenue mobilization, pay little attention to fiscal capacity and performance during aid allocation

Salih, (2012) analyzes the impact of foreign aid on the public sector in East Africa, and their results show that aid has a positive impact on both public investment and recurrent government expenditure. The study further argues that aid is negatively related to taxation and domestic borrowing.

2.4 Impact of Foreign Aid on Economic Growth

Studies on the effectiveness of foreign aid in developing countries do not agree on whether aid impacts economic growth positively or negatively. Arguments for and against foreign aid to developing countries have been put forward by different researchers.

Quazi, (2005) carries out a case study by estimating two models, an Aid-Growth model and an Aid-Fiscal model, to analyze the impact of foreign aid on economic growth and fiscal behavior in Bangladesh. Their results show that total foreign aid has a marginal effect on the economic growth of Bangladesh. Disaggregating foreign aid into loans and grants reveals that grants are associated with a statistically insignificant effect on growth, whereas loans lead to GDP growth in Bangladesh. In the fiscal model, aid loans are related to increased tax revenue, since they mostly finance productive projects, unlike aid grants, which finance non-productive public expenditures, and therefore have a negative impact on tax revenue.

Ekanayake & Chatrna (2009), analyse foreign aid data covering 85 recipient countries in Asia, Africa, the Caribbean, and Latin America during 1980-2007 to investigate the effect of foreign aid on economic growth. Estimations from their model imply that foreign aid has mixed effects on economic growth in developing countries. For example, there is a positive correlation between foreign aid and economic growth in Africa, but a negative correlation in other regions. The study further groups countries according to their income levels, that is, Low-Income Countries, Lower-middle-Income Countries, Upper-Middle-Income Countries, and High-Income Countries. In the case study, foreign aid had a positive impact on growth in countries in all income groups except for Lower-middle-Income countries, where economic growth was negatively affected by the inflow of foreign aid. Aye Mengistu Alemu and Jin-Sang Lee (2015) find a positive relationship between economic growth and foreign aid in low-income countries in Africa while they find a negative relationship in middle-income countries, also in Africa. They further concluded that Foreign Direct Investment (FDI) impacted positively on the economies of middle-income countries.

Chervin & van Wijnbergen, (2010) focus on how volatility in foreign aid affects the economic growth of 155 countries, over the period 1966-2001. The results suggest that volatility in foreign aid has a negative effect on economic growth. However when this volatility is controlled, foreign aid has a positive impact on economic growth. Asteriou, (2009) finds a positive relationship between aid and economic growth in five South Asian countries. The study used panel data analysis to establish the long-run and short-run relationships between

foreign aid and economic growth. They claim robust estimates as a result of using a panel unit root test, mean group and a pooled mean group, which are robust for panel data econometrics.

A study by Ndambendia & Njoupouognigni, (2010) on the impact of foreign aid and foreign direct investment on economic growth in Sub-Saharan Africa shows a positive relationship, but with a very low coefficient for foreign aid.

According to Islam, (1992), statistics on the inflow of foreign aid show that although Bangladesh is a recipient of one of the largest allocations of foreign aid, it remains amongst the poorest countries in the world. Foreign aid to the country aims to boost economic growth, but domestic resources impact more positively on economic growth than foreign aid The study further notes that foreign aid in the form of loans are preferred to grants.

Poverty levels are high in most African countries, especially in Sub-Saharan Africa. Mallik, (2008) analysed six of the poorest African Countries, Central Africa Republic, Malawi, Mali, Niger, Sierra Leone and Togo . These countries have had either declining or stagnant real GDP per capita despite receiving foreign aid. Cointegration analysis in the study shows a negative long-run relationship between aid and economic growth in five out of the six countries. In the short-run, foreign aid has no significant effect on growth except in Niger.

Contrary to some findings on the effect of foreign aid on economies of developing countries, (Karras, 2006) find a positive statistically significant relationship between foreign aid and economic growth in 71 developing economies. The results did not control for fiscal policies. Karras, (2006) shows that 1 percent increase in foreign aid raises per capita growth by approximately 0.14 to 0.26 percent.

Kim, (2011) analyses the success story of South Korea, which moved from being a foreign aid recipient to being a donor. Foreign aid greatly supported the economic development of South Korea. The research considered the two government regimes in Korea, the first regime full of corrupt and incompetent officials, and the second more economic development oriented, with high levels of government capacity, commitment, and ownership. Kim, (2011) conclude that good governance and financial support from the USA as the main donor fuelled the Korean economy.

Table 2-1: Summary of findings from the Empirical Literature

Author(s)	No. of Countries	Panel/Time series	Agr	Ind	GDPP	Trade	Total Aid	Grants	Loans
Gupta et al (2004)	**107**	**Panel**	**-**	+	**-**	+	**-**	**-**	+
Benedek et al (2012),	**118**	**Panel**	**-**	+	+	**-**	**-**	**-**	+
Clist & Morrissey (2011)	**82**	**Panel**	**-**	+	**-/+**	**M=+ X=-**	**N.I.M**	**-/+**	+
Hisali & Ddumba-Ssentamu, (2013)	**1**	**Time series**	**N.I.M**	**N.I.M**	**-**	**N.I.M**	+	**-**	+
Thornton, (2014)	**93**	**Panel**	**-**	+	+	+	**-**	**-**	+

Clist & Morrissey (2011) find different signs when different samples are used, that is, those for 1970-1984 and 1985-2005. They also concludes that GDP per capita affects tax revenue positively when its squared value is included in the model, and negatively when this value is excluded. N.I.M denotes not included in the model studied, M denotes imports and X exports.

Chapter Three

3 Methodology and Data

This study focuses on the panel time series analysis of 42 Sub-Saharan African countries for the period 1990-2014 (see Appendix A, Table A-1). We focus on the 42 countries because of data availability, and because they are among the largest recipients of foreign aid, especially in the form of grants. Estimation of models is carried out by employing annual panel data.

3.1 Model Specification

Our study entails determining the impact of foreign aid on tax revenue. We begin by estimating two models. One includes net foreign aid, among other control variables (Equation 3-2). The other disaggregates foreign aid into grants and concessional loans (Equation 3-1).

$$Log\left(\frac{Tax_{it}}{GDP_{it}}\right) = \alpha + \beta_1 AGRI_{it} + \beta_2 IND_{it} + \beta_3 TRADE_{it} + \beta_4 GDPP_{it} + \beta_5 GDPP^2_{it} + \beta_6 ODA_{GRANTS_{it}} + \beta_7 ODA_{NETLOANS_{it}} + \varepsilon_{it} \quad (3\text{-}1)$$

$$Log\left(\frac{Tax_{it}}{GDP_{it}}\right) = \alpha + \beta_1 AGRI_{it} + \beta_2 IND_{it} + \beta_3 TRADE_{it} + \beta_4 GDPP_{it} + \beta_5 GDPP^2_{it} + \beta_6 TOTALNET_{it} + + \varepsilon_{it} \quad (3\text{-}2)$$

Our model of interest captures the impact of grants and loans on tax revenue. We estimate the model in equation (3-1), by regressing tax revenue (% of GDP) on its determinants, which are: Agriculture – value added (AGRI), Industry – value added (IND), GDP per capita (GDPP), Trade openness (TRADE), ODA-Grants and ODA-Netloans. Nonlinear effects are captured by including a squared value of GDP per capita in the model. We estimate equation (3-1) and (3-2) using a Fixed Effects estimator that takes into account unobservable country specific effects, and which is time invariant and helps to explain differences in cross-country tax revenue.

We are employing a one-way error component model, which allows for cross-section heterogeneity in the error term. This is because a two-way error component model is not supported in Eviews® with an unbalanced panel. Our unbalanced panel is the result of missing data. We further hold strongly that a Fixed Effects estimator is more appropriate, since some econometrically unobservable factors which are country specific might influence the tax

collection. For example, management skills of the policy makers may have this effect. In contrast, a Random Effect estimator assumes unobserved country heterogeneity to be random such that: $\alpha_i = IID(0, \underset{\alpha}{\sigma^2})$ and $\mu_{it} = IID(0, \underset{\mu}{\sigma^2})$, which further assumes strict exogeneity in explanatory variables of unobserved country heterogeneity and idiosyncratic errors.

Unlike random effects, Fixed Effects allow unobserved country heterogeneity to be correlated with explanatory variables, but assumes strict exogeneity in all explanatory variables conditional on idiosyncratic error. However, since it is difficult to find appropriate observable and nonzero instrument variables to control for the unobserved heterogeneity, the fixed effect estimator wipes out unobservable country effects by demeaning the variables using within transformation. It then estimates the model by OLS, assuming all the explanatory variables are exogenous, i.e., $(X_{it}, \mu_{it}) = 0$, where $t = 1 \ldots . T$ and $= 1 \ldots . N$

3.2 Data

All data used was obtained from reliable secondary sources (Table 3-1). Taxation revenue (% of GDP) data was obtained from the IMF's Government Financial Statistics (GFS), and IMF specific country reports, to fill in the gaps. Taxation revenue refers to compulsory transfers to the private sector and to the central government for public transactions which exclude social contributions. Foreign Aid/Official Development Assistance (ODA) data was obtained from the OECD's Geographical Distribution of Financial Flows to Aid Recipients dataset. It is the sum of all aid from bilateral and multilateral donors and includes grants and concessional loans. Grants represent transfers to recipient countries with no repayment obligation, and concessional loans represent transfers with a grant element of 25 percent or more.

