

Tax Revenue Effort and Aid in Fragile States

The Case of the Comoros

Jose L. Diaz-Sanchez

Abrams Tagem

Joana Mota



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Abstract

This paper assesses the impact of aid on tax revenue effort in the context of a fragile state, using the case of the Comoros. The paper estimates a fiscal response model within a cointegrated vector autoregressive framework with annual data for the Comoros' post-independence period (1984–2017). The data suggest that grants and tax revenue in the Comoros had a significant negative relationship in the long run that remained stable throughout the post-independence period. Grants are a politically less costly source of finance, reducing the urgency of fragile states' fiscal planners to expend their reduced political capital and administrative capacity on tax collection reforms. This effect may be amplified by the large one-off budget support grants, which represent a windfall

of resources to the Comoros from bilateral partners, which often may have stopped tax reform initiatives. Although the paper does not suggest a decrease in aid to fragile states, as aid constitutes an essential support for these countries, being aware of this historically negative relationship is an important step to ensure that the government's tax revenue efforts do not slow down following, for instance, large one-off unconditional budgetary support. In addition, the paper argues that prioritizing conditional aid, focusing on aid effectiveness, and engaging more resources for capacity-building tax revenue projects and technical assistance could increase the impact of donors' interventions.

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Tax Revenue Effort and Aid in Fragile States: The Case of the Comoros

Jose L. Diaz-Sanchez, Abrams Tagem, and Joana Mota¹

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¹ Jose L. Diaz-Sanchez and Joana Mota are, respectively, Economist and Consultant at the Macroeconomic, Trade and Investment Global Practice at the World Bank. Abrams Tagem is a Research Associate with UNU-WIDER. Views expressed in this paper are of the authors' and should not be attributed to the World Bank or its Executive Directors. We thank helpful discussions and comments from Tito Cordella, Mokhtar Benlamine, Cameron McLoughlin, Oliver Morrissey, Ibrahim Ahamada, James Cust, Pierre Jean-Claude Mandon, Mamadou Tanou Balde, Lionel Roger, Raymond Bourdeaux, Idah Z. Pswarayi-Riddihough, Antoissi Said, and Paulo Correa. The authors are also grateful to participants in a seminar at University Paris-Est Créteil and at the African Economic Conference 2020. Questions on the paper may be addressed to Jose L. Diaz-Sanchez at jdiazsanchez@worldbank.org.

1. Introduction

The fiscal impact of aid has become one of the most critical issues related to aid effectiveness (Bwire, Lloyd and Morrissey, 2017; McGillivray and Morrissey, 2004). A sizable portion of aid flows passes through governments' budgets, directly influencing fiscal aggregates such as tax revenue and public expenditure. Hence, any macroeconomic impact of aid is linked to the behavior of the public sector, in particular, how decisions on taxation and expenditure are affected by aid flows (Morrissey, 2015a). Aid can decrease the country's tax effort if it is viewed by recipients as a politically cheaper source of revenue. Conversely, aid can raise tax revenues if it strengthens revenue administration or supports tax policy reform (Morrissey, 2015b; Morrissey and Torrance, 2015; Mascagni and Timmis, 2017). This paper looks at the fiscal impact of aid in the context of a fragile state, focusing on the Comoros.

The response of fiscal policy to the presence of aid is particularly relevant in the context of fragile states (FS hereafter).² FS are more dependent on external financial flows when compared to other developing countries, with the highest share of their aid flows in the form of grants (OECD, 2014; IMF, 2017). Furthermore, FS face structural challenges in expanding and sustaining tax revenue as a percentage of GDP, and their tax administration structures are generally weaker.³ The destruction of infrastructure, the disruption of the administrative and bureaucratic capacity, and the slowdown of economic activity following long periods of political instability narrow the tax revenue base and undermine fiscal discipline (Van den Boogaard et al., 2018; Addison and Murshed, 2001). Long periods of political unrest – in the sense of continuity of regime and institutions – also hinder fiscal reform processes and may interrupt technical assistance projects by development partners (Chowdury and Murshed, 2016). In this context, the political costs of raising taxes are likely to be higher in FS. In the presence of a significant amount of grants (which do not require repayment), weak administration capacity and low accountability to domestic taxpayers, incentives to collect revenues are small.

The Comoros is a suitable case for studying the role of fragility in the dynamics of aid and tax revenues. Tax revenue mobilization in the Comoros was extremely weak during its period of higher political instability (1974-2001) - at an average of 6.5% of GDP - and it has increased only slightly to 8.3% of GDP ever since (IMF, 2018a). Like most FS, the Comoros' revenues from taxes are undiversified, relying mostly on taxes from trade which amount to about two-thirds of total tax revenues (IMF, 2016b, 2018a). The Comoros is also heavily dependent on development assistance, receiving the largest part of its ODA in the form of grants, which constitutes on average 5.4% of GDP (roughly equivalent to the entire wage bill) and represents 35% of total revenues, on average, since 2001. The Comoros' dependence on grants, along with its weak revenue-generating capabilities, is inherently linked to its fragility status. The country has experienced a long period of political and social instability (mostly during its post-independence years from 1974 to 2001) and

² Different definitions of fragility exist in the literature, but most include a social, political and institutional dimension of fragility. The World Bank deems a country to be a FS when any of the following apply: (a) the weakest institutional and policy environment, based on a revised, harmonized Country Policy and Institutional Assessment (CPIA) score for IDA countries is less than 3.0; or (b) it has the presence of a UN peacekeeping operation; or (c) flight across borders of 2,000 or more per 100,000 population, who are internationally regarded as refugees in need of international protection.

³ The tax revenue-to-GDP ratio was on average 15 percent during 2005–2014 compared to 19 percent in non-FS (IMF, 2017).

remains vulnerable to inter-island conflict.⁴ Furthermore, the relationship with donors has not been smooth and uninterrupted, manifested by episodes of low engagement and abandonment of programs and projects of development partners (see Section 2).

The cross-country literature on the impact of aid on tax revenue is rather tenuous, with no consensus view on the direction of effects. The aid-tax revenue relationship at the country level appears, however, to be of more policy significance (Morrissey, 2015a). A study focusing on a country such as the Comoros with a long history of political, social, and institutional fragility can shed light on the unique tax revenue-aid relationship in FS.⁵

In this paper we estimate a fiscal response model (FRM) within a cointegrated vector autoregressive (CVAR) framework to analyze the long-term impact of aid flows on tax revenue mobilization in the Comoros. Fiscal Response Models (FRMs) draw on the seminal work of Heller (1975) and are used to model the dynamic impact of foreign aid on domestic fiscal aggregates. A number of authors have applied the CVAR for country-specific studies: Osei, Morrissey, and Lloyd (2005) use a CVAR for Ghana; Mascagni and Timmis (2017) for Ethiopia; Bwire, Lloyd and Morrissey (2017) for Uganda. While these countries differ in their fiscal and political economy context, the overall results point to a positive link between aid and tax: a result of which may emanate from donors' assistance on fiscal management (e.g., through technical assistance). Furthermore, aid conditionality appears to have been important in supporting both the decision to reform and the nature of tax reforms. Evidence at the cross-country level supports this positive relationship. Crivelli and Gupta (2016) find that conditionality in IMF-programs had a positive impact on tax revenue, in particular, for low-income countries with below-average revenue ratios.

