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Does aid fragmentation affect tax revenue dynamics in developing countries?

Observations with new tax data

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Abstract: There exists a burgeoning empirical literature on the impact of aid fragmentation on development outcomes in aid-receiving countries, with it being widely recognized that aid fragmentation is deleterious. This paper adds to the existing literature by estimating the impact of aid fragmentation on tax revenue mobilization in developing countries. Drawing on the popular system generalized method of moments technique to counter endogeneity issues, this study focuses on a sample of 90 developing countries covering the period from 2000 to 2020. We show that aid fragmentation, measured by the Herfindahl index, has a significant negative impact on recipient countries' tax revenue ratios, an impact that is not mitigated by the level of institutional quality. The paper also explores the impact of aid fragmentation on tax structure and finds convincing evidence that direct taxes, particularly corporate income taxes, are the most affected. Value-added tax is the only indirect tax affected by aid fragmentation.

Key words: aid fragmentation, Herfindahl index, tax revenue, institutional quality

JEL classification: F35, H2, P33

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Note: Table 5 was corrected on 13 September 2022, as the numbers of countries for SSA and SA had been switched.

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1 Introduction

External aid has been a major source of financing for developing countries for decades. Official development assistance makes up over two-thirds of external finance for least-developed countries (OECD 2020). The impact of aid on macroeconomic aggregates—for example, economic growth, public finances, and the quality of institutions in recipient countries—has been hugely contested in research and policy circles (e.g., Bräutigam and Knack 2004; Carter 2013; Chauvet and Ehrhart 2018; Maruta et al. 2020; Morrissey 2015). The findings are inconclusive and demonstrate strong heterogeneity.[1] The empirical literature also points out some outstanding features of foreign aid that negatively undermine its effectiveness, such as aid volatility and its detrimental effect on macroeconomic aggregates, including growth (e.g., see Boateng et al. 2021; Lensink and Morrissey 2000). Aid volatility also undermines government ability to plan a budget appropriately (Hudson and Mosley 2008) and encourages fiscal indiscipline in aid-receiving countries (Moss et al. 2006).

Side-stepping the volume and dynamic nature of aid, how it is disbursed—through coordinated donor efforts or independently by different donors—is also important (Rahman and Sawada 2012). This generates the concepts of aid fragmentation and proliferation.[2] Over the past decades, aid recipients have witnessed a considerable increase in the number of their donors, donor projects, and sectors to which they allocate aid (see Figures 1 and 2). There has also been a concomitant increase in the number of donor agencies operating across an increased number of recipient countries (World Bank 2022c). For instance, as stressed by Annen and Moers (2017), in 1960, there were fewer than three bilateral donors in the typical recipient country. In contrast, in 2011, this number was almost twenty-three. Despite several initiatives to curb aid fragmentation/proliferation and enhance coordination, a recent report by the World Bank (2022c) shows that fragmentation and proliferation remain major issues for the aid community.[3]

The impact of aid fragmentation on development outcomes has received considerable attention in the literature (e.g., Annen and Kosempel 2009; Gehring et al. 2017; Han and Koenig-Archibugi 2015; Kimura et al. 2012). The empirical evidence is mixed: results are sensitive to the conceptualization and measurement of aid fragmentation/coordination and the specific development outcomes considered. High aid fragmentation results in high transaction and/or administrative costs in recipient countries (Acharya et al. 2006) and donor countries (Anderson 2012), reductions in bureaucratic quality (Knack and Rahman 2007) and overwhelms administrative capacity in recipient countries (OECD 2009; Roodman 2006), with aid becoming less effective in improving development outcomes (Djankov et al. 2009; Kimura et al. 2012). Recipient countries may not have the administrative capacity to handle many donors and donor projects and may be overwhelmed such that increases in aid erode development outcomes.

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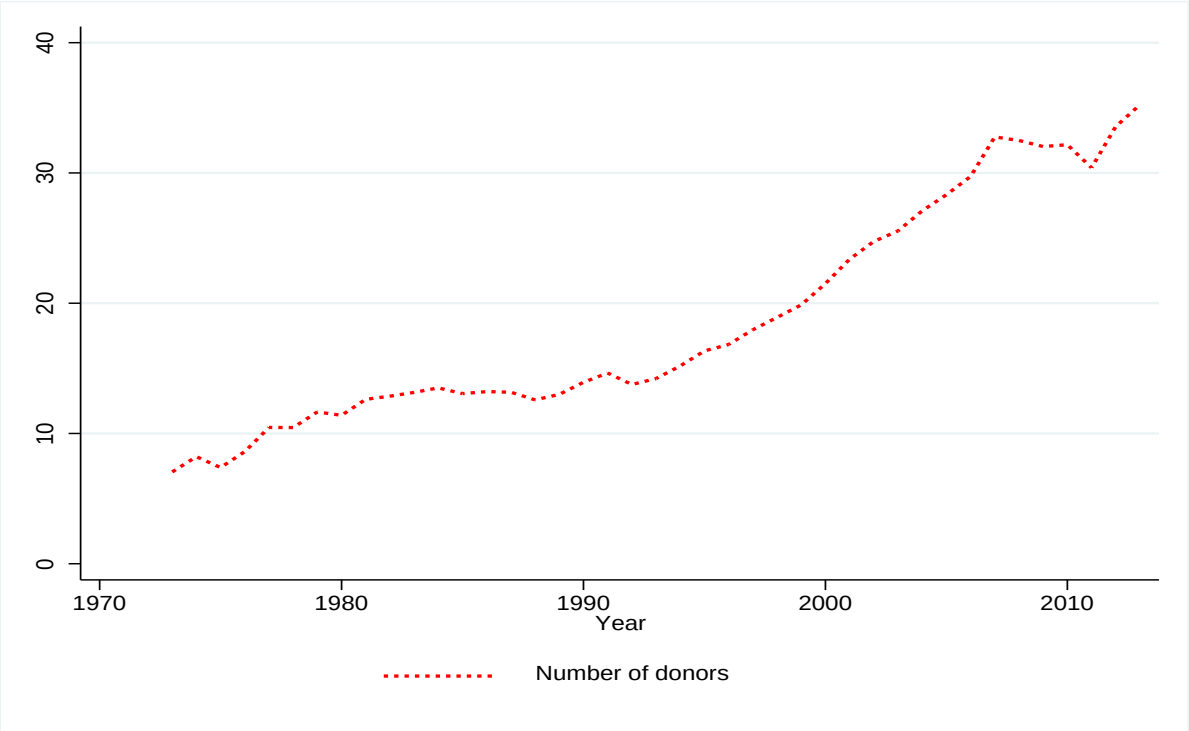
[1] Some studies posit a non-linear relationship between aid and development (see Fielding and Knowles 2011).

[2] Aid proliferation can be described as an increase in the number of donors involved in the financing and delivery of official aid finance whereas aid fragmentation can be defined as an increase in the number of donor-funded activities in recipient countries (World Bank 2022c). The latter measures the degree to which a given country's total aid budget is spread across (provided by) different donors. In this paper, aid proliferation and fragmentation are used interchangeably.

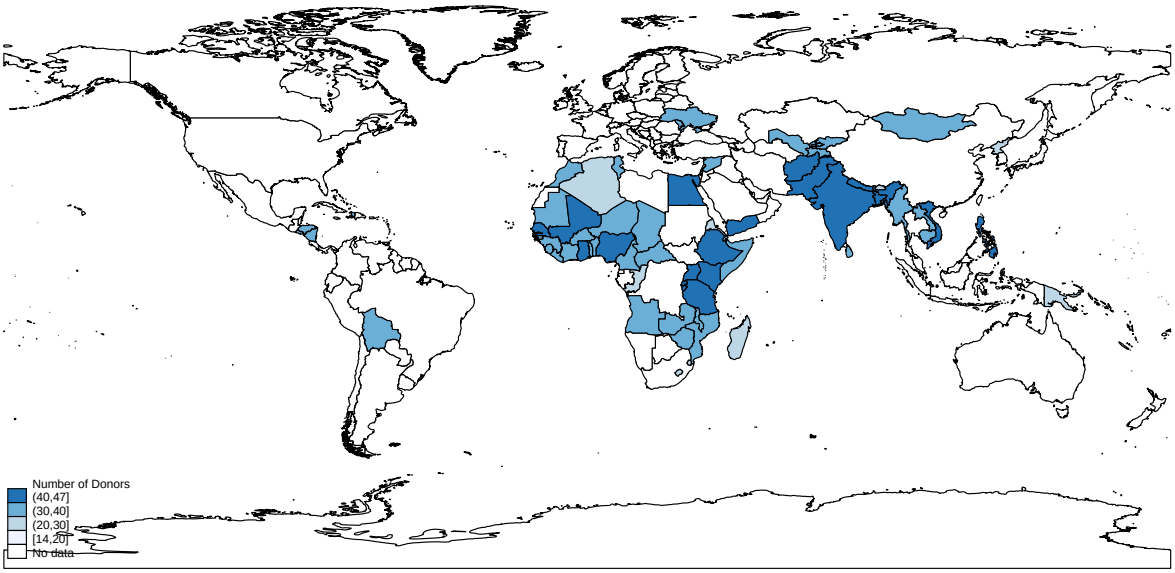
[3] The initiatives include the Rome Declaration on Harmonization in 2003, the Paris Declaration in 2005, the Accra Agenda for Action in 2008, the Busan Partnership for Effective Development Co-operation in 2012, and the Global Partnership for Effective Development Co-operation set up in 2012.