Table 3-1: Variables used

Variable	**Measure**	**Source of Data**	**Unit Root test**
Agriculture – value added	% of GDP	World Bank's WDI Database	Stationary I (0)
Industry – value added	% of GDP	World Bank's WDI Database	Stationary I (0)
Trade (Imports + Exports)	% of GDP	World Bank's WDI Database	Stationary I (0)
GDP Per Capita	US$ (constant 2010)	World Bank's WDI Database	Non-Stationary I (1)

Oil rents	% of GDP	World Bank's WDI Database	Non-Stationary I (1)
GDP	US$ (constant 2010)	World Bank's WDI Database	Non-Stationary I (1)
Tertiary school enrolment	% gross school enrolments	UNESCO Institute for Statistics	Non-Stationary I (1)
Corruption Index		ICRG and PRS	
Tax Revenue	% of GDP	IMF's GFS & IMF country reports	Stationary I (0)
ODA_grants	% of GDP	OECD database	Stationary I (0)
ODA_loans	% of GDP	OECD database	Stationary I (0)
ODA_aid	% of GDP	OECD database	Stationary I (0)
Government Expenditure	% of GDP	World Bank's WDI Database	Stationary I (0)

Source: Author

All variables are measured yearly. I (0) means the variable is stationary at level and I (1) means the variable is non-stationary at level, but becomes stationary after first difference.

Description of Other Variables

All variables are expressed as a percentage of GDP to capture their relative sizes except GDP per capita (GDP/population) and tertiary school enrolment which is expressed as a percentage of gross school enrolment.

Agriculture valued added represent the net output of the sector after adding up all the outputs and subtracting intermediate inputs. Industry, like agriculture, captures the net output, after subtracting intermediate inputs from the total output of the sector. Trade openness is captured by the sum of imports and exports of goods and services. Agriculture, industry, and trade openness are used to control for the economy's structure. GDP per capita, which captures income per person in the economy, is used as a proxy for the level of economic development. Agriculture, industry, and trade openness are used to control for the economic structure

Oil rent represents the net value of crude oil production at world prices less total cost of production, calculated by the World Bank.

3.2.1 Stationarity of Data

The Unit root test determines whether a series is stationary or non-stationary (See Table 3-1). ADF-Fisher (ADF) and Phillips-Perron-Fisher (PP) test statistics are used. All test equations include individual intercepts, individual intercepts and trends, or none. The test shows that agriculture, loans, and total aid are stationary in level when test equations include individual intercepts, individual intercepts and trends, or none. Industry, trade, grants, and tax revenue are stationary in level when test equations include individual intercepts, and individual intercepts and trends only. Being stationary in original specification means that variables are integrated of order zero, I (0). GDP per capita, oil and tertiary school enrollment are non-stationary in level but become stationary when first-differenced. This implies they are integrated of order one, I (1). The majority of variables are therefore stationary in level, I (0), and are the variables included in the baseline model (control variable) and our variable of interest, tax revenue. (Table C-1) presents the statistical tests of all variables used in the model.

3.2.2 Long run Relationship

A cointegration test is undertaken to investigate variables' long run relationship. Non-stationary variables can be converted to stationary variables through differencing. The unit root test shows that GDP per capita, oil, and tertiary school enrollment are integrated of order one, I (1). A Cointegration test is carried out to ensure that the three I (1) variables are cointegrated before they are included in the model, and, since they are integrated of the same order, the Fisher-Johansen Cointegration test is applied. Table 3-2 shows that the three variables are cointegrated, meaning that they have a long-run relationship. Additionally, it implies that a linear combination of the three I (1) variables is integrated of order zero, I (0), consequently, they can be included in the model without generation of spurious results.

Table 3-2: Johansen Fisher Cointegration Test

Series: GDPP OIL SCH

Hypothesized No. of CE(s)	Fisher Statistics (from trace test)	Prob.	Fisher Statistics (from max-eigen test)	Prob.
None	48.87***	0	50.42***	0
At most 1	5.775	0.2166	3.838	0.4284
At most 2	8.959	0.0621	8.959	0.0621

Note: ***represent significance at 1%. We reject the null hypothesis that none of our equations are cointegrated.

When variables are cointegrated, we can establish steady state equilibrium, and the absence of cointegrating equations (when dealing with non-stationary variables) may potentially result to spurious results, and wrong inferences. In our case, we carry out a Johansen cointegration test of the three I (1) variables only (see Table 3-2), and test for long run relationships/cointegration of all the variables in the model. An Autoregressive Distributed Lag (ARDL) model can be applied, since it allows a cointegration test involving variables integrated of different orders- i.e., I (0) and I (1) but not I (2) (See Table C-2, Table C-3, Table C-4, Table C-5& Table C-6).

3.3 Estimation Methods

In our model specification, one of the challenges of estimating the impact of foreign aid on taxation revenue is the possibility of reverse causality. That is, that donors may effect foreign aid depending on the levels of domestic revenue mobilization in the recipient countries. For example, donors may increase foreign grants because of a reduction in domestic revenue. Similarly, donors may increase foreign loans to countries that have shown an increase in collection of domestic revenue. The practice of giving grants to poor countries and loans to countries with steady tax revenue is necessitated because poor countries have no financial

muscle to repay loans. Moreover, most evidence points to the fact that aid levels are linked to a country's level of development.

There is a possibility our models may suffer from an omitted variable, which explains tax effort, which may further lead to the presence of impure heteroscedasticity. At the same time, the omitted variable may be correlated with some regressors in the model, while being correlated with taxation revenue, which will automatically result in endogeneity problems. In our case, endogeneity bias may arise due to correction of the independent variable, (foreign aid) with the error term, as a result of reverse causality between aid and tax revenue, and/or omitted variables, and/or measurement error. This means that OLS estimates would be unbiased but standard errors will be biased and inconsistent. We will therefore use Two Stage Least Squares (2SLS) estimation to correct for possible endogeneity, and perform feasible generalized least squares (FGLS) weights to correct for heteroscedasticity. In addition, we select 'white cross-section' which assumes errors are cross-sectionally correlated to estimate robust coefficient standard errors. To capture dynamic effects of tax revenue and to correct for serial correlation, we use one period lag of dependent variable (tax/GDP). We are unable to test for autocorrelation, heteroscedastic and cross-sectional dependence because our panel is unbalanced. Using the dependent variable lag is therefore part of our diagnostic test for autocorrelation.

Problems associated with finding a strong instrumental variable for foreign aid leads us to use one period lag of loans, grants and total net aid as the instrumental variables in our model. Both Fixed Effects and Random Effects assume strict exogeneity of the instrumental variables conditional on unobserved country heterogeneity, i.e.,$E(z_{it}, \mu_{it}) = 0$, where z_{it} is the instrument variable and μ_{it} is the unobserved country heterogeneity.

To account for country heterogeneity effects, we choose a Fixed Effects estimator. However, this estimator will be biased due to a potential endogeneity problem. We therefore apply Fixed Effects 2SLS estimator which uses one period lag of total aid, grants, and loans as instrumental variables. We further compare these with random effects. Our choice of the Fixed Effects 2SLS estimator is necessitated by the fact that it does not condition instrumental variables to be exogenous like the Random Effects 2SLS. We cannot rely fully on Random Effects 2SLS because it is challenging to find strictly exogenous instrumental variables. On the other hand, a Fixed Effects 2SLS estimator assumes instrumental variables are contemporaneously

exogenous, not necessarily strictly exogenous, which is difficult to achieve in our model (see Appendix D: Explanation of Estimation Methods)

In our third model specification in equation (3-2), we introduce tertiary school enrollment as a proxy for skills and administrative capacity of tax collectors. More qualified personnel in government revenue collection authorities translates to more revenue collection as a result of specialised data collection and analysis, and regarding broadening the tax base or increasing tax rates. We are aware of no other study in the literature that has controlled for skills and ability of tax personnel including education in their model.

$$Log\left(\frac{Tax_{it}}{GDP_{it}}\right) = \alpha + \beta_1 AGRI_{it} + \beta_2 IND_{it} + \beta_3 Export_{it} + \beta_4 Imports_{it} + \beta_5 SCH_{it} + \beta_6 GDPP_{it} + \beta_7 GDPP_{it}^2 + \beta_8 ODA_{GRANTS_{it}} + \beta_9 ODA_{NETLOANS_{it}} + \varepsilon_{it} \quad (3\text{-}2)$$

3.3.2 Expectation of Parameters

Based on the existing literature, we have formulated expectations on our parameters. For Agriculture, we expect a negative relationship with tax revenue. This is because most agricultural practices in low-income and lower-middle income countries are carried out informally or for subsistence purposes and it is extremely hard to levy tax on these. However, we expect upper-middle income countries to post a positive relationship between agriculture and tax collection. This is because agriculture in these countries is mostly practiced commercially and commercial farming ventures will have well-kept records to assist tax collection.

Industry is one of the sectors of the economy where transactions take place in a more formal environment, with firms undertaking proper book-keeping. This makes it easier to levy taxes on the industrial sector.We therefore expect a positive relationship between industry and tax revenue.

GDP per capita is used as a proxy for a country's income level. Governments of countries in the higher income categories collect more taxes. An increase in GDP per capita will eventually lead to an increase in tax revenue collection and therefore a positive relationship will be shown between per capita GDP and tax revenue.

In our analysis, trade openness constitutes the sum of exports and imports of goods and services. Trade transactions are carried out at a specific place, and this makes it easier to levy

taxes on trade. This leads to our expectation of a positive relationship between trade openness and tax revenue. Governments which are more open to trade internationally, are better positioned to increase their tax revenue.