The paper provides insights into the dynamics between grants (the predominant source of aid to FS) and fiscal aggregates, in particular tax revenues, in the context of FS. It contributes to the understanding of how aid interacts with fiscal policies within countries with a history of political, social and institutional fragility, as well as those constrained in their ability to tap into non-concessional financial markets. Our analysis focuses on grants, excluding loans and other aid allocations, because the bulk of aid flows to the Comoros (and FS in general) is in the form of grants. More importantly, we are interested in seeing how the Comoros relates to the existing literature which tends to find that grants reduce tax effort (Gupta et al., 2004; Bräutigam and Knack, 2004 ; and Benedek et al., 2012; among others).⁶ The tax revenue and grant relationship is a more unambiguous result when compared to studies using overall aid, which stems from the stronger reform disincentives associated with the lack of obligations to repay grants.

We find that grants and tax revenue in the Comoros appear to have a negative relationship in the long-run. We argue that this negative relationship is explained by the fact that grants are a politically less costly source of finance, reducing the urgency of Comorian fiscal planners to expend their reduced political capital and administrative capacity on tax collection reforms. We also suggest that this effect is amplified by the large one-off (and often unconditional) budget support grants received by the Comoros from bilateral partners, which have historically stopped tax reform initiatives.

⁴ If the Comoros would improve transparency and government effectiveness, as well as the productivity of low-yielding direct taxes, it could increase tax revenues by about 3 percentage points of GDP according to the country's tax potential (measured as the difference between the tax frontier and the actual tax ratio, see IMF, 2018a).

⁵ See World Bank (2019) for a detailed description of the Comoros fragility.

⁶ This negative effect has been challenged by a few studies using more recent data (Clist and Morrissey, 2011; Morrissey et al., 2014; Carter, 2013).

The paper is structured as follows: Section 2 provides a historical overview of the Comoros' tax revenue mobilization and aid flows; Section 3 introduces the conceptual context of FS and discusses the political costs of taxation; Section 4 summarizes the data; Sections 5 and 6 explain the methodology and the estimation results, respectively. Section 7 presents the concluding remarks.

2. Historical Relationship between Tax Revenues and Aid in the Comoros

The analysis of aid trends and fiscal policy in the Comoros is inherently linked to the country's political developments. The tight budgetary envelope and the inter-island disputes over the control of public finances are at the heart of the Comoros' political tension, while the reliance on external aid is a challenge for the pursuit of structural reforms. In light of the Comoros' political developments over the past 45 years, we distinguish three periods of the country's aid and domestic revenue trajectories. The first period starts after the Comoros gained independence from France in 1975 and continues until the adoption of the new constitution in 2001. This time frame is characterized by high political instability, low revenue mobilization, and a fast build-up of foreign debt. During the first 25 years of independence, grants were significantly above revenue from taxes, only decreasing towards the end of the 1990s. In the second period, from 2002 to 2007, the Comoros engaged in a lengthy process of political and fiscal decentralization. External grants reached a minimum low, and authorities were pressured to increase domestic revenues. From 2008 and up to the end of our sample period, the economy benefited from a more stable political environment. Political stability set the ground for the uptake of international aid, while revenue mobilization remained weak.

2.1. *Political Instability: 1975-2001*

During the first two decades of independence, public finances were permanently under pressure due to a narrow revenue base - exacerbated by extensive tax exemptions and evasion - and to a steady expansion of current expenditures. In this period, the Comoros turned to France and other donors, including those in the Gulf region, for financial aid. From 1984 up until the secessionist crisis in 1994, grants represented 10.2% of GDP, on average, 3.7 percentage points (p.p) higher than tax revenues (see Figure 1). In addition to grants, the Comoros also turned to concessional and non-concessional borrowing to finance its oversized civil service and capital-intensive projects which soon resulted in a large and rising external debt. Over this time frame, France prevailed as the Comoros' key bilateral donor and its leading supplier of budgetary grants: the latter representing the bulk of the Comoros's external aid, while concessional financing was relatively low.

Tax revenue mobilization fluctuated widely and remained at a low level throughout all periods, averaging 6% of GDP. The overall poor performance in mobilizing revenues reflected weaknesses in tax administration, particularly for taxes on international trade, which generally accounted for two-thirds of the Comoros's domestic revenues. Tax exemptions and the accumulation of tax arrears incurred by public companies were also a recurring issue. Following the advice of multilateral partners, the Comorian authorities began to adopt tax reforms in the early 1990s, but the overall outcome fell short of expectations. With budgetary grants still relatively high, the Comoros's efforts in raising domestic revenues remained insufficient, characterized by long delays and important slippages in the implementation of reforms.

The poor track record of the government's commitment to implement projects and reforms along with the persistent accumulation of foreign external payment arrears led to the collapse of aid

inflows in the mid-1990s. The decline of international support was further exacerbated by the concurrent escalation of interisland conflict. Grants decreased to 4.2% of GDP during 1995-2001, about 6 p.p below the pre-conflict average. Despite tax raises and measures to strengthen tax administration, domestic revenues also started a downward trend, partly due to the difficulty to track tax revenues collected in Anjouan and Mohéli. As a result, tax revenues decreased from an average of 7.5% of GDP during the pre-conflict period to 5.2% of GDP in 2000.

2.2 Transition: 2002-2007

Right after the new constitution was adopted, the Comoros welcomed the reestablishment of multilateral technical assistance, but budgetary grants remained low.⁷ In 2001, the government requested the IMF to monitor its economic and financial program. Despite continued assistance through technical assistance programs, the progress on the implementation of structural reforms was slow and hampered by political tension and civil strife. Grants continued in a downward trend (reaching a minimum low of 1.3% of GDP in 2003) and only recovering by 2007.

After a significant rise of tax revenues in the early 2000s to 8.2% of GDP – possibly reflecting the lift of the trade embargo and higher domestic demand in Anjouan – revenues fell back again to its historically low level. Tax revenue collection was also affected by several episodes of non-implementation of the revenue-sharing agreement. This was the case during the run-up to the 2006 elections, with revenues falling 17% short of the ongoing IMF monitoring program’s target. Furthermore, while the authorities pointed to their efforts to reduce tariffs and liberalize trade gradually, little progress was achieved in decreasing the Comoros’ high dependence on import taxes. With limited external financing available and a high wage bill, the government introduced a number of customs duties and surtaxes on imports to counterweight limited revenue resources.

2.3 Reconciliation: 2008-2019

From 2008 onwards, the Comoros started to finally benefit from a smoother political environment and consequently, international support gained momentum. Development partners re-engaged their activities in the Comoros through both projects and budget support. Budget support from multilateral partners (in particular) was conditional on the satisfactory performance on fiscal management and domestic revenue targets, which guaranteed the continuation of structural reforms. The Comoros also benefited from a revenue mobilization capacity building project that included training and technical support. Furthermore, the progress in consolidating macroeconomic stability enabled the Comoros to complete the HIPC Initiative and benefit from extensive irrevocable debt relief in 2013 (although mostly through rescheduling of debt payments).