Figure 1: Patterns of aid donors



Source: authors' construction using AidData project's database (AidData 2007; Tierney et al. 2011) that builds on the OECD creditor reporting system data.

Figure 2: Number of donors operating in developing countries, 2013



Source: authors' construction using AidData project's database (see AidData 2007; Tierney et al. 2011).

Kilby (2011) highlights that aid fragmentation could imply smaller aid projects, possibly resulting in more administrative work for recipient countries. The limited capacity of recipient governments to manage and administer aid inflows is exacerbated by the presence of many donors and projects. Rahman and Sawada (2012) show that donor proliferation leads to an inefficient supply of aid in the recipient country because of the free-riding problem among donors. In addition, duplication of aid programmes and the concomitant increased administrative burden negatively affect growth performance (Djankov et al. 2009). Focusing on the health sector, Pallas and Ruger (2017) find

that aid fragmentation affects health programme performance by increasing costs to aid-recipient countries. In another study, Gehring et al. (2017) investigate the impact of donor proliferation on aid effectiveness in the context of growth, bureaucratic policy, and education, while focusing on different indicators of fragmentation and paying attention to potentially heterogeneous effects across countries.

Although the impact of aid fragmentation on other development outcomes has been studied, there is a paucity of studies on the impact of aid fragmentation on tax revenue mobilization across developing countries. To the best of our knowledge, no recent research has paid attention to the potential impact of aid fragmentation on recipient countries' tax to gross domestic product (GDP) ratio. The relevance of the topic is justified on two grounds. First, the primacy of domestic revenue mobilization in attaining the Sustainable Development Goals (SDGs) in developing countries, tackling mounting debt sustainability issues, as well as building fiscal capacity to assuage vulnerability to future shocks (McNabb et al. 2021; Verdier et al. 2022). Furthermore, tax revenue mobilization is underscored by the need to limit fiscal risks and permanent deleterious effects of the COVID-19 pandemic and ongoing Russia–Ukraine war that has significantly increased commodity prices (Verdier et al. 2022). Second, the enduring importance of aid, donors, and donor agencies to recipient countries' development agendas (World Bank 2022c). In this context, we examine the following empirical question: does aid fragmentation hamper or enhance tax revenue mobilization in developing countries? This paper aims to bridge this gap in the literature by providing empirical evidence of the relationship between aid fragmentation and tax performance and the potential role played by institutional quality.

Equally important are the tax composition effects of aid fragmentation. The primary distinction is between the effects on direct and indirect taxes, the former requiring more investment and administrative and political effort in strengthening the capacity and efficiency of tax collection, reforming revenue administration, as well designing optimal tax policy (Besley and Persson 2011). In addition, enforcement and compliance costs are higher for direct (income) taxes compared with indirect taxes (Limberg 2022). Even within the sub-components of direct and indirect taxes, there is heterogeneity. The investments in developing the capacity to capture corporate income taxes (CITs) are higher than those needed to capture personal income taxes (PITs) because the former has more deleterious effects—such as through inefficient and ineffective tax incentives, tax avoidance, and base erosion—on domestic taxes than on the latter. Furthermore, monitoring tax compliance by multinational enterprises (MNEs) is difficult without the necessary investments in developing a coherent compliance strategy. Value-added tax (VAT), however, is more akin to direct (income) taxes in terms of investments needed to develop and collect the tax. Thus, the negative effects of aid fragmentation are more amplified for taxes that require more investment and administrative effort to collect; hence, more for direct taxes and VAT relative to indirect taxes.

Our paper makes three contributions to the foreign aid literature. First, we provide novel empirical evidence on the impact of aid fragmentation on tax performance covering the period from 2000 to 2020 for 90 developing countries. By applying estimation techniques that control for unobservable recipient heterogeneity and endogeneity, our study unveils important evidence that aid fragmentation is associated with lower tax revenue collection in recipient countries. The negative impact is robust to the inclusion of a multitude of control variables and alternative estimation techniques but weak when estimated within the context of regional and developmental disparities.

Second, we estimate the impact of aid fragmentation on components of recipient countries' tax revenue (components of taxation). There is a strong negative relationship between aid fragmentation and direct taxes, and no discernible relationship with indirect taxes. We posit that this is because larger financial and institutional investments are needed to develop and administer

direct (income) taxes compared with indirect taxes, such that any negative effects of aid fragmentation are more amplified for direct taxes. For direct taxes, the negative impact of aid fragmentation is stronger on the CIT than on the PIT. This is due to the same argument above: direct taxes requiring more investment and administrative effort in administering show stronger negative effects from aid fragmentation. For indirect taxes, the negative impact is significant only for VAT. While VAT is a consumption tax with an 'easy' tax base, it is a tax on accounting whose performance depends crucially on its design and enforcement, both of which need much administrative and political effort to develop.

Third, the impact of aid fragmentation on tax performance is modelled as depending on institutional quality in recipient countries. The direct impact (the positive or negative effects of institutions on tax performance) and indirect impact (the impact that institutions have on tax performance only through their impact on aid fragmentation) of institutions are tested. While institutions have a direct positive impact on tax performance—concurring with the literature (e.g., Fauvelle-Aymar 1999; Garcia and Von Haldenwang 2016)—they fail to fully mitigate the negative impact of aid fragmentation on tax performance. This finding on conditional effects is novel. From an economic policy standpoint, these findings concur with existing studies on other development outcomes and underscore the criticality for more and reinforced donor coordination for greater aid effectiveness. Put differently, the paper shows that much more could be gained for recipient countries in terms of tax revenue collection from improved donor coordination.

The rest of the paper is structured as follows. Section 2 provides a conceptual framework, while Section 3 introduces the data, constructs the aid fragmentation index, and presents some descriptive statistics. Sections 4 and 5 present the econometric methodology and the results, respectively. Section 6 briefly concludes the paper and draws on some policy implications.

2 Analytical framework

The impact of aid (donor) fragmentation on tax revenue mobilization can be positive or negative. It is plausible that the presence of many donors increases recipient transaction costs, which negatively affects recipient countries' administrative capabilities and ultimately reduces tax revenue. Conversely, the consequences of aid fragmentation may be beneficial: more donors active in a country allows the country to benefit from a variety of experiences and ideas—especially when the sheer number of donors suggests there might be more aid and technical assistance for tax reform—improving country ownership of tax reforms and the ensuing revenue mobilization process.

The literature identifies several reasons for expecting a negative relationship between aid fragmentation and development outcomes in recipient countries. First, aid influences domestic planners' incentives to expend political and administrative efforts to improve fiscal capacity. The political economy literature documents the unpopularity of raising taxes, and recipients might view aid as a politically less costly source of revenue with which to cover domestic expenditures (Morrissey and Torrance 2015). Thus, faced with aid flows from multiple donors or high aid shares from specific donors, the recipient government perceives aid as an alternative to increasing tax collection: there exists a political calculus between increasing tax collection and receiving more aid

from various donors or increasing specific donor aid shares.[4] The fiscal planners' choice—investing in building fiscal capacity or receiving more aid—thus depends on the respective political costs of aid and tax and how the costs offset each other (Morrissey 2015). The political costs can be quantified in terms of the bureaucratic costs of aid and taxes. The bureaucratic costs of aid relate to the costs of interacting with multiple donors whereas the bureaucratic costs of taxation relate to the costs of tax administration. In the context of low administrative capacity in recipient countries, fragmented aid will have more deleterious effects on tax performance.

Second, aid fragmentation increases short-term transaction and administrative costs for donors and recipient countries (Anderson 2012; Bigsten and Tengstam 2015; Knack and Rahman 2007).[5] As aid generates transaction costs, in a context of low administration capacity and efficacy in developing countries, the proliferation of donors would increase the administrative burden, worsen institutions' quality and tax administration, and negatively influence tax mobilization. Increased donor transaction costs are exacerbated by duplication of aid programmes, increasing the bureaucratic costs of aid (Morrissey and Torrance 2015) and the concomitant increased administrative burden negatively affects growth, indirectly reducing tax revenue mobilization (Djankov et al. 2009).