In line with arguments in the literature, we expect foreign aid in the form of loans will impact positively on tax revenue, and foreign aid in the form of grants will lead to a reduction in tax revenue. This is because loans carry an obligation to repay, implying the recipient government has to maintain current tax revenue levels, or increase them to ensure loan repayments. Grants, however, are perceived as a free source of money by recipient governments and may act as a substitute to tax revenue.

We introduced a tertiary school enrolment variable into our model, which is a proxy for skills in tax collection departments. We would expect countries with more highly-skilled tax personnel to have more efficient tax collection systems.

Our last variable is oil rent (% of GDP), which we expect to have a negative impact on tax revenue collection. The explanation for this is that governments in oil-rich countries focus less on tax collection because it is easier for them to collected oil royalties and dividends

Chapter Four

4 Empirical Results and Discussion

The economies of countries are classified by the World Bank (July 2015) according to their income levels, as Low-Income, Lower-Middle-Income Countries, Upper-Middle-Income Countries, and High-Income economies. Our analysis focuses on all countries pooled together but goes further, to investigate any structural differences related to differences in income levels. We begin by considering all 42 countries pooled together and later proceed to assess them based on their World Bank income categories.

4.1 Analysis of all countries

We estimate three models, the first with total foreign aid, the second with grants and loans and the third with grants, loans, and tertiary school enrolment. In addition we control for variables using Fixed Effects- Estimated General Least Squares (FE-EGLS)) and Fixed Effects-Two Stage Least Squares (FE-2SLS).

This section presents the results obtained by estimating equation (3-1) using FE-EGLS and FE-2SLS methods. Our baseline regression in the first model includes control variables, which are value-added agriculture as a percentage of GDP, value-added industry as a share of GDP, GDP per capita, trade openness (imports plus exports) as a share of GDP, and total foreign aid. The second model includes all the control variables in the first model, and further disaggregates foreign aid into loans and grants. The third model includes all variables in the second model and tertiary school enrolment.

Baseline regression results are provided in (Table 4-1). The structure of the economy, represented by agriculture and industry, has a significant impact on our analysis. Agriculture has a negative relationship with tax revenue. This relationship meets our initial expectation since taxing informal agricultural activities is difficult. On the other hand, industry returns an unexpected negative relationship. Taxing the industrial sector is expected to be easy, since many businesses operate in the formal sector. These findings may result from long tax holidays given to investors in the interest of promoting industry in least industrialized countries, which reduce tax collection in these countries. A further possible contributing factor could be transfer pricing by multinational companies, which dominate the industrial sector in most Sub-Saharan African countries.

More importantly, all the control variables are statistically significant. Comparing the control variables with those of Gupta, et al. (2004), shows that our GDP per capita analysis solves the effect of GDP per capita ambiguity, by reflecting a positive relationship with tax revenue. This is contrary to Gupta, et al. (2004), who find an unexpected statistically significant negative effect.Their findings might be as a result of model misspecification, since the squared term of GDP per capita was excluded in their model, but included in our model.

Our model includes the squared term of GDP per capita to capture nonlinear effects, and, an increase in GDP per capita contributes positively to tax revenue up to a certain threshold after which it declines. We determine the threshold by calculating the GDP per capita turning point using the following formula;

$$Turning\ Point = \frac{\hat{\beta}_{GDPP}}{\hat{\beta}_{DPP^2}} = 0.000266/2(-2.15E\text{-}08) = \$\ 6{,}186.05$$

Where by $\hat{\beta}_4$ and $\hat{\beta}_5$ are the estimated coefficients of GDP per capita and squared GDP per capita (see equation 3-1). The turning point of GDP per capita when all countries are pooled together is $ 6,186.05, which implies that, after this level of income, tax revenue will be affected at a decreasing rate.

An increase in total foreign aid (net loans plus grants) is associated with a statistically significant drop in taxation revenue. These results agree with previous studies such as Gupta, et al. (2004) and Benedek, et al. (2012). When aid is disaggregated into net loans and grants, it is evident that both loans and grants have a negative effect on tax revenue, and these are both statistically significant. These results suggest that donors indirectly fund tax cuts instead of productive government programs, because recipient government practice aid fungibility. Most studies find that loans have a positive effect on tax revenue, and the reverse is true for the grants (Gupta, et al. (2004), Benedek et al. (2012), Clist and Morrissey (2009)). When we analyse the 42 countries pooled together, the composition of foreign aid does not matter.That is, grants and loans impact negatively on tax revenue, as does total foreign aid. The effects of grants on tax revenue is supported by the argument that recipient governments take into account that there is no obligation to repay grants On the other hand, loans also have a negative relationship to tax revenue in the pooled analysis. We explain our findings by focusing on the frequency of debt forgiveness. Most Sub-Saharan African countries are Heavily Indebted Poor Countries (HIPC), and they frequently receive debt forgiveness. This may have corrupted any discipline

related to repayment as the recipient governments may have formed an expectation of always qualifying for debt forgiveness, and perceive loans as equivalent to grants.

Table 4-1: Baseline Models – Tax Revenue and Foreign Aid

Estimation Method	FE- EGLS	FE- EGLS	Fixed Effects 2SLS	Fixed Effects 2SLS
C	2.587994***	2.611353***	2.631084***	2.891052***
	(0.070873)	(0.085667)	(0.075964)	(0.173745)
AGR	-0.011884***	-0.012544***	-0.011613***	-0.011742***
	(0.001147)	(0.00117)	(0.001284)	(0.001341)
GDPP	0.000229***	0.000273***	0.000193***	0.000266***
	(2.87E-05)	(2.76E-05)	(2.28E-05)	(2.93E-05)
GDPP^2	-1.84E-08***	-2.13E-08***	-1.52E-08***	-2.15E-08**
	(2.35E-09)	(2.23E-09)	(1.80E-09)	(2.36E-09)
IND	-0.006535***	-0.007125***	-0.007124***	-0.007006***
	(0.001292)	(0.001258)	(0.001147)	(0.001313)
TRADE	0.001851***	0.001817***	0.001959***	0.001904***
	(0.000363)	(0.000356)	(0.000325)	(0.000385)
TOTALNET	-0.005692***		-0.006497***	
	(0.000867)		(0.001708)	
GRANTS		-0.001253**		-0.004682***
		(0.000594)		(0.001845)
LOANSNET		-0.000716**		-0.004713***
		(0.000346)		(0.001585)
R-squared	0.937029	0.947059	0.943532	0.942383
F-statistic	259.5792	303.3358	270.2752	293.9313
Prob(F-statistic)	0	0	0	0
Cross-Sections	40	40	40	40
Periods Included	24	24	23	23

Note: dependent variable is log (taxation revenue/GDP). All regressors are measured as a percentage of GDP except GDP per capita. Numbers in parenthesis are standard errors. ***, **, and * indicate significance at 1, 5 and 10 percent respectively. Two Stage Least Square (2SLS) using country Fixed Effects. One period lags of grants, loans, and total aid are used as instrument variables. Loans and foreign aid variables capture only the net, not gross. Durbin Watson statistics were 0.669672, 0.648589, 0.671142, and 0.815998 for column 1, column 2, column 3 and column 4 respectively.

Source: Author's calculations

Our models indicate that a percentage point increase in agriculture as a share of GDP leads to reduction in tax revenue by approximately 1.18% when a Fixed Effect estimator is applied to model one and 1.17% when Fixed Effects 2SLS estimator is used. This shows that the two estimators produce consistent results. Clist and Morrissey (2011) find 1.16% when current aid is used, and 1.17% when lagged aid is used. Gupta, et.al (2004) find a reduction of 1.11% in tax revenue, with a one percentage point increase in agriculture as a share of GDP. Clist and Morrissey (2011) use a Fixed Effects estimator. Gupta, et.al (2004) use both Fixed Effects and Random Effects estimators and their results were similar in both analyses. The three studies therefore find a similar negative impact on tax revenue with every one percentage increase in agriculture[2].

The signs of the parameters of our key variables (total foreign aid, loans, and grants) differ slightly from those of previous studies. The Fixed Effects Estimator shows that a one percentage point increase in total foreign aid results in a reduction in tax revenue of approximately 0.57%. The Fixed Effects 2SLS estimator shows a reduction of 0.65%, which is consistent within two standard errors (2SD). A one percentage point increase in both grants and loans reduces tax revenue by 0.47% when an FE-2SLS estimator is applied.

4.2 Analysis by Income Level

In our analysis, we divide our countries according to the World Bank's income classifications. SSA countries fall into three of the four World Bank categories: Low-income economies, lower-middle-income economies, and upper-middle-income economies. We undertake this analysis because tax regimes in countries with different income levels may react differently to total foreign aid, loans, and grants, owing to structural differences. The first baseline model includes all the main control variables and total aid (equation 4-1), and the second baseline model contains aid disaggregated into concessional loans and grants (equation 4-2).

$$Log\left(\frac{Tax_{it}}{GDP_{it}}\right) = \alpha + \beta_1 AGRI_{it} + \beta_2 IND_{it} + \beta_3 TRADE_{it} + \beta_4 GDPP_{it} + \beta_5 GDPP_{it}^2 + \beta_6 TOTALNET_{it} + + \varepsilon_{it} \quad (4\text{-}1)$$

and

[2] Here we mean the contribution of these - agriculture, industry, trade, grants, loans and foreign/total aid - as a percentage of GDP.

$$Log\left(\frac{Tax_{it}}{GDP_{it}}\right) = \alpha + \beta_1 AGRI_{it} + \beta_2 IND_{it} + \beta_3 TRADE_{it} + \beta_4 GDPP_{it} + \beta_5 GDPP_{it}^2 + \beta_6 ODA\_GRANTS_{it} + \beta_7 ODA\_NETLOANS_{it} + \varepsilon_{it} \quad (4\text{-}2)$$

4.2.1 Upper-Middle Income Economies

The results shown in (Table 4-2) are interesting because they differ from those of the pooled panel. When agriculture contributes more to GDP in UMICs, this has a positive effect on taxation revenue.These results are in line with the argument that Upper-Middle-Income countries (UMICs) undertake commercial agriculture, where business transactions are carried out formally and are recorded. This therefore makes it easy for taxes to be levied. The results show that one percentage point increase in agriculture as a percentage of GDP increases tax revenue by 2.39% when our model (4-1) is estimated with a Fixed Effects 2SLS estimator. Another important difference from our analysis of pooled country data is that an increase in foreign aid translates into a statistically significant increase in taxation revenue. A one percentage point increase in total aid leads to a statistically significant increase in tax revenue of between 2.65% and 8.87%. Their values are about 2SD of each other, given the high standard error for FE-2SLS.