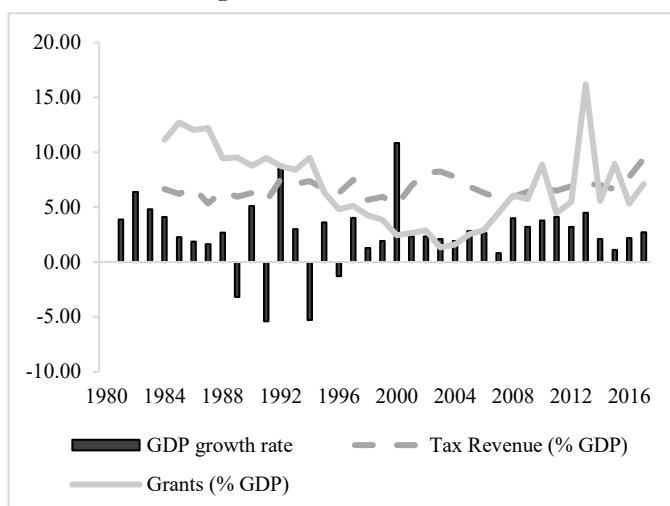
During the same period, there was a surge of donor interest from the Gulf region. Over \$90 million (or 7.5% of GDP) in one-off budget grants were disbursed up to 2017, earmarked primarily for the repayment of domestic arrears and civil service wage arrears. Saudi Arabia, in particular, provided over \$60 million in one-off budget grants to pay government salaries and finance other expenses. This includes a budget grant in December 2015 of \$45 million equivalent to about 80% of the wage bill for that year. Furthermore, from 2010 to 2012, the government more than doubled revenues from non-tax sources thanks to the “economic citizenship program”, which involved the sale of Comorian citizenship and passports mostly to Saudi Arabia and Kuwait.

⁷ A national reconciliation agreement in 2001—the Fomboni Agreement—introduced the *tournante* system of a rotating presidency between the islands, which has helped to pave the way for successive peaceful and democratic handovers since 2002.

With increased support from bilateral donors, the commitment to financial assistance programs with development partners has been mixed. In 2015, the government sought to obtain a disbursement under the IMF’s Rapid Credit Facility (RCF). However, this was later withdrawn following a large Saudi budget grant. After the completion of a World Bank budget support program in 2015, a follow-up program was dropped in part because of the aforementioned reason (the program was officially dropped in 2018). A six-month IMF Staff Monitored Program was also signed in November 2016, but neither of the reviews could be completed. The government later suspended the program unilaterally.

Even though the authorities implemented a number of tax reforms in recent years, tax revenue collection continued to lag expectations and remained at its historically low level for most of the third period. Only since 2016 have tax reforms started to bear fruit with tax revenues reaching 7.8% of GDP.⁸ Nonetheless, the Comoros’s fiscal vulnerabilities remained. Weak revenue administration coupled with a low level of formal economic activity continued to restrict the revenue base and contributed to the persistent weak domestic revenue performance. Despite continued technical support from multilateral donors, the Comoros has not yet been able to raise tax revenues sufficiently to be less dependent on external grants for fiscal equilibrium.

Figure 1. Historical evolution of grants and tax revenues for the Comoros (% of GDP)



Source: IMF’s GFS database

3. Conceptual Context: Fragile States and the Political Costs of Taxation

3.1 Characteristics of Comorian Fragility

The Comoros is a peculiar case for considering the role of fragility in permeating the impact of aid on revenue mobilization. First, episodic conflicts in the Comoros are largely small-scale and sub-national, stemming from the strained relationship that exists between the three islands and the national government. The causes of Comorian conflict are consistent with the literature on sub-national conflict (World Bank, 2016; Parks, Colletta and Oppenheim, 2013) including: (i) perceptions of state illegitimacy and/or unwillingness to address socioeconomic issues. For example, deprivation, inequality, non-monetary poverty and uneven provision of services across islands exist (World Bank, 2019), and that could drive political instability. (ii) Regional, ideological and ethnic-related conflict, including various secession attempts from some islands (such as from

⁸ Recent reforms were focused in the customs administration, notably in improving customs valuation procedures and reducing customs exemptions.

Anjouan and Mohéli in 1997, and Anjouan in 2007). (iii) Eroded government legitimacy (e.g., endemic corruption and impunity of state personnel). Sub-national conflict in the Comoros has historically eroded the capacity of the union government to collect the optimal level of tax revenue since some indignant islands did not fully report tax revenue collected.

Second, the country experiences acute revenue-raising challenges which are exacerbated by the Comoros' weak tax administration (IMF, 2016a, 2018b) and large one-off revenues. IMF (2018a) compares the Comoros to other small states,⁹ with the average tax/GDP ratio and revenue structure composition in the former lower than the average tax/GDP ratio of all other small states except Timor-Leste. While external factors (e.g. commodity price shocks) usually strongly influence tax revenue mobilization and exacerbate tax volatility in other developing countries, such factors are relatively small in the Comoros. Tax revenue performance and volatility in the Comoros stem from their dependence on one-off sources of income: for example in recent years, the aforementioned one-off large budget support grants mostly coming from Saudi Arabia in 2015 and 2017, the HIPC debt relief in 2013; and revenues obtained from the sale of the telecommunications license in 2015. Reliance on these one-off flows erodes budget credibility as they are too unpredictable to be used for budgetary planning (i.e. implementing reforms that should help boost revenue performance) and/or result in fiscal vulnerability in the recipient country. Alternatively, dependence on one-off unstable flows may underpin ambitious reforms to strengthen revenue mobilization and support transitions from aid dependence to tax reliance.

3.2 Evaluating the Political Costs of Taxation

In the context of developing countries, political economy circumstances, in addition to other well documented factors (e.g., narrow tax base, low tax revenue diversification, and weak revenue administration) play a role in explaining poor domestic revenue mobilization (Prichard et al., 2012). Developing countries may be taxing as much as is economically and politically feasible, which may not be enough to generate economic gains. The political economy literature argues that increasing taxes is unpopular and agents do not like paying taxes (especially in developing countries where agents do not get good public service in return) so much administrative and political effort is expended on tax collection (Morrissey, 2015b; Morrissey, 2013; Morrissey and Torrance, 2015). Such interactions between agents paying taxes (household and firms) and those in charge of the collection (the government) point to political costs of tax collection. These political costs are assessed according to accountability, autonomy and bureaucratic costs of taxation.

The costs of accountability refer to whom and the extent to which a government must account for its uses of revenue, and the costs are likely to be higher for aid than taxes (Morrissey, 2015b). Donor agencies have to account to their governments on how their aid is used so they implement strong monitoring mechanisms to minimize fungibility. These often come with conditions attached, and recipients have to expend effort in trying to comply with them. The costs of autonomy are reflected in a country's (in)ability to make independent policy choices since aid-dependent governments cede some policy influence on donors and lose leverage in negotiating on policy conditionality (Morrissey and Torrance, 2015). In addition, there are bureaucratic costs of tax and aid. The former relates to the costs of tax administration while the latter, which is a function of the number of donors, refers to the costs of organizing, and attending meetings with different donor agencies. The bureaucratic costs of aid are still high, and this is exacerbated by donor proliferation, disbursement heterogeneity, and the changing requirements on monitoring aid.¹⁰

⁹ It is important to point out that these comparator countries are fundamentally different in terms of the level of economic development, economic structure, political development and resilience to economic shocks.