Third, fragmented aid accentuates collective action problems in recipient countries (Han and Koenig-Archibugi 2015).[6] Competition among donors may lead to lax financial management, quicker aid disbursements and less supervision, which fuels corruption and rent-seeking behaviour in recipient countries and undermines tax revenue mobilization (Djankov et al. 2009). Fourth, as aid programmes are commonly associated with policy reforms including economic liberalization and macroeconomic stabilization policies that have typically been a component of conditional lending (Aizenman and Jinjarak 2009; Baunsgaard and Keen 2010), fragmented aid—with conditions from various donors, some of which are conflicting—would be associated with tax revenue reductions.[7]

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[4] Diaz-Sanchez et al. (2022: 179) show that increased dependence on France and donors from the Gulf region eroded incentives to raise taxes in Comoros. Comorian authorities, under advice from multilateral partners, initiated tax reforms but there were long delays and slippages in implementing those reforms.

[5] Donor transaction costs are all the direct and indirect costs incurred by a donor that are not received as resource transfers by the recipient countries. They include salaries for donor staff, travel expenses, and other variable costs like buildings and materials (Anderson 2012). Recipient transaction costs are related to the (tax) administrative burden of handling many donors. These can be described, in political calculus terms, as bureaucratic costs of aid and taxation (Morrissey 2015). High recipient transaction costs undermine the effectiveness of aid, directly and indirectly (Acharya et al. 2006). The direct transaction costs include the time spent organizing and attending meetings with various donors (i.e. bureaucratic costs), as well as the effort expended in understanding various donor procurement and reporting requirements. The indirect transaction costs include poaching of poorly remunerated government employees (Knack and Rahman 2007), corrupt practices prompted by the diversity of aid channels and lack of accountability across donors and recipients (Acharya et al. 2006; World Bank 2022c), and donor competition resulting in unintentional negative consequences.

[6] Collective action problems arise from donor dilemma when deciding between buttressing recipient countries' long-term development agenda and pushing their own interests (De Renzio 2016; Han and Koenig-Archibugi 2015). On the one hand, donors have an incentive to promote long-term development outcomes in recipient countries. On the other hand, donors must respond to their own domestic pressures and promote their interests. Collective action problems may become insurmountable when the number of donors is large.

[7] This is the classic tax transition reform: phasing out international trade taxes (because of trade and/or economic liberalization) and replacing them with domestic taxes, especially VAT and income taxes (Baunsgaard and Keen 2010). Thus, a negative effect of aid fragmentation on tax revenue may prevail when the reduction in international trade taxes—a condition upon which aid may be disbursed—is not compensated for by an increase in domestic taxes. There is empirical evidence to back this non-replacement evidence (Moller 2016; Waglé 2011).

A positive relationship between aid fragmentation and development outcomes is less espoused in the literature. Nevertheless, there might be attendant benefits of aid fragmentation. The proliferation of donors could be beneficial to aid recipients as it might be associated with greater aid allocations. Gutting and Steinwand (2015) conclude that in case of unexpected aid shortfalls, countries with highly concentrated aid or donor structures—more than half of aid from just one donor—largely experience aid shocks that are on average more than those with a broader donor base. Hence, donor proliferation can reduce both the frequency and the impact of shocks to aid flows by making the recipient country less dependent on a single donor, or a small group of donors (no matter how influential they are to the recipient country). Furthermore, the multiplicity of donors and donor agencies can provide opportunities for discussing alternatives important to the recipient country's balanced development (Sato et al. 2011). Gehring et al. (2017) argue that in the rare event where a recipient wastes all aid finance to its country, it still benefits from exchanging with different donor agencies, which indirectly affects growth. Han and Koenig-Archibugi (2015) argue that a higher number of donors entails a greater diversity of perspectives that can help select and implement better policies.

The main question emanating from this discussion is: do the negative effects of aid fragmentation outweigh the positive ones? The response to this question depends on three key factors: different indicators of fragmentation, recipient characteristics, and the constituent parts of taxation.

2.1 Indicators of fragmentation and their potential implications

The choice of aid fragmentation indicator is important in estimating the impact on tax revenue mobilization. The concept of fragmentation consists of different facets, each with computational properties that affect the specific development outcome being considered. 'Fragmentation' can be conceptualized as the share of a specific donor's aid in total aid disbursed to a recipient each year. Other indicators capture the lack of lead donors—a few dominant donors who may take over the bulk of coordination activities. Fragmentation can also be captured by the presence of many small donors who provide small amounts of aid but add to the overall number of donors and contribute to the ensuing coordination problems.

The Herfindahl index is popularly used to depict aid proliferation and fragmentation based on specific donor shares. The index, ranging from 0 to 1, is obtained by taking the share of a specific donor's overall aid finance each year, squaring the share, and summing across all donors. Lower values, thus, indicate higher aid (donor) fragmentation and vice versa. The Theil index of fragmentation is similar to the Herfindahl index, the main difference being the former can be disaggregated to incorporate 'between' and 'within' components.

The concentration ratio differs from the Herfindahl index, the former captured by the sheer number of donors. The standard concentration ratio adds up the shares of a predetermined number of largest or smallest donors, and a shift in proportions among the preselected large donors does not alter the concentration ratio. This means that additional donors are not detrimental when only a small number of big donors are considered. The concentration ratio can be seen as a proxy for tax autonomy, that is, the leverage aid donors have on tax policy. A government that is dependent on aid cedes some policy influence power to donors and a government with more domestic revenue (hence, less aid) has greater autonomy. The effects are expected to be non-monotonic: few donors (or the presence of a predetermined number of large donors) will imply more leverage by donors.

2.2 Recipient characteristics

Various recipient countries' characteristics are relevant for gauging the impact of aid fragmentation, the most important of which are political and institutional factors. Positive or negative impacts of aid fragmentation can be enhanced or mitigated by the level of institutional quality in recipient countries. Brun et al. (2009) find that the impact of aid on tax effort depends crucially on the quality of institutions in the recipient country. A negative relationship is prevalent in countries with weak institutional quality whereas a positive relationship is dominant in countries with strong institutional quality. The importance of institutions as a permeating factor can be gleaned from the limited existing literature. If the level and fragmentation of aid do erode incentives to invest in fiscal capacity and increase tax mobilization, the negative effect is more likely to be exacerbated where institutions—economic and political—are weak. In countries with strong institutions, any negative impact of aid or aid fragmentation on fiscal capacity is placated or even reversed.

For an exposition, we focus on the control of corruption (or lack thereof). Corruption deprives the state of resources that can be used to increase collective capacity (such as spending on pro-poor sectors) and investments in fiscal capacity. IMF (2019) shows that an improvement in the control of corruption index is associated with an increase in government revenues. A more corrupt government—hence, more corrupt tax administration—facilitates opportunities for tax evasion and avoidance, through tax legislation and administration. Tax exemptions and incentives are granted without the requisite oversight, granted to politically connected firms and individuals (increasing their inefficiency and ineffectiveness) and subject to abuse (Newiak et al. 2022). Customs administration is more susceptible to corruption because it is based on observable trade flows (Newiak et al. 2022). Furthermore, more corrupt governments take advantage of diversified aid resources that are disbursed with minimal supervision, perpetuating corrupt practices in tax administration. To the extent that increased transparency and accountability are specific conditions associated with aid, aid will have a favourable impact (positive or marginally negative) on fiscal capacity in low-corruption environments.

2.3 Components of taxation

Aid fragmentation also has a fundamental impact on tax structure and composition; the primary distinction is between direct and indirect taxes. The choice between direct and indirect taxes is correlated with tax design, administration, and enforcement capacity (Acosta-Ormaechea et al. 2022). Thus, investments, organizational and political effort in designing tax policy, developing tax collection capacity, improving collection efficiency, and administering taxes are higher for direct taxes than for indirect taxes (Besley and Persson 2011, 2013). As such, investments in developing direct taxes require more coordinated donor efforts, the absence of which reduces incentives to develop fiscal capacity. Indirect taxes are collected from 'easier' tax bases (e.g., consumption and international trade) whereas direct taxes are collected from tax bases that are more difficult to observe (e.g., personal income and corporate income). We posit that the negative effects of aid fragmentation related to increased transaction costs in both recipient and donor countries, higher bureaucratic costs of aid, and increased corruption opportunities presented by uncoordinated aid are exacerbated for direct taxes relative to indirect taxes. Four mechanisms are posited for this.

First, while indirect tax bases may be buoyant and respond to changes in GDP—for example, increased government consumption or investment would result in an increase in household consumption, hence more VAT/sales tax and excise revenues—they need less investment in

improving revenue collection than direct taxes.[8] In addition, indirect taxes like customs taxes easily change contemporaneously and in the short term. Direct taxes, on the other hand, may also be buoyant but need much more investment in developing and administering (Besley and Persson 2013). For example, improvements in collecting and administering income taxes involve investments in using third-party information, setting up large taxpayer offices, developing the capacity to assess and rationalize corporate tax incentives, developing the legal judicial framework to counter tax avoidance, as well as developing the requisite legal and administrative capacity to collect capital gains taxes (De Mooij et al. 2020).