We further disaggregate foreign aid into loans and grants, as shown in (Table 4-2). The results show that tax revenue in UMICs responds differently to concessional loans and grants from our study countries in the other income groups. Contrary to earlier findings in the pooled analysis, both loans and grants are positive, but mostly not significant. The reason for this might be that UMICs do not fall under HIPC initiatives and are therefore not eligible for debt forgiveness. For governments of UMICs, the obligation to repay concessional loans is an incentive to tax more. We also attribute increased revenue collection to better developed institutionsin these countries which have well-developed systems, and more transparent governance.

Other variables respond more or less the same as they do in our pooled analysis, apart from trade openness, which is not significant. The GDP per capita turning point for UMICs was calculated in the same way it was calculated for all our pooled country sample, and the turning point is at $ 7,619.05.

Table 4-2: Upper-Middle- Income Countries – Taxation Revenue and Foreign Aid, Grants and Loans

Estimation Method	FE_ EGLS	FE_ EGLS	Fixed Effects 2SLS	Fixed Effects 2SLS
C	1.945988*****	2.324999***	1.223888***	1.48951***
	(0.273485)	(0.238596)	(0.431983)	(0.49255)
AGR	0.013706	0.006512	0.023871***	0.012112
	(0.008551)	(0.007521)	(0.00889)	(1.24E-02)
GDPP	0.00035***	0.000286***	0.000466***	0.00032***
	(4.97E-05)	(5.43E-05)	(8.23E-05)	(8.93E-05)
GDPP^2	-2.33E-08***	-2.01E-08***	-3.07E-08***	-2.10E-08***
	(3.21E-09)	(3.61E-09)	(5.85E-09)	(6.65E-09)
IND	-0.009655***	-1.02E-02***	-7.72E-03**	-0.009089***
	(0.002375)	(1.99E-03)	(3.69E-03)	(0.003328)
TRADE	0.000151	-0.000163	0.000978	-0.000632
	(0.000399)	(0.000325)	(0.000612)	(0.000603)
TOTALNET	0.026528***		0.088679***	
	(0.007299)		(0.03127)	
GRANTS		0.000223		0.008349
		(0.000777)		(0.005329)
LOANSNET		0.00091		0.005323***
		(0.00055)		(0.001941)
R-squared	0.867554	0.867915	0.857522	0.851674
F-statistic	65.50271	59.13782	70.79569	57.70431
Prob(F-statistic)	0	0	0	0
Observations	133	131	128	126
Cross-Sections	7	7	7	7
Periods Included	24	24	23	23

The dependent variable is log (Tax/GDP), all variable are expressed as a percentage of GDP except GDP per Capita. Values in parentheses, (), are a standard error. ****, ** and * represent significance at 1%, 5% and 10%.

Source: Author's calculations

4.2.2 Lower-Middle-Income and Low-Income Economies

The findings for Lower-Middle-Income countries (LMICs) and Low-Income countries (LICs) are similar to our analysis of pooled sample (see Table 4-3). This is because LMICs (24% of the pooed sample) and LICs (57% of the pooled sample) dominate the pooled sample and the analysis' findings[3]. For example, a reduction in tax revenue as a result of a one percentage point increase in agriculture production in a country's GDP is similar to the findings with the pooled sample, which averaged around 1.1%.

We further establish the threshold at which an increase in GDP per capita translates to an increase in tax revenue at a decreasing rate, by calculating the turning points in LMICs and LICs. These are $ 1,161.07 and $ 2,530.41 respectively.

Our findings from analysing countries by income category are consistent with our argument that loans and grants are perceived as free money by recipient governments of LMICs and LICs which are members of the HIPC initiative. This is consistent, because UMICs post different results. Thus, carrying out an analysis of countries by income group is more revealing than analyzing the countries as a pooled sample, which reflect the average effect of the majority of countries in our study, which are LMICs and LICs.

[3]LMICs stand for Lower-Middle-Income Countries, LICs stand for Low-Income Countries and UMICs stand for Upper-Middle Income Countries.

Table 4-3: Lower-Middle and Low-Income Economies – Taxation Revenue, Total Aid, Loans and Grants

Estimation Method	Fixed Effects 2SLS Lower-Middle	Fixed Effects 2SLS Lower-Middle	Fixed Effects 2SLS Low-Income	Fixed Effects 2SLS Low-Income
C	2.822988***	3.238541***	2.168584***	3.364747***
	(0.193274)	(0.330421)	(0.175722)	(0.63)
AGR	-0.010913***	-0.013041***	-0.010161***	-0.01106***
	(0.002394)	(0.003497)	(0.001624)	(0.002353)
GDPP	6.95E-05	0.000208*	0.000802*	0.001384**
	(0.000127)	(0.000118)	(0.000485)	(0.000562)
GDPP^2	-1.33E-08	-4.11E-08*	-2.02E-07	-5.96E-07
	(2.35E-08)	(2.48E-08)	(4.18E-07)	(4.83E-07)
IND	-0.010448***	-0.00857***	-0.00762***	-0.006133*
	(0.001704)	(0.00221)	(0.002248)	(0.003476)
TRADE	0.00198***	0.001622*	0.005841***	0.004499***
	(0.000614)	(0.000902)	(0.000633)	(0.001135)
TOTALNET	-0.008982		-0.005745***	
	(0.006133)		(0.001902)	
GRANTS		-0.007663**		-0.01593**
		(0.003346)		(0.006619)
LOANSNET		-0.003178		-0.014353***
		(0.002296)		(0.005136)
R-squared	0.922982	0.914459	0.788974	0.660398
F-statistic	151.5073	145.3913	55.31282	59.59915
Prob(F-statistic)	0	0	0	0
Observations	207	207	430	428
Cross-sections	10	10	21	21
Period Included(yr)	23	23	23	23

Note: The dependent variable is a log of taxation revenue/GDP; all regressors are measured as a percentage of GDP, except GDP per capita. Numbers in parenthesis are robust standard errors. ***, ** and * indicate 1, 5 and 10 percent, respectively.

Source: Author's calculations

4.3 Introduction of Tertiary School Enrolment

We introduce our third model, which contains a variable for tertiary school enrolment, as the proxy for skills-level of the workforce and specifically as a measure of revenue departments' administrative ability to collect taxes. Tertiary school enrollment is included in the model as a determinant of tax revenue because we assume that country's workforce is correlated with the availability of skilled personnel for tax collection duties.That is, a country with more educated tax collectors will collect more tax revenue. The estimated model results shown in (Table 4-4) agree with our expectations of a positive effect of tertiary school enrolment on tax revenue collection. Using a Fixed Effects 2SLS estimator, a percentage point increase in tertiary school enrolment leads to a 1.45% increase in tax revenue. The ratio of tertiary school enrolment to gross school enrolment was purposely used in the model, as a policy variable to inform policymakers about the role of education in DRM.

During model specification, we intended to introduce tertiary school enrolment as one of the control variables in the baseline models. However, variable which meant too few observations to make plausible inferences. The control variables in this model, grants and concessional loans, behaved more or less the same as in the pooled analysis, which is also a test for robustness by adding more variables.

Table 4-4: Tax Revenue, Foreign Aid and Tertiary School Enrolment

Estimation Method	Fixed EGLS	Fixed EGLS	Fixed Effects 2SLS	Fixed Effects 2SLS
C	2.492087***	2.594802***	2.56E+00**	3.32E+00***
	(0.167379)	(2.29E-01)	(0.180646)	(4.64E-01)
AGR	-0.012131***	-1.22E-02***	-1.27E-02***	-0.013069***
	(0.003052)	(3.15E-03)	(0.003299)	(3.33E-03)
GDPP	0.000163*	0.000152*	0.000118	1.05E-04
	(9.46E-05)	(8.21E-05)	(0.000112)	(1.06E-04)
GDPP^2	-2.75E-08***	-2.65E-08***	-2.12E-08**	-1.91E-08*
	(9.48E-09)	(8.33E-09)	(1.04E-08)	(1.02E-08)
IND	-0.001176	-0.00141	-0.002248	-0.00373
	(0.002389)	(0.002388)	(0.002407)	(2.52E-03)
TRADE	0.001329*	0.001467**	0.001932***	0.002619***
	(0.000748)	(0.000687)	(0.000684)	(0.000799)
SCH	0.025328***	0.026043***	0.023155***	0.028638***
	(0.00592)	(0.006978)	(0.006452)	(0.009461)
TOTALNET	0.000709		-0.000879	
	(0.001925)		(0.003143)	
GRANTS		-0.001129		-0.009898*
		(0.001503)		(0.005506)
LOANSNET		-0.000451		-0.005095
		(0.000545)		(0.003205)
R-squared	0.814365	0.812617	0.822236	0.797122
F-statistic	35.60542	34.20043	35.38436	34.29709
Prob(F-statistic)	0	0	0	0
Observations	393	392	373	372
Cross-Sections	37	37	37	37
Periods Included	23	23	22	22

Note: The dependent variable is a log of taxation revenue/GDP. All regressors are measured as a percentage of GDP, except GDP per capita. Numbers in parenthesis are robust standard errors. ***, ** and * indicate 1, 5 and 10 percent respectively

Source: Author's calculations

4.4 Robustness Test

To test for robustness, we can either add or subtract regressors, and monitor how the estimates behave in response to these modifications of model specifications. A stable model, which is the measure of robustness, will not reflect major changes in estimates regarding signs and magnitudes. We choose to add two control variables to the baseline model: Oil rent as a percentage of GDP) and tertiary school enrolment (as a percentage of gross school enrolment). The choice of oil rent was compelled by the argument in the literature that oil exporters make low tax efforts because it is easy for their governments to collect oil related revenue, such as royalties and dividends, than taxes (Uche & Uche, 2004). These governments may prefer non-tax revenue since it requires less accountability to their citizens.