¹⁰ Knack and Rahman (2007) discuss the short-term and long-term costs of donor fragmentation: the former relating to unnecessary waste of resources and duplication of country analytic work (such public expenditure reviews and

3.3 *Fiscal Response*

Interest in modeling the dynamic impact of foreign aid on domestic fiscal policy has gained prominence in the development literature. These studies are referred to as Fiscal Response Models (FRMs), and they draw heavily on the seminal work of Heller (1975). The underlying intuition for estimating fiscal response models is public sector decision makers maximizing utility given budget and, time constraints. The decision-makers are assumed to be rational and possess homothetic preferences, but there is dissension on the precise form the utility function should take (Lloyd et al., 2009). Consequently, FRMs adopt a perfectly symmetric loss function in which overshooting and undershooting targets result in equal losses in utility. This is unrealistic given the nature of expenditure and revenue targets implies that undershooting revenue targets (especially in social sector spending) may be more detrimental than overshooting it (Gang and Khan, 1999).¹¹

The FRMs, though important in charting a path for the eventual cross-country and country-specific research on the fiscal effects of aid are fraught with limitations relating to data; the nature of the recipient government's utility function (Feeny, 2006; Feeny and McGillivray, 2010); theory and empirical estimation of revenue and expenditure targets (Feeny and McGillivray, 2010; Franco-Rodriguez et al., 1998); econometric techniques yielding inconsistent results (McGillivray and Morrissey, 2004), and the inherently static nature of FRMs (Lloyd et al., 2009; Morrissey, 2015a).

The primary econometric innovation in estimating FRMs has been the adoption of the Cointegrated Vector Autoregressive (CVAR) approach, which has more advantages than the three-stage least squares (3SLS) adopted in earlier FRMs. The CVAR adequately captures the Data Generating Process (DGP): that is, it easily encapsulates the budget process and how aid permeates into the process. The benefits of the CVAR and how it relates to pristine FRMs are two-fold. First, the method allows for dynamic interactions across variables over time, allowing for a distinction between long-run (equilibrium) and short-run (adjustment to equilibrium) dynamics between foreign aid and domestic fiscal aggregates; a re-parameterization coined the Vector Error Correction Mechanism (VECM). Instead of specifying individual equations which depict structural relationships between variables, all equations (long-run and short-run) are encompassed in one common framework.

Second, the CVAR does not impose exogeneity of aid and it treats all other fiscal variables as potentially endogenous, with each variable explained by its own lags and lags of other variables. Additionally, the error correction term and the long-run coefficients are important in determining the exogeneity status of aid and other fiscal variables. Another particularly important feature of the CVAR is that it is an atheoretical approach, but economic theory is often invoked to choose the variables to include in the analysis, select the appropriate normalization and interpret the results (Osei et al., 2005).¹²

poverty assessment reports), resulting in high transaction costs. The longer-term costs undermine the quality of governance in already weak administrations characterizing developing countries; for example, the use of expatriates instead building domestic capacity through 'learning by doing', and funding investment projects with high recurrent costs in future years.

¹¹ Feeny (2006) proposes a utility function that allows for asymmetries and shows that incorporating those asymmetries has no major econometric implications given that the reduced form and structural equations are similar to those derived from perfect symmetry.

¹² Discussions and surveys of the literature on the country-specific fiscal effects of aid using the CVAR methodology include Osei et al., (2005) for Ghana; Morrissey, M'Amanja and Lloyd (2007) for Kenya; Martins (2010) and Mascagni and Timmis (2017) for Ethiopia; Bwire et al., (2017) for Uganda.

Below we provide a conceptual framework for the dynamics between foreign aid, taxes, spending and borrowing; based on a government budget identity¹³ which could form the basis for testing hypotheses.

In the underlying budget identity, all revenues and borrowing must equal total expenditures:

$$\text{Domestic Revenue} + \text{Aid} + \text{Borrowing} = \text{Expenditures} \quad (1)$$

Where revenue includes tax and non-tax revenues, borrowing includes domestic and foreign borrowing (excluding concessional loans from bilateral and multilateral donors), aid includes grants and concessional loans while expenditures consist of government capital and recurrent expenditures. Equation (1) is based on the underlying accounting identity, which is not predictive of the effects aid might have on domestic fiscal variables. Aid is posited to affect domestic fiscal variables in a manner that can only be determined empirically (Lloyd et al., 2009).

First, aid can influence tax revenue: a negative relationship plausible when aid (especially grants), viewed by recipient countries as a politically cheaper source of revenue crowds out domestic taxation; and a positive relationship plausible when aid strengthens revenue administration or supports tax policy reform through technical assistance, projects, and budget support. Recent cross-country and country-specific research on the impact of aid on taxation provides insights to show how donors can support increasing tax revenue rather than allowing aid to substitute for domestic effort (Tagem, 2017; Clist and Morrissey, 2011; Clist, 2016; Mascagni and Timmis, 2017; Bwire et al., 2017). This is through behavioral effects, gauged by the political costs of aid and tax which offset each other (Morrissey and Torrance, 2015; Morrissey, 2015b; Tagem, 2017); the positive impact of transfers of ideas and practices through technical assistance and projects for capacity building (Tagem, 2017; Goldsmith, 2001); and the stability of donor-recipient relations which manifests itself in the stability of foreign aid flows (Tagem, 2017).¹⁴

Second, aid should have a direct financing impact on the level and composition of government spending (Morrissey, 2015a). Aid can also have an indirect impact on spending through donors' policy conditions. Third, due to acute data limitations in the literature domestic borrowing is usually treated as a residual and at most used for short-term adjustment. This is true for countries with little domestic borrowing (such as the Comoros) and other FS. Nonetheless, aid is also expected to influence domestic borrowing. Aid reduces borrowing when donor conditionality (typically IMF and World Bank) is fully applied (Osei et al., 2005; McGillivray and Morrissey, 2004); by increasing the capacity to service debt thus increasing borrowing (Ouattara, 2006); and by being substituted for borrowing in situations whereby dips in aid result in increased borrowing as governments seek alternative sources of finance for statutory expenditures.

4. Data

We rely on annual data from the IMF's Government Finance Statistics (GFS) database covering the period 1984 – 2017 in millions of Comorian Franc (KMF).¹⁵ For the empirical analysis pursued, the variables are treated in levels. The advantages of using national data to estimate the fiscal effects of aid are well documented (see *inter alia* Mascagni and Timmis, 2017; Dom and Roger, 2020). These include national data being the one used for government decision-making, representing

¹³ The fiscal effects of aid estimated from equation (1) can move in different directions as discussed above; with each possible fiscal effect discussed in detail in different strands of the public finance literature.

¹⁴ Aid commitments are known in advance since donors publicize their aid budgets. When actual disbursements differ from commitments, as is usually the case, it may be a result of macroeconomic uncertainty (such as the consequences of the 2008 financial crisis); fractious and tenuous relationships between donors and recipients (such as between the Comoros and the Islamic Republic of Iran); and instability resulting from pressures in the donor countries and organizations.