Second, because of the difficulty in observing direct (income) tax bases, (quasi) voluntary compliance is crucial in collecting direct taxes. The compliance depends on the nature of the fiscal contract between the state and taxpayers: the exchange of tax revenues for goods and services provided by the state (Bräutigam et al. 2008; Ross 2004). Fiscal contracts between the state and taxpayers are more consensual for direct taxes and taxes levied on accounting categories, eliciting higher voluntary compliance. Conversely, those levied on the movement of goods (customs on external borders and internal sales) and other indirect taxes generate fiscal contracts that are less consensual and do not elicit as much (quasi) voluntary compliance. Moore (2007) illustrates the shift of state revenues in Western Europe, from sources requiring low organizational effort to broad-based taxation (those requiring a higher organizational effort). We argue that the administrative and political effort expended in generating a fiscal contract is larger for direct taxes (loosely, referred to as 'broad-based taxes') than for indirect taxes; therefore, the negative effects of the absence of aid coordination will be stronger on direct taxes.

Third, enforcement, compliance, and total administrative costs are higher in administering direct taxes than indirect taxes, requiring higher investments and administrative effort to capture the former (Besley and Persson 2013). For example, direct taxes are more susceptible to tax evasion (in the case of PIT) and tax avoidance (base erosion and profit shifting, in the case of CIT) so investments to countervail those challenges are bigger. Even within direct taxes, the requisite investment in developing and administering CIT is larger than it is for administering PIT because of the mobility of CIT. Such investments include setting up anti-tax avoidance legislation, increased use of withholding taxes for foreign capital and service providers, expanding the tax base to attract the informal sector, and recurrent improvements in tax administration (through digitalization, compliance strategies, etc.). Furthermore, indirect taxes are unaffected by tax competition and are relatively stable.

Fourth, VAT is different from other indirect taxes as it is levied on accounting categories (such as value added). Investments in developing VAT are as important as those needed for developing direct taxes (Limberg 2022), making VAT equally susceptible to the deleterious effects of aid fragmentation. While it may be a consumption tax with an 'easy' or 'obvious' tax base, its performance depends on huge investments in improving its design and enforcement. The administrative costs of improving VAT design and enforcement are as high as for direct (income) taxes, which are higher than the costs for administering trade taxes and excises. Typical investments to improve VAT performance and efficiency include generating a long-term compliance strategy (to curb evasion), developing strong VAT refund systems (the lack of which severely undermines the efficiency of VAT), developing capacity to assess and rationalize VAT exemptions (the pervasiveness of which erodes VAT efficiency), increased digitalization to curb

[8] This scenario is similar for an increase in exports or imports. Although most export taxes have been abolished, import tariffs are still being used by some countries and the border is one of the biggest sources of revenue in developing countries. Furthermore, an increase in imports might increase tax revenue not because of the importance of tariff revenue but because imports are a strong proxy for economic activity (Tagem and Morrissey 2021).

the impact of corruption, and streamlining VAT statutory rates. All of these require considerable effort to reduce administrative costs.

3 Data and construction of the aid fragmentation index

3.1 Data

The empirical investigation of this paper relies on annual data for a sample of 90 developing countries covering the period from 2000 to 2020. Revenue data are sourced from the Government Revenue Dataset, version 2021 (UNU-WIDER 2021).[9] The primary dependent variable is the non-resource tax-to-GDP ratio, permitting distinction from the tax-to-GDP ratio (which includes resource components). To explore impacts on recipient countries' tax structures, we also obtain data on components of taxes, that is, direct and indirect taxes (both as shares of GDP). To explore heterogeneity further, sub-components of direct and indirect taxes are obtained, specifically income taxes, PIT, CIT, goods and services taxes, VAT and trade taxes.[10]

Aid data are obtained from the Organisation for Economic Co-operation and Development's (OECD) Development Assistance Committee (DAC) database, version 2021 (see OECD 2021). They include net and gross aid disbursements, both as shares of GDP. The aid-to-GDP ratio is included in the model such that interest is in estimating the effect of a more or less fragmented aid landscape, given the level of aid.

Economic/structural variables are chosen following the literature on determinants of tax-to-GDP ratios across countries (Crivelli and Gupta 2014; Tagem and Morrissey 2021). These are the sectoral contribution of value added in GDP (i.e. agriculture and natural resources, as percentages of GDP), trade openness (percentage GDP) and financial sector development, proxied by the share of credit in GDP. All the variables are obtained from the World Development Indicators database (World Bank 2022a).

The effect of natural resource rents on tax performance has been widely researched in the literature but remains controversial. Although pioneering studies posited a positive effect of natural resource rent on tax revenue (Chelliah et al. 1975; Tanzi 1992), recent resource curse literature highlights a negative association between natural resource rents and tax revenue, suggesting a crowding-out effect (e.g., Crivelli and Gupta 2014). Hence, the effect of natural resource rents on tax performance is a priori ambiguous. Trade openness captures the volume of international trade (exports and imports) in the GDP. A substantial increase in trade volume makes it more amenable to taxation through domestic consumption and corporate profits (Gnangnon and Brun 2019). The share of agriculture value added (percentage GDP) is negatively associated with tax performance given the large informal, subsistence nature of the sector. In addition, the agricultural sector is more often subject to politically motivated tax exemptions, as it is considered a sector providing food for subsistence (Agbeyegbe et al. 2006).

Investment in developing tax capacity depends crucially on the nature and quality of prevailing political and economic institutions in the recipient countries (Besley and Persson 2011, 2013). Developing countries receive different kinds of aid from varying donors, and the interplay between

[9] See Appendix Tables A1–A3 for a list of countries, statistics, and data source details. All data collected exclude social contributions and grants and are expressed as a percentage of GDP.

[10] For a recent discussion on tax revenue patterns in sub-Saharan Africa, see Tagem and Morrissey (2021).

aid flows and the quality of institutions significantly influences investments in fiscal capacity. We proxy for the quality of institutions by using the control of corruption index, obtained from the World Governance Indicators (WGI) database (World Bank 2022b). It captures perceptions of the extent to which public power is exercised for private gain (blurring of boundaries between public resources and private property of rulers) and the capture of the state by elite and private interests. Strong economic and political institutions are expected to promote tax administrations, permitting higher compliance and more tax revenue collection. Lower quality of institutions—portrayed by higher corruption—undermine revenue collection through a lack of accountability and transparency in tax administration, complicated tax laws, frequent contact between taxpayers and tax officials, and weak legal and judicial systems (Tanzi 1998; Thornton 2008).

3.2 Aid fragmentation index

The most commonly used measure of aid fragmentation in the literature is the Hirschman–Herfindahl index (HHI) (e.g., see Djankov et al. 2009; Gehring et al. 2017; Knack and Rahman 2007; Temple and Van de Sijpe 2017). The HHI measures probability in two random draws of US$2 in overall aid finance in a recipient country, with each dollar coming from a different donor. The measure of aid fragmentation is computed by subtracting the concentration index from a value of one. The HHI reflects the distribution of participation shares across donors. The more skewed the shares of the contributing donors, the lower the aid (donor) fragmentation. Formally, the aid fragmentation index can be expressed as:

$$AFI(HHI)_{rt} = 1 - \sum_{d=1}^{n} \left[\frac{D_{drt}}{TD_{rt}}\right]^2 \tag{1}$$

where subscripts *r*, *d*, and *t* denote the recipient of aid, the donor, and the period, respectively. $AFI(HHI)_{rt}$ is the HHI-based aid fragmentation index for recipient *r* in year *t*, $TD_{rt} = \frac{1}{n}\sum_{d=1}^{n} D_{drt}$ is the total disbursement amount from all donors, and D_{drt} is the disbursement amount from donor *d* to recipient *r* in year *t*. Hence, $\left[\frac{D_{drt}}{TD_{rt}}\right]^2$ is the share of the disbursement amount of donor *d* in the total disbursement amount from all donors. *n* is the number of donors.[11] Based on Equation 1, the resulting *AFI* will range from zero to one with higher values indicating high fragmentation of aid and vice versa. A value of zero shows no fragmentation at all, with the recipient country receiving all its aid finance from a single donor (complete donor dependence). A value of one shows total fragmentation, with the recipient country receiving aid from all available donors. Values of zero and one are implausible, with recipient countries instead falling within the range.[12]