Uche & Uche (2004) carry out a study in Nigeria on oil and the politics of revenue allocation. They reveal that present-day Nigeria is poorer than it was in the pre-oil era. They attribute this to an overemphasis on oil revenue compared to other sources of revenue. Our variable oil rent (% of GDP) is therefore expected to lower tax revenue, and the model meets our expectation, showing that a one percentage point increase in oil rent (% of GDP) leads to a reduction in tax revenue by approximately 1.14% when a Fixed Effects 2SLS model is estimated.

Tertiary school enrolment is used as a proxy for skilled tax collectors who are proficient in data collection and analysis to develop efficient and fair tax systems and to broaden their country's tax base. Tertiary school enrolment has a positive impact on tax revenue, as expected. The results, presented in (Table 4-5) are similar to those of the baseline models of our pooled countries, especially the signs of the estimates. Notably, a variable like agriculture has consistent signs, and similar estimate magnitudes in the pooled model and the robustness model. Similar observations are made for GDP per capita, amongst other control variables. Grants and concessional loans are also consistent in signs, but their magnitude changes slightly when instrumental variable models are estimated. On the other hand, Fixed Effects models maintain consistency in signs and almost equal magnitudes for the baseline regression estimates. Our two additional variables, oil rent (% of GDP) and school enrolment, are statistically significant, and their impact on tax revenue is in line with our theoretical expectations (see Table 4-5).

Table 4-5: Taxation Revenue and Foreign Aid: Other Controls Included (Robustness Test)

Estimation Method	FE_ LS	FE_ EGLS	Fixed Effects 2SLS	Fixed Effects 2SLS	Fixed Effects 2SLS
C	2.594802***	3.12987***	3.324386***	2.727346***	2.743532***
	(0.228649)	(0.07784)	(0.463626)	(0.176684)	(0.453862)
AGR	-0.012229***	-0.018513***	-0.013069***	-1.11E-02***	-0.010552***
	(0.003151)	(0.00076)	(0.003331)	(1.44E-03)	(0.003524)
GDPP	0.000152*	0.000105***	0.000105	0.000278***	0.000177
	(8.21E-05)	(1.58E-05)	(0.000106)	(2.99E-05)	(1.28E-04)
GDPP^2	-2.65E-08***	-8.31E-09***	-1.91E-08*	-2.17E-08***	-2.20E-08**
	(8.33E-09)	(1.51E-09)	(1.02E-08)	(2.44E-09)	(1.02E-08)
IND	-1.41E-03	-1.11E-02***	-0.00373	-0.00385***	2.01E-03
	(2.39E-03)	(1.42E-03)	(0.002522)	(0.00139)	(2.17E-03)
TRADE	0.001467**	0.002989***	0.002619***	0.002278***	0.004334***
	(0.000687)	(0.000271)	(0.000799)	(0.000411)	(9.51E-04)
GRANTS	-0.001129	-0.001632**	-0.009898*	-0.003562*	-6.23E-03
	(0.001503)	(0.000649)	(0.005506)	(0.001852)	(4.61E-03)
LOANSNET	-0.000451	-0.001434***	-0.005095	-.004458***	-0.00377
	(0.000545)	(0.000394)	(0.003205)	(0.001605)	(0.002746)
SCH	0.026043***		0.028638***		0.022933***
	(0.006978)		(0.009461)		(0.008378)
OIL		-0.014112***		-.011395***	-0.023514***
		(0.000853)		(0.002018)	(0.005461)
R-squared	0.812617	0.730967	0.797122	0.943539	0.824232
F-statistic	34.20043	272.0408	34.29709	289.3852	36.63919
Prob(F-statistic)	0	0	0	0	0
Observations	392	810	372	779	367
Cross-Sections	37	40	37	40	37
Periods Included	23	24	22	23	22

Note: The dependent variable is log (Tax/GDP), all variable are expressed as a percentage of GDP, except GDP per Capita. Values in parentheses, (), are standard errors. ****, ** and * represent significance at 1%, 5% and 10%.

Source: Author's calculations

Diagnostic Tests

The panel used in this study is an unbalanced panel because of missing data. As a result, our analysis software, Eviews, limits us when carrying out diagnostic tests. During estimations, we use various methods, as to counter major econometric problems such as heterogeneity, endogeneity, and heteroscedasticity to ensure our estimates are unbiased.

Durbin-Watson statistics indicate that the baseline models in (Table 4-1) are suffering from autocorrelation. To correct the autocorrelation problem, and also capture tax revenue's dynamic effects, the models in (Table 4-6) are estimated by using a one period lag of tax revenue (dependent variable) as one of the explanatory variables. Durbin-Watson statistics in the models reported in (Table 4-6) are very close to 2, which is a rule of thumb for zero autocorrelation models. For example, columns (1) and (3) have Durbin-Watson statistics of 1.930015 and 1.935594, respectively, while columns (2) and (4) have statistics of 1.969344 and 1.970926 respectively. They are close to 2 and we can therefore, argue that these models have zero autocorrelation. Comparing (Table 4-1) and (Table 4-6), it is clear that standard errors are slightly larger in (Table 4-1) than in (Table 4-6) as expected, but this does not increase the number of statistically significant variables. This implies that the dynamic model estimates robust standard errors which are efficient.

Since serial correlation affects the standard errors only, estimates are less affected (especially the signs), and thus interpretation is similar to the estimates in (Table 4-1). However, adding a lagged dependent variable on the right hand side means that we must adjust the estimate's coefficients on the independent variables by $1/1-0.73$ to capture their long run effect, whereby 0.73 is the coefficient of the lagged dependent variable (LnTax(-1)).

Table 4-6: Tax Revenue and Foreign Aid: Correction for Autocorrelation (Using lag of dependent variable)

Estimation Method	Fixed EGLS	Fixed EGLS	Fixed Effects 2SLS	Fixed Effects 2SLS
	(1)	(2)	(3)	(4)
C	0.677554***	0.656134***	0.634979***	0.691942***
	(0.099068)	(0.100568)	(0.114426)	(0.163478)
LNTAX(-1)	0.720822***	0.739973***	0.731438***	0.73301***
	(0.027031)	(0.025931)	(0.026787)	(0.026568)
AGR	-0.002661**	-0.002852**	-0.002578**	-0.002534**
	(0.001221)	(0.001271)	(1.26E-03)	(0.00126)
GDPP	4.19E-05**	5.95E-05***	4.91E-05**	6.52E-05***
	(1.80E-05)	(1.74E-05)	(2.18E-05)	(1.63E-05)
GDPP^2	-3.22E-09**	-4.67E-09***	-3.79E-09**	-5.04E-09***
	(1.28E-09)	(1.29E-09)	(1.51E-09)	(1.15E-09)
IND	-0.000294	-0.000383	-0.000403	-0.000431
	(0.000645)	(0.000647)	(0.000713)	(0.000642)
TRADE	0.000886***	0.000986***	0.000855***	0.000932***
	(0.000219)	(0.000226)	(0.000207)	(0.000224)
TOTALNET	-0.002016*		-0.000818	
	(0.001159)		(0.001531)	
GRANTS		-0.000797**		-0.001055
		(0.000253)		(0.001519)
LOANSNET		-0.000319*		-0.00136
		(0.000165)		(0.001439)
R-squared	0.964563	0.967403	0.965097	0.966925
F-statistic	440.2354	467.8994	445.24	475.7556
Prob(F-statistic)	0	0	0	0
Durbin-Watson	1.930015	1.969344	1.935594	1.970926
Observations	791	789	790	786
Cross-Sections	40	40	40	40
Periods Included	23	23	23	23

The dependent variable is log (Tax/GDP). All variable are expressed as a percentage of GDP, except GDP per Capita. Values in parentheses, (), are standard errors. ****, ** and * represent significance at 1%, 5% and 10%.

Source: Author's calculations

Chapter Five

5 Conclusion and Policy Recommendations

Our underlying hypothesis for our study is that recipient governments treat loans differently from grants. Loans have a positive impact on tax revenue, because of the obligation to pay, which acts as an incentive to collect more tax.Grants, however, are treated as a source of free resources, and this creates a disincentive to tax. This should be an incentive for policymakers to channel borrowed funds (loans) to productive projects that ultimately increase taxes and facilitate repayment.

We start our analysis with a basic model of our study countries as a pooled sample, and then carry out a similar analysis for countries grouped according to World Bank income categories (Upper-Middle-Income, Lower-Middle-Income, and Low- Income) , to account for structural differences.