¹⁵ Note that the Comoros became independent in 1975, but no data are available for the first 8 years of independence.

what flows through the government's accounts; the absence of conversions to meet international standards. Nonetheless, given the paucity of quality fiscal data in the Comoros, as in most fragile or conflict-afflicted states (FCVs), we make recourse to international data. The data include grants, government spending (including capital and recurrent spending) and tax revenue. Non-tax revenue is excluded due to its windfall nature: i.e. they represent unsustainable one-off revenues such as from the Economic Citizenship program (which culminated in substantial non-tax revenues in 2013) and the sale of the telecommunications license in 2015 (IMF, 2018a).

Focus is on external grants, instead of concessional loans or total aid because grants constitute the bulk of international aid flows to the Comoros. Due to the country's historical fragility and level of development, concessional loans have not been disbursed with any regularity or in any significant amount.¹⁶ Total aid is expansive and has many constituent parts (grants, concessional loans, technical assistance and capital subscriptions) which may or may not have an impact on domestic revenue mobilization. Furthermore, aid for domestic resource mobilization (DRM) - from the OECD Creditor Reporting System (CRS) database - has only been available for the recent past, making it unsuitable for the kind of time series analysis we aim to pursue. In the case of the Comoros, such data are simply unavailable. Grants are, therefore, the best proxy for aid which flows through recipient's budgets and are expected to elicit a behavioral fiscal response.

It is also noteworthy that we exclude all forms of domestic borrowing from the analysis. We omit domestic borrowing, so we do not end up estimating a budget identity. Furthermore, there are no reliable data on domestic borrowing for the Comoros and, given the country's level of development and fragility, fiscal planners barely have access to domestic capital markets, so domestic borrowing is small (although it has been slowly increasing in recent years).

5. Cointegrated VAR (CVAR) Model

We estimate an FRM within a cointegrated vector autoregressive (CVAR) framework. The CVAR postulates that there is a relationship between fiscal variables in the system and it allows the data to reveal the kind of relationship. The econometric notions of long-run and short-run effects are intuitive when considering the impact of grants on domestic fiscal variables. Grants can either play a long-term financing and budgetary role or merely relax the budget constraint (short-term impact). This economic distinction relates to the econometric notions of stationarity: when grants are nonstationary and at most integrated of order 1, it would imply recipients directly incorporate the level of grants into their budget (plausible given that aid commitments are known some time in advance) and grants form part of the long-run cointegrating relationship (Bwire et al., 2017; Lloyd et al., 2009). Alternatively, if grants are stationary, then their impact on other fiscal variables is limited to the short-run, relaxing the budget constraint (probably by substituting for borrowing in concessional markets or from private, non-concessional markets). Furthermore, the exogeneity or endogeneity of grants affects its fiscal impact on the other domestic variables.

Consider an unrestricted 3-dimensional VAR (p) model, of lag length p :

$$Z_t = \varphi_1 Z_{t-1} + \varphi_2 Z_{t-2} + \dots + \varphi_p Z_{t-p} + \theta W_t + \varepsilon_t \quad (2)$$

Where Z_t is a ($n \times 1$) vector of jointly determined nonstationary variables, W_t is a ($q \times 1$) vector of q deterministic variables (the constant term, linear trend, dummies and other regressors which are considered fixed and non-stochastic), φ_i ($i=1, 2, \dots, p$) and θ are ($n \times n$) and ($n \times q$) matrices of coefficients to be estimated using a ($t=1, 2, \dots, T$) sample of data. ε_t is a ($n \times 1$) vector of Gaussian errors which are identically and independently distributed. Provided the variables are integrated of order one (I(1)) and cointegrated, equation (2) also has an unrestricted error correction term in

¹⁶ Also note that the country has contracted a very few non-concessional loans in its all history.

equilibrium, observationally equivalent to the VAR in equation 2 but easing estimation and hypothesis testing as all terms become stationary. The re-parameterization is given by:

$$\Delta Z_t = \alpha \beta' Z_{t-1} + \sum_{i=1}^{p-1} \Omega_i \Delta Z_{t-i} + \theta W_t + \varepsilon_t \quad (3)$$

Where ε_t are independent and identical error terms and $(\alpha, \beta, \Omega_1, \dots, \Omega_{p-1}, \theta)$ are freely varying parameters. The ECM above is designed to differentiate between $n - r$ pushing factors: i.e. influences that move equilibria, creating stochastic trends and r pulling factors: influences that correct deviations from equilibrium, giving rise to long-run relations (Juselius, Møller and Tarp, 2014; Hoover et al., 2008). Interest in this study is on the pulling factors.

Interpretation of the coefficients of the re-parameterization is critical: the levels effect is summarized in the matrix $\alpha \beta'$ while short-term dynamics are summarized in $\Omega_1, \dots, \Omega_{k-1}$. The columns of β' represent the cointegrating vectors that quantify the equilibrium (long-run) relations between grants and other fiscal variables in the system while the coefficients α indicate the speed of adjustment to equilibrium, following a shock. The coefficients in the Ω_i matrices allow for short-run adjustments between variables, allowing for differences in long-run, short-run and error correcting dynamics. If cointegration tests determine one cointegrating relationship in the data, this relationship can be viewed as a statistical analogue of the budgetary equilibrium among other core fiscal variables, as predicted by fiscal response theory (McGillivray and Morrissey, 2004). The identification of the long-run relation becomes relatively direct if there exists a single long-run relationship.

Assuming this one cointegrating relationship r , a vector of linear trends restricted to lie in the cointegrating space ($\alpha \beta' t$), and an unrestricted constant, the CVAR takes the form:

$$\begin{bmatrix} \Delta tax_t \\ \Delta grants_t \\ \Delta spending_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{bmatrix} \begin{bmatrix} \beta_1' tax_{t-1} \\ \beta_2' grants_{t-1} \\ \beta_3' spending_{t-1} \end{bmatrix} + \begin{bmatrix} \Omega_1 \Delta tax_{t-1} \\ \Omega_2 \Delta grants_{t-1} \\ \Omega_3 \Delta spending_{t-1} \end{bmatrix} + \theta W_t + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix} \quad (4)$$

Representing equation (4) in a way that allows testing hypotheses, causality between variables and normalizing on tax revenue, we get:

$$\beta_1 tax + \beta_2 grants + \beta_3 spending = 0 \quad (5)$$

The above equation can be normalized on the tax revenue variable such that setting $\beta_1 = -1$ yields:

$$tax = \beta_2 grants + \beta_3 spending \quad (6)$$

Given that the CVAR describes only the long-run response to a *ceteris paribus* change in each of the variables, there is interest in deciphering the causal links between grants and other variables in the system. Thus, the paper will focus on some long-run parameter restrictions to provide empirical grounding for the structural analysis underlying the causal links between grants and domestic fiscal variables. These include:

- The long-run exclusion test, evaluated by placing restrictions on β , following the null hypothesis that $\beta_i = 0$. If accepted, it would mean that the variable is superfluous to the long-run relation and so it can, at most, have a short-run impact. The test is evaluated by restricting the β coefficient of interest to zero, while the other β coefficients are left unrestricted.