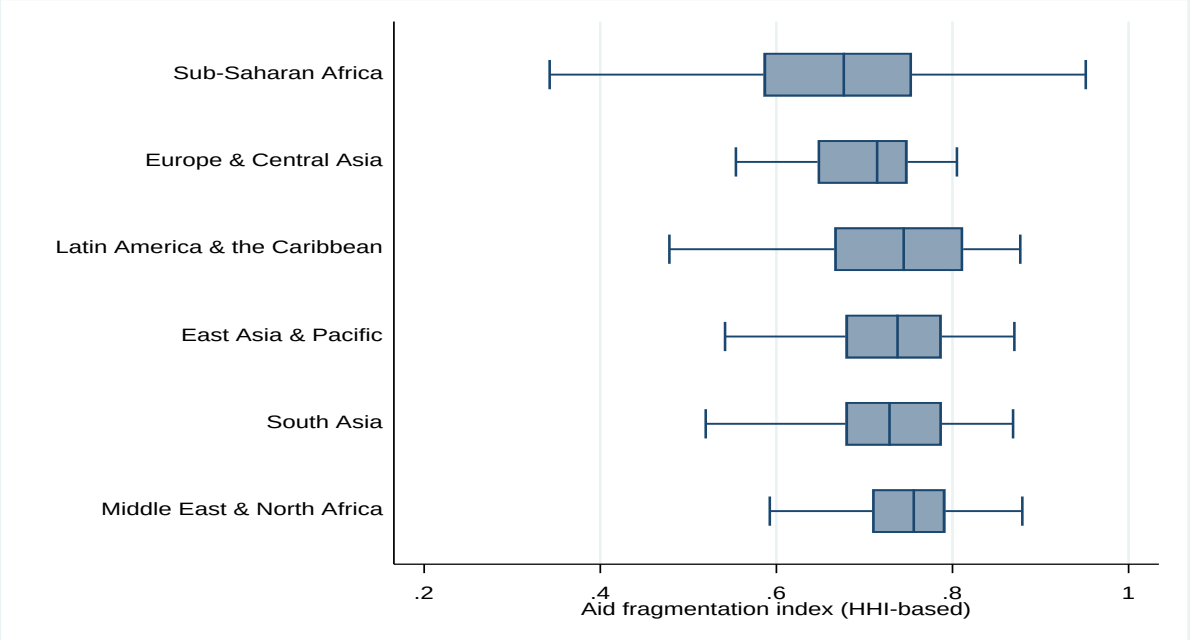
The sample average *AFI* stands at 0.70. Cabo Verde records the highest *AFI* (0.95), whereas Madagascar records the lowest *AFI* (0.16). Thus, Cabo Verde and Madagascar stand as the

[11] The HHI is generated with aid data from the 'Official Donors, Total' column of Table 2a of the OECD DAC data tables. This includes 29 DAC bilateral donors, all multilateral donors, non-DAC donors, and private donors. Private donors only started disbursing from 2009.

[12] The HHI is derived from donors' aid data and typically overestimates the amount of aid that goes through a recipient country's budget. For example, technical assistance does not go through recipient budgets. Furthermore, the HHI is not based on aid given specifically for domestic revenue mobilization. While the latter is the ideal data from which aid fragmentation indexes can be generated, the data are spotty and unsuitable for non-cross-sectional econometric analysis.

recipients with the most and least fragmented structure of aid, respectively. Significant differences also emerge across regions (Figure 3).[13] Sub-Saharan Africa (SSA) and South Asia exhibit the highest aid fragmentation index (above the sample average), while the remaining regions record the lowest aid fragmentation index. This highlights greater donor proliferation in the former groups than in the latter groups.

Figure 3: Aid fragmentation index by region (average values)



Source: authors' construction using the OECD DAC database (see OECD 2021).

4 Empirical strategy

We empirically explore the relationship between aid fragmentation and tax revenue, building on the attendant literature on determinants of tax performance (e.g., Gnangnon and Brun 2019; Yogo and Ngo Njib 2018). We postulate the following dynamic equation:

$$Tax_{it}=a+\beta Tax_{it-1}+\psi AFI_{it}+\boldsymbol{Z}_{it}\boldsymbol{\delta}+\lambda_i+\zeta_t+\varepsilon_{it} \quad (2)$$

Tax_{it} is the non-resource tax-to-GDP ratio for country i at time t. We included the one-period lagged value of the dependent variable to capture dynamics and persistence in tax performance (current levels of tax performance are partly determined by past levels of tax performance. AFI_{it} is the aid fragmentation index and Z_{it} is a set of control variables that explains tax performance. λ_i captures unobserved country-specific, time-invariant factors that permit estimating within-country variations like colonial heritage, indigenous institutions, and natural resource endowment. ζ_t denotes time-varying factors that could potentially affect aid fragmentation (and other independent

[13] The lower and upper hinges of each box show the 25th and 75th percentiles, respectively. The horizontal line indicates the median, and the endpoints of whiskers mark the next adjacent value.

variables) and the tax ratios, such as business cycle effects and other global shocks.[14] The last term, ε_{it}, is an idiosyncratic disturbance.

Although the extensive existing studies on aid disbursement typically consider aid to be endogenous, potential endogeneity issues related to aid fragmentation have not been discussed. There might be a reverse impact of taxes on aid levels and fragmentation. Lower levels of taxation—due to multiple constraints (administrative constraints, e.g., the complexity of tax systems, and political constraints, e.g., vested interests of elites, benefitting from tax incentives) or inherent structural characteristics [e.g., see the discussions in Junquera et al. (2017) and Mullins et al. (2020) on the challenges to revenue mobilization in low-income countries]—may be a primary reason for receiving aid from multiple donors. Recipients diversifying their aid portfolio or donors increasing their aid shares to recipient countries may be viewed as an insurance (smoothing) mechanism against chronic challenges in raising taxes in those recipient countries. There might also be a simultaneous relationship between aid fragmentation and tax performance. Structural characteristics may determine low revenue and high aid: countries with weak tax bases and low tax ratios may attract more (diversified) aid and vice versa. Furthermore, donors with high aid shares might reduce or increase their aid shares for reasons independent of recipient countries' tax performance.

Thus, the classic linear ordinary least square (OLS) estimation could provide consistent and unbiased coefficients in the absence of endogeneity (e.g., see Gehring et al. 2017). Including country fixed effects also reduces endogeneity arising from omitted time-invariant variables, permitting causal estimation of the impact of aid fragmentation on tax performance. However, estimating a dynamic specification using OLS and fixed-effect estimators would lead to biased estimates due to the correlation between the lagged dependent variable and the error term (Nickell 1981). The bias is especially significant in panel data with short time dimensions. Therefore, the most suited estimator for dynamic panel data models is the generalized method of moments (GMM) estimator that allows for dealing with the endogeneity of the tax ratio and endogeneity issues that might arise from all right-hand variables in our baseline model. In addition, the use of the GMM estimator in the dynamic model is strongly justified as some of the covariates could be a function of the tax ratio, and the presence of country dummies generally leads to biased estimates (Nickell 1981; Wooldridge 2002).

Recall that in the literature, the two GMM estimators commonly used are the difference GMM estimator (Arellano and Bond 1991) and the system GMM estimator (Arellano and Bover 1995; Blundell and Bond 1998). For the difference GMM estimator, Equation 2 is differenced to remove country fixed effects, and then the first-differenced variables are instrumented by the lagged values of the variables in level, whereas in the system GMM estimator, both equations in levels and first differences are used in a system that allows the use of lagged differences and lagged levels of the explanatory variables as instruments. Put differently, the system GMM estimator is an extension of the difference GMM estimator. Therefore, we rely on the system GMM estimator that, by eliminating fixed effects through first differencing, allows correcting for omitted variables and endogeneity bias by using lagged (one to two lags) endogenous regressors as effective instruments (Roodman 2009). However, the validity of the GMM estimation relies on the main assumption that instruments are exogenous (Roodman 2009). Therefore, we use the Hansen test statistic for over-identification to check the validity of the instruments. In addition, GMM estimations are

[14] The downside of including time dummies is it restricts the effects of global shocks and business cycles to be the same across countries. Furthermore, it implicitly assumes that each country's ability to react to those shocks is the same.

validated by the absence of a second-order serial correlation in the residuals in difference. Accordingly, the Arellano–Bond test is used to check that condition.

The validity of the system GMM estimator is gauged using standard diagnostic tests (Blundell and Bond 1998). These include the Arellano–Bond tests of first-order serial correlation in the residuals (AR(1)) and no second-order correlation in the residuals (AR(2)). We include the *p*-value of the Hansen test of over-identifying restrictions, that is, orthogonality of the instruments to the error term (hence instrument validity). We also report the number of instruments used in each regression; for an appropriate model, the number of instruments should be less than the number of cross-sections (Roodman 2009).