Strategy for Discussion:

1) Basic Model (Analysis of pooled country sample)
2) Analysis of countries by Income Category
3) Addition of Tertiary schooling variable

In the basic model, there is a positive relationship between tax revenue and GDP per capita, as expected, because tax revenues increase with rising incomes. We also find that the relationship is nonlinear by including GDP per capita squared, which was significant with a negative sign. To determine the threshold at which an increase in income level affects tax revenue at a decreasing rate, we calculate turning for the pooled sample and for each income group.. UMICs have a turning point of $ 7,619.05, LMICs of $ 2,530.41, LICs of $ 1,161.07, and our pooled country sample of $ 6,186.05.

We also control for the structure of the economy, by including terms for agriculture as a share of GDP and industry as a share of GDP. We find an increase in agriculture as a share of GDP has a negative effect on tax revenue. This is expected because much agricultural production is informal or on subsistence agriculture, which makes it difficult to levy tax in this sector. However, industry similarly showed a negative impact on the tax revenue. We consider this is due to the large number of countries in our sample that provide prolonged tax holidays to industrial companies, especially multinationals, which practise transfer pricing.

Trade openness posts a positive effect on tax revenue in the basic model, which showed that more trade led to a higher tax/GDP share. This captures the fact that some taxes are trade-related (e.g. tariffs, excises, etc.) but would also indicate that more foreign trade leads to greater prosperity and a higher tax/GDP share.

Grants and loans both have a negative sign, indicating that governments, overall, find them to be a disincentive to tax, or they are used as a substitute for tax revenue collection. It appears that policymakers in HIPC countries expect to receive debt relief/forgiveness on their loans, and thus don't take the obligation to repay seriously.

In contrast, agriculture had a positive effect on tax revenue in UMICs. This can be explained by the fact thatthese countries have attained significant levels of economic and institutional development, which translates into more formal businesses and, commercial agriculture, both of which are easier to tax.

Results for industry as a percent of GDP were not as expected. Levying taxes in formal sectors of the economy should be easier, because these sectors have formal transaction records. The negative impact of an increase in industry input to GDP on tax revenue might be explained by the high share of multinationals in the industrial sector, which practise transfer pricing. UMICs might also be affected by prolonged tax holidays for investors.

We examine our variables of interest in countries grouped by income category. This analysis shows foreign aid, loans, and grants have a negative impact on tax revenue. This is more less the same as the findings under pooled analysis, implying that the composition of foreign aid does not matter. UMICs posted different results, where foreign aid, loans, and grants total had a positive effect on tax revenue.

Most of the LMICs and LICs in our sample receive debt relief under the HIPC initiative. We argue that recipient governments formulate an expectation of always receiving debt forgiveness and therefore treat both loans and grants as a free source of funds, and a substitute for taxation revenue. This creates a disincentive to tax citizens, who demand accountability for their taxes. However, UMICs in our sample respond differently and both loans and grants demonstrate a positive effect on tax revenue. The positive effect of loans is a result of UMICs being ineligible for debt relief, and their governments are obligated to repay their loans, which creates an incentive to collect more taxes. The positive relationship between grants and tax revenue is explained by the fact that UMICs have achieved a significant level of development which

translates into increased levels of efficiency and accountability in revenue systems from additional resources added to the fiscal.

Lastly, we undertake a robustness check by introducing a variable for tertiary school enrolment as a proxy for the skills level of the workforce in tax administration. We also introduce a variable for oil rent as a percentage of GDP, to test the resource curse effect. We find that higher education levels (representing more skilled tax administrators) were significantly associated with a higher rate of tax collection, and increases in oil rents reduced the tax share. After introducing these new variables, the coefficients on the other variables appeared to remain roughly stable, indicating a reasonable amount of robustness in the model.

One clear policy implication of this study is that donors could channel their grants and loans directly to Non-Governmental Organisations (NGOs) or the private sector, rather than to the governments of LMICs and LICs, thus reducing any disincentive that these governments might have to forgo taxation.

We recommend further research to investigate the impact of industry as a share of GDP on tax revenue collection. We further recommend research to evaluate the most effective foreign aid transmission mechanism through NGOs and to what extent this would impact on tax revenue collection.

One of the limitations of this study arose during diagnostic tests on heteroscedasticity, autocorrelation, and cross-section dependency. We employ estimation methods to correct heteroscedasticity and heterogeneity. For autocorrelation, we estimate our baseline regression of our pooled country sample by the use of a lagged dependent variable on the right-hand side. Results of this model were not significantly different from the pooled analysis.

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Appendices

Appendix A World Bank Classification of Countries by income level (July 2015)

Table A-1: Categories used for Study Countries

Low-Income	**Lower-Middle Income**	**Upper Middle**	**Oil Exporting countries**
Benin	Cameroon	Angola	Angola
Burkina Faso	Cape Verde	Botswana	Cameroon
Burundi	Congo, Rep.	Equatorial Guinea	Chad
Central African Republic	Cote d'Ivoire	Gabon	Congo, Rep.
Chad	Ghana	Mauritius	Equatorial Guinea
Comoros	Kenya	Namibia	Gabon
Congo, Dem. Rep.	Nigeria	Seychelles	Nigeria
Eritrea	Senegal	South Africa	Sudan
Ethiopia	Sudan		
Gambia, The	Zambia		
Guinea			
Guinea-Bissau			
Liberia			
Madagascar			
Malawi			
Mali			
Mozambique			
Niger			
Rwanda			
Sierra Leone			
Tanzania			
Togo			
Uganda			
Zimbabwe			

Appendix B Descriptive Statistics

Table B-1: Summary Statistics and Variable Definition

Variable	Definition	Descriptive Statistics					
		Mean	Median	Max	Min	Std. Dev.	Obs
TAX	Tax Revenue/GDP	12.25904	11.22402	38.26640	0.600195	6.154496	827
AGR	Agriculture/GDP	28.43661	29.38456	62.38273	2.032283	15.02896	827
IND	Industry/GDP	24.66205	21.28279	77.41366	6.791070	12.39448	827
GDPP	GDP per Capita	1627.903	687.6126	11124.66	160.3213	2271.789	827
TRADE	Trade/GDP	66.32686	58.62814	225.0231	11.08746	30.56700	827
GRANTS	Grants/GDP	76.24851	77.06210	100.0000	14.37607	14.72454	827
LOANSNET	Net Loans/GDP	9.501905	11.73806	84.17094	-110.52	22.32220	827
TOTALNET	TotalAid Net/GDP	11.32370	9.610271	94.44210	-0.25188	10.15494	827

All variables are as a percentage of GDP, except for GDP per Capita

Source: Author's calculations

Appendix C Explanation of Test

a) Unit Root Test

This is critical to carrying out any form of empirical analysis. For instance, two non-stationary variables trending together over time may post a very high R^2 despite the two being unrelated. Carrying out regression with non-stationary variables may violate standard assumptions and eventually produce spurious results and wrong inferences. To test for unit root, we use Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, where the null hypothesis is the presence of unit root, or rather a series which has characteristics of a random walk, and the alternative hypothesis is absence of unit root/stationary. Most of our non-stationary variables are converted to stationary variables by first differencing. If a non-stationary variable is converted to stationary variable by first differencing, it is said to be integrated of order one, I (1) and integrated of second order, if it is differenced twice, I (2).

Unit root exists in two forms, deterministic and stochastic process. The deterministic process is mean reverting, meaning that the deviation from the mean value is temporary. The stochastic process results in permanent deviations from the mean, leading to long run effects on the variable. Variables which possess stochastic processes can be stationary through differencing and variables with the deterministic process are detrended by being regressed on time to remove the time effects.

Let us consider a random walk model without drift;

$$Y_t = \rho Y_{t-1} + \mu_t$$

Where Y_t represents the time series variable and μ_t the error term. In the event$\rho = 1$, the variable is non-stationary, and when absolute values of $\rho \leq 1$, the series is stationary and the error term,μ_t, is white noise. Non-stationary variables are first differenced by subtracting the previous term from the current term i.e. $Y_t - Y_{t-1}$.

This test seeks to establish whether the dependent variable, tax, is stationary or non- stationary. All test methods show that the series is non-stationary at level but becomes stationary after first difference, implying that tax is I(1). We further investigate our key variables, grants and net loans, and are also found to be non-stationary at level, but stationary on first difference. This means that tax, grants and net loans are cointegrated of the same order. Since the subject variables are cointegrated of the same order, I(1), and are all non-stationary, which is a

precondition for the cointegration test, we can run a Johansen cointegration test to establish their long-run relationship.

Table C-1: Unit Root Tests

Variable	ADF-Fisher Test		Phillips-Perron Fisher Test		
	Level	First Difference	Level	First Difference	Order of Integration
Tax	-3.4787***		-3.7126***		I (0)
LnTax	-4.0944***		-5.0802***		I (0)
Agriculture	-3.1597***		-3.4752***		I (0)
Industry	-1.8615***		-1.9726***		I (0)
GDP per Capita	1.56865	-13.9464***	1.2471	-17.7749***	I (1)
Trade	-3.7888***		-3.7011***		I (0)
Exports	-3.9865***		-4.7134***		I (0)
Imports	-3.7845***		-4.6864***		I (0)
Total Aid	-6.3889***		-6.5997***		I (0)
Grants	-8.7030***		-8.6327***		I (0)
Net Loans	-9.48191***		-9.02385***		I (0)
Oil	-02.18***	-11.1848***	0.35572	-15.1666***	I (1)
School	6.01E+0	-3.7863***	6.00998	-4.36962***	I (1)

Note: *** represent rejection of null hypothesis at 1% level of significance. ADF & PP Choi Z- statistics are used and all test equations include individual intercept and trend. The null hypothesis is the presence of unit root (non-stationary) and the alternative is stationary.

b) Long Run Relationship/Fisher-Johansen Cointegration Test

If any linear combination of two or more series are integrated of order zero, I (0), we conclude that the series are cointegrated (Engle and Granger, 1987). A Johansen Cointegration test can only take place if the series involved are integrated of the same order. Engle and Granger (1987) and Johansen (1988) are the two commonly used methods to carry out cointegration tests. Deviations from the equilibrium of cointegrated variables will eventually return to the equilibrium point, meaning that the shock is not permanent or rather does not cause permanent deviations. These deviations from the equilibrium path can be modeled by an Error Correction Model.