- The long-run weak exogeneity test, that is, a zero row in α restrictions. The test indicates which fiscal aggregates adjust to restore budgetary equilibrium in light of disequilibrium. The restriction is evaluated as $H_0: \alpha_i = \mathbf{0}$ (Johansen (1996)), where, if accepted, would insinuate that the variable impacts on the long-run path of other variables of the system, while simultaneously the weakly exogenous variable is not influenced by the other variables in the system. This would imply that the variable is long-run forcing (Lloyd et al., 2009). The test is evaluated by placing a restriction on the α coefficient of interest, while the other α coefficients are left unrestricted.
- The revenue displacement test. As mentioned in Section 3, the impact of aid (grants in particular) on taxes may be in opposite directions. There may be positive effects through the influence of technical assistance, revenue-related donor conditionality or through increased efficiency in revenue collection. There are also legitimate concerns that aid grants can discourage tax revenue collection through negative behavioral effects if recipients view grants as a politically less costly source of revenue. Thus, to test the hypothesis that aid displaces tax revenue we leave other β coefficients unrestricted and test that the β coefficients for grants and revenue (β_1 and β_2) are equal and of opposite sign.

6. Results

6.1 Order of Integration

As a precursor to estimating FRMs it is important to evaluate the order of integration of the variable series. As mentioned in Section 5, grants can play a dual role of influencing the long-run budgetary equilibrium (i.e., when it is I(1)) and also relaxing the budget constraint (i.e., I(0) and restricting the impact to the short-run). We apply the ADF test, described in the appendix, and cannot reject nonstationary in levels for our three main variables (tax revenue, grants and government spending) at conventional levels of significance, while the first differenced series of all the variables are stationary. Non-stationarity in levels implies the variables can form a cointegrating relationship, i.e., a budgetary equilibrium between grants and domestic fiscal variables.

6.2 Model Specification

Fitting the cointegrating VECM entails specifying the number of lags (to capture the full dynamics) to be included, the latter of which is determined by minimizing information criteria. The Schwarz and Hannan-Quinn information criteria suggest $p=1$, the Akaike information criterion suggests $p=2$ while the likelihood-ratio (LR) test suggests $p=4$. Going by the information criteria, the appropriate lag-length will be $p=1$, which implies the fiscal response model reduces to one with the long-run only. However, grants might also have a short-run impact (in addition to the long-run impact if the appropriate lag length is indeed one) in relaxing the budget constraint, making $p=1$ unrealistic. Alternatively, including $p=4$ is also unrealistic given that the impact of grants elicits quick adjustment dynamics in the domestic fiscal variables. This points to $p=2$ being the most preferable choice, also consistent with the standard lag-length used in estimating FRMs in the literature.

Having correctly specified the data generating process, focus shifts to determining the cointegration rank r ; the number of cointegrating relationships in the data. This corresponds to the r pulling factors and $p - r$ pushing factors discussed in Section 5. We test for cointegration following the Johansen (1988) test procedure: the trace test procedure.

6.3 Long-Run Estimates of the Baseline Model

The long-run results in Table 1 demonstrate that grants and tax revenue have a negative relationship. It is also evident that an increase in grants has a smaller effect in reducing tax revenue than an increase in tax revenue will have in reducing grants (similar to the findings in Bwire et al., 2017), consistent with the need for grants reducing as domestic revenue increases. In view of these results, there are several reasons that could explain this negative relationship.

First, aid in the form of grants (implying no obligation of repayment) may be viewed as a politically less costly source of finance than domestic revenues, reducing the fiscal planners' urgency to expend political and administrative effort on tax collection. The evidence suggests that in the Comoros, the political costs of taxation may exceed the political costs of aid, evaluated according to accountability and bureaucratic costs. Accountability to domestic taxpayers is typically low in weak administrations, especially in FS (see Section 3). In the Comorian context it is exacerbated by the strained relationship between the three islands and the national government, resulting in the national government not collecting as much in tax revenue (or total revenue) as is optimal. Factoring in the structural difficulties impinging on developing countries' ability to raise revenue, it becomes clear that grants are politically less costly to manage. While fiscal planners will have to account to the multiple donors on how their grants are being used, for the Comoros, as for other FS, there are not too many alternative financing options available (OECD, 2014). FS are generally constrained in their abilities to attract Foreign Direct Investment (FDI) as well as non-concessional finance and have inherent difficulties in using remittances beyond financing household expenditures. Furthermore, in the case of the Comoros, even in the aftermath of the *tournante* (2016)¹⁷ and the ensuing relative political stability,¹⁸ the national government struggles for legitimacy and the government's extractive capacity is limited by the unavailability of easy tax handles.

Table 1: Estimates of the long-run relationship between variables

| Annual Data (1984 – 2017, N=34) | | | | |
|--|-------------|---------------|---------------------|---------|
| Coefficients of Co-integrating relationship (β') | | | | |
| | Tax Revenue | Grants | Government Spending | TREND |
| | 1.000 | -0.501*** | 0.800*** | 58.850 |
| | (na) | (-5.27) | (7.09) | (0.54) |
| | -1.996*** | 1.000 | 1.596*** | 117.442 |
| | (-3.31) | (na) | (8.14) | (0.35) |
| | 1.250*** | 0.626*** | 1.000 | -73.574 |
| | (4.22) | (7.71) | (na) | (0.34) |
| Adjustment coefficients (α) | | | | |
| | -0.311** | -1.656** | 0.359 | |
| | (-2.13) | (-2.53) | (1.34) | |
| Test for long-run exclusion | | | | |
| | 15.87 | 19.45 [0.000] | 19.06 [0.000] | |
| | [0.000] | | | |
| Test for weak exogeneity | | | | |

¹⁷ A national reconciliation agreement in 2001—the Fomboni Agreement—introduced the “*tournante*” system of a rotating presidency between the islands.

¹⁸ Since the introduction of the *tournante* system under the 2001 Constitution, the Comoros has experienced three relatively smooth transitions of presidential power.

| | | | |
|-----------------------------|------------------|---------------|---------------|
| | 4.027 [0.045] | 6.267 [0.000] | 1.700 [0.192] |
| Revenue displacement | | | 17.83 [0.000] |

Notes: (i) The rows of cointegrating relationships (β') represent alternative normalizations of the one cointegrating relationship and t-ratios are in parentheses. The adjustment coefficients (α) are estimated based on normalization of tax revenue *, **, *** represent significance at 10%, 5% and 1% respectively. (ii) Null hypothesis for long-run exclusion: the variable can be excluded from the cointegrating relations; $\chi^2(n)$ distribution; p-values indicating at which level the null can be rejected. (iii) The null hypothesis for weak exogeneity of the variable to the cointegrating relationship is the variable being weakly exogenous. An $\chi^2(n)$ distribution with p-values indicating at which level the null can be rejected.