5 Empirical analysis

5.1 Baseline results

The diagnostic tests validate our econometric specification. The coefficient on the lagged dependent variable is positive and significant at the 1 per cent level, confirming the persistence and inertia in tax revenue mobilization, legitimizing our choice of dynamic estimator. The *p*-value on the first-order serial correlation test is zero and significant, indicating correlation, whereas the *p*-value associated with the second-order serial correlation test is non-zero and insignificant. Both confirm the validity of our econometric approach. Furthermore, the *p*-value of the Hansen *J* test is greater than 10 per cent and the total number of instruments is fewer than the number of countries. All these demonstrate the appropriateness of the system GMM approach.

The baseline empirical results of the effect of aid fragmentation on the tax-to-GDP ratio are reported in column 1 of Table 1. We find that the coefficient on aid fragmentation is negative and statistically significant, suggesting that aid fragmentation is harmful to tax revenue mobilization in developing countries. Quantitatively, the results indicate that a 1 percentage point increase in the aid fragmentation index is associated with 0.03 percentage points decrease in the tax-to-GDP ratio, on average. Although the magnitude of the effect may be small, it nevertheless demonstrates unintended negative consequences of aid (donor) fragmentation or an absence of donor coordination on tax performance, in line with our conceptual framework and predictions. The finding suggests that aid received in many small pieces from many donors may erode incentives to raise taxes by increasing the bureaucratic costs of aid, and fragmented aid generates large transaction/administrative costs for recipients, undermining tax revenue collection efforts. Fragmented aid may also be disbursed with lax financial management rules, exacerbating collective action problems and creating avenues for corruption and rent-seeking which undermine tax revenue mobilization.

The other control variables have expected signs, consistent with empirical evidence. Financial sector development has a positive impact on tax ratios, through states' ability to directly tax the domestic financial sector and that an improved domestic financial sector is characterized by higher growth, a lower underground economy, higher international trade, and lower tax evasion (Lompo 2021).[15] The level of development (captured by the real GDP per capita), the level of trade openness, the level of aid, and the quality of institutions also have significant positive associations

[15] A better functioning financial system can assess potential investors and choose the most successful ones. In addition, they are better equipped to mobilize and provide appropriate financing to investors rather than to individuals (Lompo 2021).

with the tax ratio while agriculture value added has a negative relationship. These findings are consistent with existing evidence (Clist and Morrissey 2011; Crivelli and Gupta 2014; Gupta 2007). Countries' tax capacity is positively related to their level of development. Thus, more developed countries collect more tax revenue than less developed countries. Increased trade volumes generate important tax receipts (especially for imports, which are a proxy for economic activity), as well as strong and good institutional quality, which is conducive to greater tax revenue collection.

Table 1: Baseline results

Dependent variable: non-resource tax (% GDP)	Total taxes	Direct taxes	CIT	PIT	Indirect taxes	VAT	Trade taxes	G&S taxes
Dependent variable (lagged)	0.110***	0.573***	1.002***	0.307***	0.162***	0.783***	0.657***	0.926***
	(0.025)	(0.055)	(0.066)	(0.047)	(0.034)	(0.042)	(0.006)	(0.057)
Aid fragmentation	−0.026***	−0.009**	−0.006**	−0.005**	−0.011	−0.008***	−0.003	−0.006
	(0.007)	(0.044)	(0.003)	(0.002)	(0.007)	(0.003)	(0.003)	(0.004)
Financial sector development	0.025***	0.006***	0.000	0.006	0.015***	0.001	−0.002*	0.001
	(0.004)	(0.002)	(0.000)	(0.004)	(0.003)	(0.001)	(0.001)	(0.001)
Log aid (% GDP)	0.011***	0.004***	0.000	0.002**	0.005**	0.002***	0.001*	0.001
	(0.002)	(0.001)	(0.000)	(0.001)	(0.002)	(0.001)	(0.000)	(0.001)
Log trade (% GDP)	0.026*	−0.001	0.000	−0.004	0.003	0.000	0.003***	0.001*
	(0.013)	(0.003)	(0.006)	(0.003)	(0.005)	(0.001)	(0.001)	(0.001)
Log agriculture value added	−0.012*	−0.009***	−0.0002	−0.001	−0.006	−0.006***	−0.000	−0.001
	(0.006)	(0.003)	(0.001)	(0.005)	(0.005)	(0.002)	(0.001)	(0.001)
Resource rents	−0.0004	−0.000	0.000	0.000	−0.001**	−0.000	−0.000	−0.000*
	(0.0003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Control of corruption	0.015**	−0.001	−0.0003	0.005	0.005	0.001	0.003	−0.001
	(0.006)	(0.003)	(0.001)	(0.003)	(0.006)	(0.003)	(0.002)	(0.002)
Constant	0.123*	0.083***	0.003	0.042	0.098**	0.503***	0.012	0.010
	(0.068)	(0.024)	(0.007)	(0.036)	(0.043)	(0.016)	(0.009)	(0.009)
Observations	1,134	1,084	811	795	1,192	793	1,143	1,142
Countries	90	89	70	73	90	66	87	88
AR (1) *p*-value	0.028	0.000	0.000	0.132	0.008	0.007	0.132	0.001
AR (2) *p*-value	0.126	0.636	0.711	0.312	0.182	0.199	0.315	0.458
Hansen OID (*p*-value)	0.261	0.146	0.103	0.279	0.086	0.902	0.017	0.072
Instruments	26	24	15	14	25	16	19	20
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: GDP, gross domestic product; CIT, corporate income tax; PIT, personal income tax; VAT, value-added tax; G&S, goods and services tax; OID, over-identifying restrictions; FE, fixed effect. *, **, and *** denote statistical significance at 10, 5, and 1 per cent levels, respectively. Standard errors are reported in parentheses. The number of instruments is strongly limited—starting with the second lag of the dependent variable and the first lag of the control variables—to avoid the over-fitting problem. In all specifications, the null hypothesis is rejected for lack of first-order (AR (1)) serial correlation in the first-differenced error terms, but not rejected for the second-order (AR (2)). In addition, the robust (to heteroskedasticity and autocorrelation) Hansen's p-value validates the over-identification restrictions. All these statistical tests validate the econometric method. This applies to all regressions in the paper.

Source: authors' calculations.

5.2 Tax components

We explore the effect of aid fragmentation on constituent parts of taxes, first distinguishing between direct and indirect taxes and later distinguishing between the various components of both taxes. The results support the harmful effects of aid fragmentation on all sub-components of taxation and suggest three key findings. First, aid fragmentation has a strong negative relationship with direct taxes but no significant relationship with indirect taxes (columns 2 and 5 of Table 1). As discussed in Section 2, investments, and political and organizational effort in developing fiscal capacity, are higher for direct than for indirect taxes, hence the larger magnitude of negative effects on the former. The deleterious effects of aid fragmentation are stronger on direct taxes than on indirect taxes. Second, aid fragmentation has a negative impact on both CIT and PIT, but the magnitude of impact is more severe on CIT (columns 3 and 4 of Table 1). Investments in developing the administrative capacity to administer corporate taxes are much larger than PITs, given the broader potential tax base of the former compared with the latter, as well as the stronger negative effects of corporate tax issues on domestic revenue (e.g., tax competition, granting of tax incentives, and tax avoidance) compared with PITs (e.g., tax evasion). For example, corporate taxes are collected from domestic and foreign firms (MNEs), whereas PITs are collected on the incomes of individuals (some of them employed by MNEs). The contributions from MNEs are substantial, but so is their ability to avoid paying taxes through base erosion and other tax optimization techniques. Third, all indirect taxes, except VAT, have no significant relationship with aid fragmentation (columns 4–8 of Table 1). VAT is a unique accounting tax whose performance depends entirely on its design and enforcement, both of which require considerable administrative and political effort to develop.

5.3 Robustness analysis

In this section, we undertake some robustness exercises to ascertain the validity of our primary findings. First, we gauge the role of institutional quality to test two effects: the direct effect of institutional quality on tax ratios (following the standard tax performance literature) and the indirect (mediating) effect of institutions on tax ratios, through their effect on aid fragmentation. The latter ascertains whether there are countries where higher institutional quality means they can cope better with more fragmented aid, and it mediates the effect on tax revenue. We proxy for the quality of institutions by using the other measures from WGI, in addition to the control of corruption, including political stability, rule of law, government effectiveness, regulatory quality, and voice and accountability. The results are reported in Table 2.

All measures of institutional quality—except regulatory quality—have a positive association with tax ratios, concurring with empirical evidence in the literature (Garcia and Von Haldenwang 2016; Yogo and Ngo Njib 2018). The mediating impact—estimated by interacting aid fragmentation with various measures of institutional quality—shows a negative relationship with tax ratios for only political stability and government effectiveness. This suggests that the quality of recipients' institutions is not strong enough to assuage the negative effects of aid fragmentation on tax revenue performance. Overall, the findings suggest that while the process by which governments are selected, the capacity of governments to effectively formulate and implement sound policies, and citizens' respect for economic institutions themselves stimulate higher tax performance, they do not appear to assuage the adverse effects of aid fragmentation on tax performance in the sample of countries.