This test seek to establish the long-run relationship among tax, agriculture, industry, GDP per capita, trade, grants and net loans. Pedroni's Residual Cointegration Test carry's out the test

by formulating a null hypothesis of no cointegration and an alternative hypothesis of the presence of cointegration. In our analysis, most of the methods show that our variables are not cointegrated-which implies they do not have a long-run relationship.

We perform the same test to establish the long-run relationship between tax and our variables of interest, grants and net loans. The same conclusion is reached, where most methods show no cointegration among these variables (Table C-2)

Table C-2: Cointegration Test

Series**:** LNTAX AGR GDPP IND TRADE GRANTS LOANSNET

Hypothesized No. of CE(s)	Fisher Stat.* (from trace test)	Prob.	Fisher Stat.* (from max-eigen test)	Prob.
None	1097.	0.0000	1677.	0.0000
At most 1	1126.	0.0000	657.9	0.0000
At most 2	754.2	0.0000	464.6	0.0000
At most 3	433.4	0.0000	261.4	0.0000
At most 4	227.9	0.0000	143.7	0.0000
At most 5	140.6	0.0000	103.3	0.0002
At most 6	132.1	0.0000	132.1	0.0000

c) ARDL Model or Bound Test

According to the empirical studies, (Pesaran, Shin, & Smith, 2001, Pesaran & Shin, 1999), carrying out regression with variables integrated on different orders might produce biased estimates. In our case, since the non-stationary variables are cointegrated, we can carry out regression without reproducing spurious results. To test for cointegration with variables integrated of different order calls for a more advanced model, like ARDL, which has been tested to allow analysis of variables with different orders of integration. The ARDL model in equation (C-1), includes lags of both regressand and regressors as explanatory variables

$$y_{it} = \beta_0 + \beta_1 y_{i,t-1} + \cdots + \beta_p y_{i,t-p} + \alpha_0 X_{i,t} + \alpha_1 X_{i,t-1} + \cdots + \alpha_q X_{i,t-q} + \varepsilon_{i,t} \qquad \text{(C-1)}$$

ARDL Model Results

The short run relationship is represented by the differenced variables and a test for a long run relationship among the baseline model variables is carried out on a one period lag of subject variables.

Table C-3: ARDL Model Results

Dependent Variable: D(LNTAX)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.436186	0.107878	4.043326	0.0001
D(LNTAX(-1))	-0.007523	0.034411	-0.218629	0.8270
D(LNTAX(-2))	-0.051159	0.034547	-1.480864	0.1391
D(AGR(-1))	0.002104	0.001245	1.690215	0.0915
D(AGR(-2))	0.000962	0.000986	0.976072	0.3294
D(GDPP(-1))	8.61E-06	2.95E-05	0.291383	0.7709
D(GDPP(-2))	-3.39E-05	2.90E-05	-1.168595	0.2430
D(IND(-1))	0.001898	0.001272	1.492561	0.1360
D(IND(-2))	0.001747	0.001088	1.605453	0.1089
D(TRADE(-1))	-4.22E-05	0.000405	-0.104208	0.9170
D(TRADE(-2))	0.000218	0.000230	0.949488	0.3427
D(GRANTS(-1))	-0.001481	0.000602	-2.458519	0.0142
D(GRANTS(-2))	-0.000279	0.000465	-0.598658	0.5496
D(LOANSNET(-1))	-0.000358	0.000332	-1.077211	0.2818
D(LOANSNET(-2))	-5.52E-05	0.000241	-0.228846	0.8191
LNTAX(-1)	-0.218775	0.026961	-8.114415	0.0000
AGR(-1)	-0.000223	0.001170	-0.190718	0.8488
GDPP(-1)	2.11E-05	7.54E-06	2.797919	0.0053
IND(-1)	0.000842	0.001041	0.808378	0.4192
TRADE(-1)	0.000308	0.000256	1.202056	0.2298
GRANTS(-1)	0.000481	0.000715	0.673114	0.5011
LOANSNET(-1)	-0.000232	0.000345	-0.671721	0.5020

Table C-4: Wald Test Diagnostic

Test Statistic	Value	df	Probability
F-statistic	12.04315	(7, 636)	0.0000
Chi-square	84.30203	7	0.0000

Null Hypothesis: C(16)=C(17)=C(18)=C(19)=C(20)=C(21)=
C(22)=0

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(16)	-0.218775	0.026961
C(17)	-0.000223	0.001170
C(18)	2.11E-05	7.54E-06
C(19)	0.000842	0.001041
C(20)	0.000308	0.000256
C(21)	0.000481	0.000715
C(22)	-0.000232	0.000345

Restrictions are linear in coefficients.

To reject or fail to reject the null hypothesis, we need to compare the F-statistic with the Pesaran critical value at 5 percent level. Since we are using unrestricted intercept with no trend model, the Pesaran table gives 3.79 as the lower bound and the upper bound value is 4.85. The guidelines state that when the F-Statistic is greater than the upper bound, we can reject the null hypothesis. In our case, the F-Statistic is 12.04 which is greater than 4.85, the Pesaran upper bound. This means that we can reject the null hypothesis and choose the alternative. By rejecting the null hypothesis, we are simply saying that, C(15)=C(16)=C(17)=C(18)=C(19)=C(20)=C(21)≠0, jointly. These are the coefficients of log (Tax), Agriculture. GDP per capita, Industry, Trade, Grants and Net loans respectively, which the test argues have long run relationship/association.

We estimate our long-run model and derive the residual to establish the speed adjustment towards long-run equilibrium, since the coefficients of the differenced variables represent the

short run relationship. (Table C-5) shows that the error correction term (ECT (-1)) is negative and statistically significant, which meets the guidelines for determining a system's speed of adjustment towards long run equilibrium. Our system adjusts to long run equilibrium at a speed of80.49%.

Table C-5: Dependent Variable

Dependent Variable: D(LNTAX)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.012982	0.005558	2.335878	0.0198
D(LNTAX(-1))	0.633147	0.205006	3.088427	0.0021
D(LNTAX(-2))	-0.141725	0.038081	-3.721693	0.0002
D(AGR(-1))	0.001669	0.001031	1.618971	0.1060
D(AGR(-2))	-0.000343	0.001240	-0.276775	0.7820
D(GDPP(-1))	-1.18E-05	3.36E-05	-0.352469	0.7246
D(GDPP(-2))	-1.30E-05	3.06E-05	-0.424275	0.6715
D(IND(-1))	0.002030	0.001175	1.726937	0.0847
D(IND(-2))	-0.000419	0.001370	-0.306158	0.7596
D(TRADE(-1))	0.000281	0.000442	0.635317	0.5255
D(TRADE(-2))	0.000358	0.000194	1.842905	0.0658
D(GRANTS(-1))	-0.000852	0.000469	-1.818071	0.0696
D(GRANTS(-2))	0.001053	0.000564	1.869029	0.0621
D(LOANSNET(-1))	-0.000481	0.000208	-2.318001	0.0208
D(LOANSNET(-2))	0.000329	0.000247	1.336456	0.1819
ECT(-1)	-0.804886	0.211017	-3.814318	0.0002

Short Run Causality

Key variables in this study are grants and concessional loans. We are interested in establishing their short run causality, as much as we are interested in their long run causality. We use the Wald test to diagnose coefficients of grants and net loans, with lagged two periods, these are C (12), C (13), C (14), and C (15) respectively, as shown in (Table C-6). According to the tabulated results, we reject the null hypothesis at 1% significance level. We therefore conclude that grants and concessional loans jointly have short run causality on tax revenue (running from grants and loans to taxation revenue). The same test was carried out on other independent variables, and the results (not tabulated) show that there is short run causality running from the independent variables jointly to tax revenue.

Table C-6: Short Run Causality Wald Test

Test Statistic	Value	df	Probability
F-statistic	4.558131	(4, 600)	0.0012
Chi-square	18.23252	4	0.0011

Null Hypothesis: C(12)=C(13)=C(14)=C(15)=0

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(12)	-0.000852	0.000469
C(13)	0.001053	0.000564
C(14)	-0.000481	0.000208
C(15)	0.000329	0.000247

d) Hausman Test

The Hausman test determines whether a Fixed Effects or Random Effects model is more appropriate for our estimation. Fixed Effects assume country heterogeneity, and Random effects assume country homogeneity. The null hypothesis in this test is that a Random Effects model is appropriate, and the alternative hypothesis is that a Fixed Effects model is appropriate. According to the results presented in (Table C-7), the p-value is statistically significant. We reject the null hypothesis and use Fixed Effects model in our estimations.