The bureaucratic costs of taxation refer to the costs of tax administration, and although reforms to tax administration have been implemented over the years, the revenue (tax and customs) administration in the Comoros is still weak (IMF, 2016a, 2018b; World Bank, 2019). The bureaucratic costs of aid, a function of the number of donors involved in the country is also high. Overall, the political calculus demonstrates that the political costs of taxes are higher than those of aid. Moreover, accountability and bureaucratic costs of taxation should be even higher in the presence of one-off (and often unconditional) grants. Historically, large one-off budget support in the Comoros, has slow downed or even stopped reform processes, including tax reforms, as it happened with the 2015 and 2016 IMF programs (see Section 2).

Another possible explanation of the negative relationship between grants and tax revenue could be related to the reduced number of donor budget support and projects targeting revenue collection and fiscal capacity. A limited number of budget support programs from multilateral organizations have focused, even if partially, on tax revenue reforms, while only a few donors' projects have focused on governance improvements, including on tax administration capacity, albeit with mixed results (see Section 2).¹⁹

The results discussed in Table 1 are *ceteris paribus*, partial equilibrium estimates which cannot describe causal links between domestic fiscal variables. The long-run parameter restrictions (see section 5) provide empirical grounding of the causal links between fiscal variables of interest. The long-run exclusion test demonstrates that all variables enter the system cointegrating space, with the variables having a long-run fiscal impact on themselves. This implies that grants are indeed necessary for the long-run relations and play a significant role in the fiscal equilibrium: unsurprising since grants form part of the domestic revenue package and are directly incorporated into the budget. Tax revenue also enters the system cointegrating space, suggesting that tax revenue has a significant long-run impact on other fiscal variables in the system. Spending is also important for the fiscal equilibrium given budgetary decisions are typically made with spending as the dependent variable: i.e. given the level of spending the government decides to embark on, fiscal planners have to raise revenue (through taxes, non-taxes, grants and borrowing) to cover those expenditures.

Long-run weak exogeneity is rejected for tax revenue and grants (both are endogenous) but accepted for spending, which tells us that both taxes and grants adjust to disequilibrium (Bwire et al., 2017; Mascagni and Timmis, 2017). Endogeneity of taxes is at odds with the statutory nature of tax systems in developing countries. While tax systems are often statutory, and the behavior of policy makers and tax administrations displays considerable inertia (Morrissey and Torrance, 2015), in the Comoros, on the other hand, the tax system is dominated by customs receipts, which is a

¹⁹ A considerable amount of budget support grants is used to finance wages and salaries (IMF, 2018a), further eroding the government's extractive capacity and undermining incentives to mobilize revenue through taxes.

component of the revenue system that can easily adjust contemporaneously (IMF, 2018a). This behavior of taxes is consistent with taxes adjusting in response to donor variability in aid disbursement, i.e. aid uncertainty (Lensink and Morrissey, 2000) and unanticipated changes in spending. Grants are also found to be endogenous, reaffirming the results from the long-run exclusion test. The result on grants is consistent with stable donor-recipient relations where Comorian fiscal planners have a target revenue for grants from their main bilateral and multilateral partners (aid commitments are typically known in advance) and they incorporate this level into fiscal planning. Furthermore, it shows that grants adjust to fiscal conditions in the Comoros; evident from episodes of large one-off budget support grants being used to settle arrears in wage bills and project grants mostly financing capital spending (IMF, 2016a, 2018).

Weak exogeneity is accepted for spending, which reflects the functionality of spending systems in small FS that display spending rigidity. Since spending policies are typically prepared for the medium to long term they are not easily reversed once implemented. This is particularly true for public payroll and/or statutory expenditures: the wage bill in the Comoros does not react to fluctuations in tax revenue (IMF, 2018b). Furthermore, spending in the Comoros is driven mainly by recurrent expenditures, the bulk of which are wages and salaries, reflecting patronage politics under which the Comoros is governed (IMF, 2016a, 2018b; World Bank, 2019). Additionally, IMF (2018b) suggests that reductions in spending are more detrimental to growth than increases in taxes, perhaps strengthening fiscal planners' behavior.

Combining the weak exogeneity and long-run exclusion results across variables, it appears that causality runs from spending to tax revenue and grants while the latter two variables adjust to each other. This fits a scenario where the government sets spending targets according to their development objectives and then tries to find the resources (grants and taxes) to finance the objectives, factoring in unpredictability in the disbursement of grants and the vulnerability of tax systems.

Given the negative relationship between grants and tax revenue, we explicitly test if grants displace tax effort: a test for aid substituting for tax revenue (Martins, 2010; Bwire et al., 2017). This is done by normalizing on government spending, and testing that grants and tax revenue are equal and of opposite signs. The hypothesis that grants substitutes for tax revenue (and effort) in a one to one relationship is firmly rejected at the 1 percent level of significance. This suggests that grants do not fully displace revenues in the long-run.

In light of the discussion of Section 2 on the different dynamics of taxes and grants in the Comoros over time, we perform several tests to assess the stability of the cointegration relationships using the Gregory–Hansen residual-based cointegration methodology with structural break.²⁰ The tests results do not show convincing evidence of breaks in the cointegration relationships. This result suggests that throughout our sample period there was not a significant change in the relationship between domestic taxation and grants.²¹

²⁰ The break point is determined endogenously via the Gregory-Hansen (1996) procedure by considering three alternative models: a level shift, a level shift with a trend, and a regime shift, which allows the slope vector to shift as well. The test purposes residual-based tests for the null hypothesis of no-cointegration with structural break. The test results to our sample data reveal that sufficient evidence of cointegration with the break is not found in any of the three models. Test results are not presented here for space purposes but are available upon request.

²¹ We do not attempt or report any impulse response functions (IRFs) in the analysis. The computation of IRFs is based on the analyst's ability to identify exogenous shocks from one variable (especially grants) to the other fiscal variables over time. Nonetheless, the long-run exclusion and weak exogeneity tests show that grants are indeed endogenous to the system, thus invalidating the premise upon which IRFs provide meaningful inference.

7. Concluding Remarks

The socio-economic challenges of FS are exacerbated by political instability, conflict and violence. It is not surprising then that according to the World Bank, by 2030, FS will host 46 percent of the world's extreme poor. FS governments often lack the institutional capacity and financial resources to respond to their country's vulnerabilities, with partners and donors playing a key role in supporting their development efforts. The development community has recently started to reinforce the allocation of resources towards increasing FS governments' ability to tackle existing drivers of fragility. Nevertheless, attention must be given to the potential unintentional negative effects of such a sizable increase in aid, which if not accompanied by aid quality, could be simply seen as a windfall of resources to recipient countries with no long-term gains in the country's prosperity. This paper focused on the interaction of aid flows and taxation in FS.

For more than three decades in the Comoros' history, little progress was achieved in implementing tax revenue reforms that would enable the country to become less dependent on aid for development. This paper suggests that political economy factors related to the Comorian fragility, including the high flow of grants (with no repayment obligation) in a context of weak administration capacity and low accountability to domestic taxpayers, help to explain the limited effort in collecting domestic revenues. Besides, we argue that this effect is amplified by large and episodic budget grants, that have the potential of delaying structural reforms and overall diminish the political will to enact policy reform.