Table 2: Role of institutional quality

Dependent variable: non-resource tax (% GDP)	Political stability	Rule of law	Government effectiveness	Regulatory quality	Accountability	Control of corruption
Dependent variable (lagged)	0.673*** (0.047)	0.697*** (0.044)	0.759*** (0.036)	0.679*** (0.047)	0.685*** (0.044)	0.683*** (0.044)
Aid fragmentation	−0.015* (0.008)	−0.025* (0.015)	−0.012 (0.010)	−0.020* (0.012)	−0.015* (0.009)	−0.019 (0.012)
Institutional quality	0.008*** (0.003)	0.015*** (0.007)	0.010** (0.005)	0.009 (0.006)	0.009** (0.004)	0.013** (0.006)
Aid fragmentation × institutional quality	−0.013** (0.006)	−0.028 (0.018)	−0.018* (0.010)	−0.015 (0.015)	−0.005 (0.009)	−0.013 (0.012)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.036 (0.032)	0.034 (0.034)	0.025 (0.029)	0.030 (0.035)	0.023 (0.031)	0.029 (0.032)
Observations	1,133	1,134	1,134	1,134	1,134	1,134
Countries	90	90	90	90	90	90
AR (1) *p*-value	0.010	0.010	0.013	0.012	0.012	0.012
AR (2) *p*-value	0.178	0.166	0.181	0.181	0.177	0.171
Hansen OID (*p*-value)	0.522	0.329	0.158	0.242	0.361	0.356
Instruments	26	24	23	23	24	23
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: see Table 1 note.

Source: authors' calculations.

Second, we test the sensitivity of the results from the baseline specification to additional control variables including remittances (% GDP), the level of education, inflation, the population size, foreign direct investment (FDI), the level of development (as proxied by GDP per capita) and a tax revenue diversification index.[16] The estimated results are reported in Table 3 and remain qualitatively unchanged. The additional variables add nothing to the analysis as all the variables match existing empirical evidence. Indeed, remittances are expected to fuel increased tax ratios and a higher level of education is expected to be conducive to greater tax compliance. (e.g., see Bird et al. 2008; Gordon and Li 2009). On the other hand, higher inflation episodes are negatively linked to tax collection capacity (Tanzi 1978). FDI and the level of development are also associated with a positive increase in tax ratios (Camara 2022; Gnangnon 2017). Higher inward FDI expands the domestic tax base—through increases in PIT from their expatriates, increases in CIT, as well as attendant increases in consumption taxes, like VAT—which results in an increase in domestic taxes. Countries' tax capacity is positively related to their level of development. Thus, countries collect a ratio of tax revenue ratio relating to their stage of development. Having a diversified tax base has no impact on tax revenue mobilization in developing countries.

[16] All the additional variables are obtained from the World Development Indicators (World Bank 2020a). The tax revenue diversification index is obtained from Compaoré et al. (2020).

Table 3: Robustness analysis, more control variables

Dependent variable: non-resource tax (% GDP)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Total tax				
Dependent variable (lagged)	0.110*** (0.025)	0.141*** (0.041)	0.150*** (0.036)	0.142*** (0.037)	0.005 (0.045)	0.050 (0.048)	0.104** (0.049)	0.304*** (0.038)
Aid fragmentation	−0.026*** (0.007)	−0.017* (0.008)	−0.022** (0.009)	−0.019** (0.008)	−0.020** (0.010)	−0.013* (0.007)	−0.015** (0.007)	−0.036** (0.016)
Financial sector development	0.025*** (0.004)	0.015*** (0.004)	0.018*** (0.005)	0.018*** (0.005)	0.019*** (0.006)	0.030*** (0.006)	0.017*** (0.005)	0.003 (0.006)
Log aid (% GDP)	0.011*** (0.002)	0.004 (0.003)	0.009*** (0.003)	0.007*** (0.003)	0.008** (0.004)	0.007** (0.003)	0.007** (0.003)	0.012*** (0.004)
Log trade (% GDP)	0.026* (0.013)	0.008 (0.007)	0.012* (0.007)	0.004 (0.006)	0.002 (0.010)	−0.016 (0.011)	−0.009 (0.011)	0.003 (0.017)
Log agriculture value added	−0.012* (0.006)	−0.016** (0.007)	−0.021*** (0.006)	−0.019*** (0.006)	−0.021** (0.009)	0.016 (0.011)	0.036** (0.015)	−0.002 (0.014)
Resource rents	−0.0004 (0.0003)	−0.001* (0.000)	−0.001** (0.000)	−0.001* (0.000)	−0.001** (0.001)	−0.001*** (0.000)	−0.002*** (0.000)	−0.002** (0.007)
Control of corruption	0.015** (0.006)	0.026*** (0.007)	0.014* (0.007)	0.016** (0.007)	0.026*** (0.009)	0.025*** (0.008)	0.018** (0.008)	0.024*** (0.008)
Remittances		0.001*** (0.001)	0.001 (0.001)	0.001 (0.001)	−0.001 (0.001)	−0.000 (0.001)	−0.001 (0.001)	−0.004*** (0.001)
Education			0.0003* (0.000)	0.0004** (0.000)	0.0004** (0.000)	0.000 (0.000)	0.0004** (0.000)	0.001*** (0.000)
Inflation				−0.000 (0.000)	−0.000 (0.000)	−0.001* (0.000)	−0.001*** (0.000)	−0.0002 (0.001)
Log population					0.006* (0.003)	0.001 (0.003)	0.001 (0.003)	0.009** (0.004)
Foreign direct investment						0.001* (0.001)	0.001** (0.001)	0.001*** (0.001)
GDP per capita							0.042*** (0.012)	0.018 (0.011)
Tax revenue diversification								−0.026 (0.016)
Constant	0.123* (0.068)	0.148*** (0.054)	0.159*** (0.051)	0.164*** (0.046)	0.123 (0.083)	0.128* (0.073)	−0.272* (0.146)	−0.079 (0.198)
Observations	1,134	925	925	890	890	890	882	382
Countries	90	89	89	87	87	87	86	47
AR (1) *p*-value	0.028	0.029	0.030	0.040	0.140	0.115	0.011	0.084
AR (2) *p*-value	0.126	0.238	0.231	0.245	0.226	0.228	0.173	0.226
Hansen *p*-value	0.261	0.055	0.121	0.125	0.018	0.093	0.084	0.369
Instruments	27	19	17	16	16	17	15	12
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: see Table 1 note.

Source: authors' calculations.

Third, we rely on an alternative econometric estimation method. Indeed, the common criticism of the GMM estimator is the well-known problem of too many instruments. The instruments in the system GMM estimator can grow quadratically in *T*, leading to inconsistent estimations and causing several problems in finite samples (Roodman 2009). To address this problem, we use the bias-corrected least-squares dummy variable regression model. The results are provided in Table 4. The findings remain broadly consistent with the baseline results for total and direct taxes, but insignificant for all other taxes.

Table 4: Robustness check, an alternative method

Dependent variable: non-resource tax (% GDP)	Total taxes	Direct taxes	CIT	PIT	Indirect taxes	VAT	Trade taxes	G&S taxes
Dependent variable (lagged)	0.923*** (0.042)	0.957*** (0.033)	0.863*** (0.042)	0.963*** (0.055)	0.900*** (0.000)	0.922*** (0.024)	0.873*** (0.073)	0.954*** (0.012)
Aid fragmentation	−0.007** (0.004)	−0.004** (0.002)	−0.002 (0.002)	−0.0002 (0.001)	0.0004 (0.003)	−0.004 (0.002)	−0.003 (0.003)	−0.006 (0.004)
Financial sector development	0.002 (0.001)	0.001 (0.000)	0.001* (0.000)	0.000 (0.000)	0.002 (0.001)	0.001 (0.001)	−0.002* (0.001)	0.001 (0.001)
Log aid (% GDP)	0.001 (0.000)	0.0001 (0.000)	0.0004* (0.000)	0.0002 (0.000)	0.001* (0.000)	0.002*** (0.001)	0.001* (0.000)	0.001 (0.001)
Log trade (% GDP)	0.002*** (0.001)	0.001 (0.000)	0.001** (0.001)	−0.0001 (0.000)	0.002** (0.001)	0.000 (0.001)	0.003*** (0.001)	0.001* (0.001)
Log agriculture value added	−0.000 (0.001)	−0.0001 (0.003)	−0.0002 (0.001)	−0.0004 (0.001)	−0.000 (0.001)	−0.006*** (0.002)	−0.000 (0.001)	−0.001 (0.001)
Resource rents	−0.0001** (0.000)	0.000 (0.000)	0.000 (0.000)	−0.000 (0.000)	−0.000*** (0.000)	−0.000 (0.000)	−0.000 (0.000)	−0.000* (0.000)
Control of corruption	0.002 (0.002)	0.001 (0.001)	0.0001 (0.000)	0.0003 (0.001)	0.001 (0.001)	0.001 (0.003)	0.003 (0.002)	−0.001 (0.002)
Observations	1,134	1,084	811	795	1,192	793	1,143	142
Countries	90	89	70	73	90	66	87	88

Note: see Table 1 note.