Table C-7: Fixed Effects vs Random Effects Model

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	27.132921	7	0.0003

Table C-8: Baseline Models: Tax Revenue and Foreign Aid (Comparing RE & FE

Estimation Method	Fixed EGLS	Random EGLS	Fixed Effects 2SLS	Random Effects 2SLS
C	2.611353***	3.122385***	2.891052***	3.580997***
	(0.085667)	(0.169622)	(0.173745)	(0.339498)
AGR	-0.012544***	-0.021623***	-0.0117242***	-0.022612***
	(0.00117)	(0.002514)	(0.001341)	(2.68E-03)
GDPP	2.73E-04***	1.88E-04***	0.000266***	1.56E-04***
	(2.76E-05)	(4.17E-05)	(2.93E-05)	(4.46E-05)
GDPP^2	-2.13E-08***	-1.79E-08***	-2.15E-08***	-1.48E-08***
	(2.23E-09)	(3.46E-09)	(2.36E-09)	(3.84E-09)
IND	-0.007125***	-0.0111***	-0.007006***	-1.22E-02***
	(0.001258)	(0.001784)	(0.001313)	(1.91E-03)
TRADE	0.001817***	0.002359***	0.001904***	0.002481***
	(0.000356)	(0.000629)	(0.000385)	(0.000705)
GRANTS	-0.001253**	-0.002222*	-0.004682***	-0.006715*
	(0.000594)	(0.001298)	(0.001845)	(0.003766)
LOANSNET	-0.000716**	-0.001442**	-0.004713***	-0.005757**
	(0.000346)	(0.000655)	(0.001585)	(0.002541)
R-squared	0.947059	0.216377	0.942383	0.180651

F-statistic	303.3358	32.30657	293.9313	32.52465
Prob(F-statistic)	0	0	0	0
Observations	827	827	794	794
Cross-Sections	40	40	40	40
Periods Included	24	24	23	23

Note: The dependent variable is log of taxation revenue/GDP. All regressors are measured as a percentage of GDP, except GDP per capita. Numbers in parenthesis are robust standard errors. ***, ** and * indicate 1, 5 and 10 percent respectively. Estimation is Two Stage Least Square (2SLS) using country Fixed Effects

In (Table 4-1) we use Fixed Effects and Fixed Effects 2SLS to estimate the two models, and in (Table C-8), we estimate the model by comparing Fixed Effects and Random Effects with Fixed Effects 2SLS and Random 2SLS estimators. To decide on the appropriate model, we carry out the Hausman Test. The null hypothesis prefers a Random Effects over Fixed Effects estimator. In our test, we reject the null hypothesis at 1% and choose the Fixed Effects estimator as the appropriate estimator. This is supported in the literature which states that unobserved country heterogeneity explains the difference in tax revenue across counties. (Table C-8) further supports our test by depicting higher R-squared in Fixed Effects estimator than in Random Effects, i.e., 0.942383 and 0.180651

Appendix D Explanation of Estimation Methods

Fixed Effects

The error term in equation (3-1) contains the unobservable country heterogeneity, and the stochastic disturbance term which is assumed to be independently and identically distributed with a mean of zero and constant variance$(0, \delta_{\mu}^{2})$.

$$\varepsilon_{it} = \alpha_i + \mu_{it} \tag{D-1}$$

Where α_i denotes the unobservable country-specific effect and μ_{it} denotes the stochastic disturbance term.

To further explain how the fixed effect works, we will consider the model below, where X_{it} represents all the explanatory variables of our model in equation (3-1)

$$y_{it=}\alpha + X_{it}\beta + \varepsilon_{it} \tag{D-2}$$

Where $i = 1 \ldots . N$ and $t = 1 \ldots . T$ which are country and time indicators respectively. X_{it} is a time-varying $1 \times K$ regressors matrix which comprises both exogenous and endogenous variables in the model.

Substituting equation (D-1) into equation (D-2) yields the following one-way error component model:

$$y_{it} = \alpha + \alpha_i + + x_{it}\beta + \mu_{it} \tag{D-3}$$

To estimate our model, we employ within transformation, where the unobservable country-specific effects are wiped out after transformation of the model, to use a Fixed Effect estimator which assumes strict exogeneity.

Considering a hypothetical model in equation (D-6), we average over time and obtain:

$$\bar{y} = \alpha + \alpha_i + + \bar{x}_i\beta + \bar{\mu}_i \tag{D-4}$$

Where $\bar{y} = \sum_{t=1}^{T} y_{it}/T$

The transformed model is obtained by subtracting equation (D-4) from equation (D-3) which gives:

$$y_{it} - \bar{y} = \beta(x_{it} - \bar{x}_i) + (\mu_{it} - \bar{\mu}_i) \tag{D-5}$$

Let $\ddot{y}_i = y_i - \bar{y}$, $\ddot{x}_i = x_{it} - \bar{x}_i$ and $\ddot{\mu}_i = \mu_{it} - \bar{\mu}_i$ such that averaging our model across countries, we end up with the following model:

$$\ddot{y} = \alpha + \beta\ddot{x} + \ddot{\mu} \tag{D-6}$$

By restricting $\sum_{i=1}^{N} \alpha_i = 0$

Moreover, equation (D-5) and (D-6) end up without the country-specific effect,$_i$, proving the argument that transforming the data wipes out the effect. In our study, we estimate a

multivariate model specified in equation (3-1) but transformed in the same way as the hypothetical model explained above, by simply time-demeaning each explanatory variable.

Fixed Effects 2sls Estimator

This section explains how instrument variables work, where z_{it} is, $1 \times L$, defines time-varying instrument variables which also contain all the exogenous variables in x_{it} which is $1 \times K$ for all t. For identification conditions, $L \geq K$.

The matrix of explanatory variables X defined over $T \times K$ is given as:

$X = \begin{pmatrix} x_{i1} \\ x_{i2} \\ \vdots \\ x_{it} \end{pmatrix}$ and matrix of instrument variables $Z = \begin{pmatrix} z_{i1} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & z_{it} \end{pmatrix}$

Using a Fixed Effects Instrument Variable estimator, the coefficient is estimated as shown below:

$$\hat{\beta} = \left[\left(\sum_{i=1}^{N} \grave{X}_i Z_i\right)\left(\sum_{i=1}^{N} \grave{Z}_i Z_i\right)^{-1}\left(\sum_{i=1}^{N} Z_i X_i\right)\right]^{-1} \times \left(\sum_{i=1}^{N} \grave{X}_i Z_i\right)\left(\sum_{i=1}^{N} \grave{Z}_i Z_i\right)\left(\sum_{i=1}^{N} \grave{Z}_i y_i\right)$$

The coefficient can also be estimated using Fixed Effects 2SLS by running auxiliary regression—, i.e., running reduced form regressions of X_{it} on Z_{it} to obtain fitted values of X_{it}, $\hat{X}_{it}$, which is termed as the first-stage, and using fitted values, $\hat{X}_{it}$ in place of X_{it} to estimate the values of beta, which is second-stage, therefore combining first-stage and the second- stage (2SLS chooses the fitted values which is highly related with the endogenous variable), estimation of the β is given as;

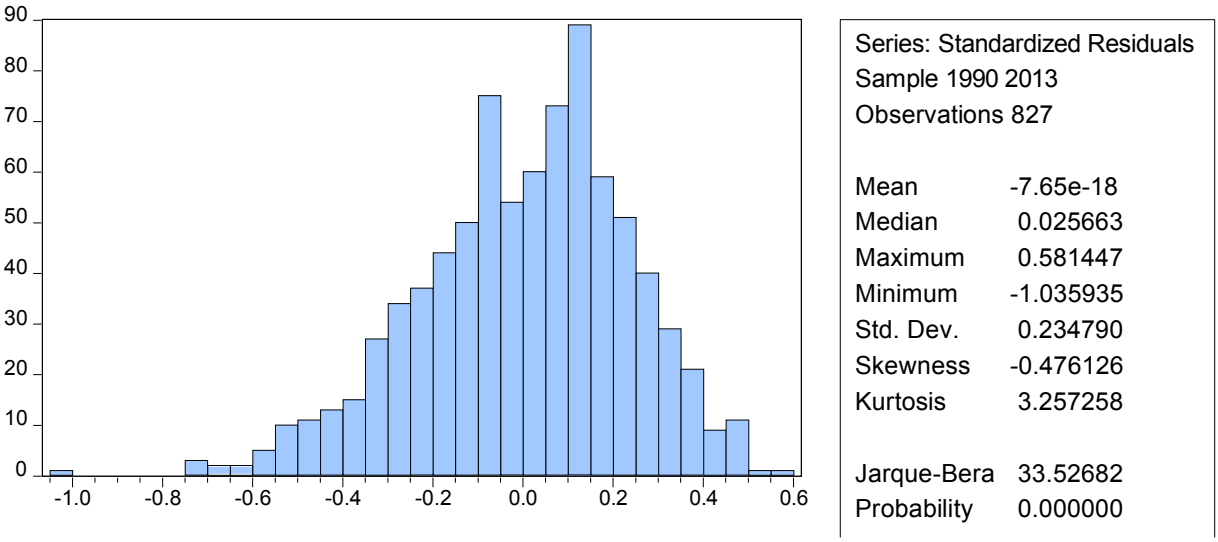
$$\hat{\beta} = \left(\sum_{i=1}^{N}\sum_{t=1}^{T} \hat{X}'_{it} X_{it}\right)^{-1}\left(\sum_{i=1}^{N}\sum_{t=1}^{T} \hat{X}'_{it} y_{it}\right)$$

Appendix E Diagnostic Test

a) Testing Joint Validity Of Fixed Effects

Redundant Fixed Effects Tests		
Test cross-section Fixed Effects		
Effects Test	Statistic	d.f.
Cross-section F	71.58088***	(39,781)

b) Residual Normality Test



c) Residual Stationarity