Long periods of government instability, as one of the many perils of FS, could be at the heart of the negative relationship between tax effort and grants found in this paper. Indeed, Carmignani (2003) argue that when governments have doubts about their survival in office, they may forego their initial commitments by delaying or reversing structural reforms. This could help explain historical slippages in the implementation of reforms in the Comoros. However, an assessment of isolated factors affecting the Comoros or FS in general is beyond the scope of our paper and we leave it for further research.

From the Comorian government's perspective, being aware of this negative relationship is an important step to ensure that the country's long-term priorities in tax capacity building are not slowed down following large and episodic budgetary support from donors. From the donors' point of view, prioritizing conditional aid and focusing on aid effectiveness and engaging more resources for capacity building tax revenue projects and technical assistance could improve the impact of the interventions.

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APPENDIX

Table A1: Descriptive statistics

| Variable | Mean | Median | Minimum | Maximum | Standard deviation |
|-----------------------|-----------|-----------|-----------|-----------|--------------------|
| Grants | 14,751.15 | 10,685.3 | 3146.7 | 66,956.13 | 12,541.69 |
| Tax revenue | 15,932.53 | 13,221.34 | 5,358.5 | 44,012.28 | 9671.11 |
| Non-tax revenue | 3871.34 | 2,571.05 | 191 | 17,287.33 | 3945.56 |
| Total expenditure | 34,613.35 | 27,588.85 | 17,649.51 | 77,886.82 | 17,519.5 |
| Capital expenditure | 9,436.79 | 7,146.05 | 2677.43 | 29,490.18 | 7,357.7 |
| Recurrent expenditure | 25,176.57 | 21,366.26 | 13,493.01 | 49,738.64 | 10,552.3 |

Notes: The data are in millions of KMF.

A1. Order of Integration.

As a precursor to estimating FRMs it is important to evaluate the order of integration of the variable series. Standard empirical analyses of time-series data assume all variables to be stationary. Nonetheless, most macroeconomic time-series are non-stationary so including a mixture of nonstationary and stationary variables in the same regression may result in spurious regressions thereby invalidating inference. Unit root tests are very essential tools in identifying the univariate properties of time series to detect the presence of non-stationarity and make sure the variables have the right stationarity properties. The most used test for determining order of integration and the amount of differencing required to induce stationarity is the Augmented Dickey Fuller (ADF) unit root test (Dickey and Fuller, 1979, 1981). The ADF specification estimated in this paper is given below.

$$\Delta y_t = \mu_i + \beta_i t + (\rho - 1)y_{t-1} + \sum_{j=1}^p \delta_{ij} \Delta y_{t-j} + u_t \quad (A1)$$

Where y is the time-series data (tax revenue, grants and government spending), t is the linear time trend; ρ is the maximum number of lags and u_t is the Gaussian error term. Lagged values of the dependent variable are incorporated to curb serial correlation in the error terms, providing unbiased results. The null hypothesis for the unit root test is:

$$H_0: (\rho - 1) = 0$$

Against the alternative that:

$$H_1: (\rho - 1) < 0$$

If the value of the ADF test statistic is greater than the five percent critical value of the ADF statistic, then the null hypothesis of $(\rho - 1) = 0$ cannot be rejected. That is, the series in question is non-stationary and has a unit root. Otherwise, the null hypothesis is rejected, and the series is stationary. Thus, the order of integration $I(h)$ could be interpreted as the number of times (h) a series should be differenced to make it stationary.

Table A2: ADF unit roots tests

| Levels: ADF test with intercept only | | | | | | | | | |
|---|----------------|--------|----------------|--------|----------------|--------|----------------|--------|--|
| | Tax | | Grants | | Spending | | Non-tax | | |
| Lags | <i>t</i> -stat | 5% CV | <i>t</i> -stat | 5% CV | <i>t</i> -stat | 5% CV | <i>t</i> -stat | 5% CV | |
| 0 | 2.570 | -2.978 | -2.994 | -2.978 | 1.786 | -2.978 | -2.526 | -2.978 | |
| 1 | 1.953 | -2.980 | -1.317 | -2.980 | 1.679 | -2.980 | -2.007 | -2.980 | |
| 2 | 2.051 | -2.983 | -0.668 | -2.983 | 2.341 | -2.983 | -0.944 | -2.983 | |
| 3 | 2.761 | -2.986 | -0.520 | -2.986 | 2.708 | -2.986 | -1.525 | -2.986 | |
| 4 | 2.399 | -2.989 | 0.300 | -2.989 | 1.774 | -2.989 | -0.708 | -2.989 | |
| Levels: ADF test with intercept and trend | | | | | | | | | |
| | Tax | | Grants | | Spending | | Non-tax | | |
| Lags | <i>t</i> -stat | 5% CV | <i>t</i> -stat | 5% CV | <i>t</i> -stat | 5% CV | <i>t</i> -stat | 5% CV | |
| 0 | 0.502 | -3.568 | -4.035 | -3.568 | -0.413 | -3.568 | -3.641 | -3.568 | |
| 1 | 0.029 | -3.572 | -2.142 | -3.572 | -0.419 | -3.572 | -3.070 | -3.572 | |
| 2 | -0.005 | -3.576 | -1.570 | -3.576 | 0.056 | -3.576 | -1.628 | -3.576 | |
| 3 | 1.229 | -3.580 | -1.481 | -3.580 | 0.590 | -3.580 | -2.859 | -3.580 | |
| 4 | 0.791 | -3.584 | 0.401 | -3.584 | 0.280 | -3.584 | -1.932 | -3.584 | |
| Differences: ADF test with drift | | | | | | | | | |
| | Tax | | Grants | | Spending | | Non-tax | | |
| Lags | <i>t</i> -stat | 5% CV | <i>t</i> -stat | 5% CV | <i>t</i> -stat | 5% CV | <i>t</i> -stat | 5% CV | |
| 0 | -3.137 | -1.697 | -11.059 | -1.697 | -4.812 | -1.697 | -7.344 | -1.697 | |
| 1 | -1.911 | -1.701 | -6.647 | -1.701 | -3.886 | -1.701 | -7.756 | -1.701 | |
| 2 | -2.449 | -1.706 | -4.381 | -1.706 | -2.994 | -1.706 | -2.675 | -1.706 | |
| 3 | -1.284 | -1.711 | -3.154 | -1.711 | -1.655 | -1.711 | -3.590 | -1.711 | |
| 4 | -0.790 | -1.717 | -0.376 | -1.717 | -1.513 | -1.717 | -3.536 | -1.717 | |

Notes: *t*-stat is the ADF test statistic and 5% CV is the 5 per cent critical value.

Table A3: Residual Diagnostic Tests: Baseline Model

| Residual normality (<i>p</i> -values) | | | | |
|--|--------------|-------|------------|----------|
| | Multivariate | | Univariate | |
| | | Tax | Grants | Spending |
| | 0.000 | 0.257 | 0.000 | 0.648 |
| Residual autocorrelation (<i>p</i> -values) | | | | |
| | | LM(1) | LM(2) | |
| Autocorrelation | | 0.692 | 0.383 | |

Notes: (i) For the normality tests the null hypothesis, H_0 , is for normally distributed errors while the alternative hypothesis is of non-normal errors. (ii) For the autocorrelation tests the null hypothesis, H_0 , is no serial correlation against the alternative of serial correlation in the errors.