Source: authors' calculations.

Fourth, we demonstrate heterogeneity by splitting the sample across two dimensions: geographical location and level of development. For the geographical location, we distinguish between the SSA region and other regions (columns 1–6 of Table 5). Aid fragmentation has a negative relationship with tax performance across all regions except SSA. Focusing on the regional dummies, the results show that Europe and Central Asian countries display greater significant tax revenue collection effort than other regions, whereas the Middle East and North Africa indicate a lower tax revenue ratio compared with other regions. The interaction terms between regional dummies and aid fragmentation are insignificant for all regions except SSA, which is intuitive and suggests that the adverse effect of aid fragmentation is pronounced in the SSA region.

For the level of development, we distinguish between low-income countries and other developing countries, the latter comprising lower-middle-income and upper-middle-income countries.[17] Low-income countries differ fundamentally in their revenue-raising abilities (or lack thereof) relative to other developing countries (Mullins at al. 2020) and they receive more aid from a multitude of donors and donor agencies (World Bank 2022c). Based on the above, we test if a country's level of development mediates the negative impact of aid fragmentation on tax revenue mobilization (columns 7–8 of Table 5). The interaction term is insignificant across both groups of countries, suggesting that aid fragmentation is detrimental to tax performance, irrespective of a country's level of development.

[17] The countries are split based on the World Bank's income classification.

Table 5: Heterogeneity, geographical region, and level of development

Dependent variable: non-resource tax (% GDP)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Regions						Level of development	
	ECA	SSA	SA	LAC	MENA	EAP	LIC	MIC
Dependent variable (lagged)	0.072***	0.113***	0.107***	0.112***	0.084***	0.105***	0.139***	0.138***
	(0.024)	(0.026)	(0.025)	(0.024)	(0.025)	(0.025)	(0.027)	(0.026)
Aid fragmentation	−0.0277***	0.0037	−0.0262***	−0.0324***	−0.0295***	−0.0229***	−0.0294**	−0.0476**
	(0.007)	(0.020)	(0.006)	(0.010)	(0.008)	(0.007)	(0.012)	(0.022)
Region	0.0460**	0.0174	−0.0310**	0.0003	−0.0222*	−0.0022		
	(−0.023)	(−0.012)	(−0.012)	(−0.016)	(−0.013)	(−0.015)		
Income level							−0.0042	−0.0105
							(−0.008)	(−0.013)
Aid fragmentation × region	0.021	−0.045*	0.026	0.046	0.029	−0.018		
	(−0.071)	(−0.024)	(−0.031)	(−0.037)	(−0.025)	(−0.041)		
Aid fragmentation × income level							0.008	0.033
							(−0.019)	(−0.033)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.164***	0.072	0.134**	0.124*	0.119*	0.114*	0.136*	0.130*
	(−0.058)	(−0.070)	(−0.068)	(−0.065)	(−0.065)	(−0.067)	(−0.073)	(−0.067)
Observations	1,134	1,134	1,134	1,134	1,134	1,134	1,134	1,134
Countries	6	37	7	14	12	14	21	69
AR(1) *p*-value	0.052	0.019	0.032	0.020	0.047	0.034	0.016	0.011
AR(2) *p*-value	0.119	0.127	0.124	0.123	0.120	0.125	0.133	0.134
Hansen OID (*p*-value)	0.266	0.176	0.246	0.188	0.321	0.229	0.260	0.295
Instruments	26	26	26	26	26	26	26	26
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: GDP, gross domestic product; ECA, Europe and Central Asia; SSA, sub-Saharan Africa; SA, South Asia; LAC, Latin America and the Caribbean; MENA, Middle East and North Africa; EAP, East Asia and the Pacific; LIC, low-income countries; MIC, middle-income countries.

Source: authors' calculations.

6 Conclusion

Domestic revenue mobilization remains an important objective for attaining the SDGs and dealing with the rising debt vulnerabilities across many developing countries. Raising taxes is particularly challenging for low-income countries (McNabb et al. 2021; Mullins et al. 2020), hence their continued dependence on aid from traditional bilateral and multilateral donors. Over the past decades, however, an increasing number of new donors has emerged in the development assistance community, generating increasing numbers of aid partnerships for developing countries. There has also been an increase in the number of donor agencies. These have resulted in the increased proliferation of actors in the aid community, despite international efforts to enhance donor coordination and reduce aid fragmentation. Such aid fragmentation has been found to undermine aid effectiveness in developing countries by increasing transaction costs in recipient countries, fuelling rent-seeking and corrupt behaviour in recipient countries, and reducing tax and overall administration (Djankov et al. 2009; Knack and Rahman 2007). While the literature on aid fragmentation is relatively scant, there are no empirical studies on its effects on tax revenue mobilization. This study contributes by estimating the impact of aid fragmentation on tax revenue mobilization in developing countries. To perform the analysis, we construct a measure of aid fragmentation using the Herfindahl index, based on donors' respective shares in total aid finance to a recipient country. Drawing on the popular system GMM estimator to deal with endogeneity issues, this study focuses on a sample of 90 developing countries covering the period from 2000 to 2020.

There are three fundamental aspects to the analysis. First, aid fragmentation has a negative relationship with tax revenue mobilization. The negative relationship can be explained by a political calculus favouring collecting aid from multiple donors over raising taxes and resulting in higher bureaucratic costs of aid. Highly fragmented aid also induces high administrative/transaction costs in both donor and recipient countries, further exacerbating bureaucratic costs of aid in recipient countries. Within the context of constrained tax administration capacity, increased transaction costs are difficult to sustain. In addition, fragmented aid may exacerbate collective action problems. Given the speed with which aid is disbursed in the backdrop of lax financial management and increased use of parallel projects, fragmented aid creates avenues for corrupt and rent-seeking practices. Our findings are robust to the inclusion of more control variables and an alternative estimation approach, but weak when we split countries by level of development and geographical location.

Second, the paper also explored the impact of aid fragmentation on the tax structure across countries and found convincing evidence that direct taxes are most negatively affected. Even within direct taxes, there is heterogeneity with the negative impact stronger on CIT than on PIT. For indirect taxes, there are no effects except for VAT, for which there is a strong negative relationship with aid fragmentation. We argue that these strong effects on direct taxes (as well as its constituent parts) and VAT are because they require more investment and greater political and administrative effort in developing and administering, hence they need more donor coordination to ensure beneficial effects. Indirect taxes, especially goods and services taxes (such as standard sales taxes and excises) and international trade taxes (such as tariffs and excises on imported goods) mostly require just observing the consumption or trade flow, and hence, require less investment.

Third, institutions are posited to influence tax performance, directly and indirectly, the latter acting through their impact on aid fragmentation. The results are intuitive. Although the control of corruption has a direct positive effect on tax performance, its interactive effect is insignificant, which is similar to other measures of institutions except for regulatory quality. Institutions do not completely assuage the negative impact of aid fragmentation on tax revenue mobilization. At most,

only institutions depicting the process by which governments are selected (captured by an interaction term between political stability and aid fragmentation) and the capacity of governments to effectively formulate and implement sound policies (captured by an interaction term between government effectiveness and aid fragmentation) have an effect.

The findings concur with the extant empirical literature on aid fragmentation but provide novel evidence of the impact on tax revenue mobilization. As the first empirical work in the literature to provide strong evidence of the impact of aid fragmentation on tax revenue in developing countries, the paper shows interesting policy options. The results show that the deleterious effects of aid fragmentation are more profound on broad-based taxes [i.e. those based on income (CIT and PIT) and accounting categories (VAT)]. Developing the capacity to administer and collect these taxes is crucial and donor coordination in this domain would have galvanizing effects. The effects may also depend on the nature of the aid flow. For technical assistance—which is crucial for tax administration and tax policy reform—the concentration of a few lead donors (hence less fragmentation) may be essential in enhancing its potential positive impact on tax revenue mobilization.

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Appendix

Table A1: List of countries

	Income level	Region		Income level	Region
Algeria	Middle income	MENA	Lao PDR	Middle income	EAP
Angola	Middle income	SSA	Lebanon	Middle income	MENA
Armenia	Middle income	ECA	Lesotho	Middle income	SSA
Bangladesh	Low income	SA	Libya	Middle income	MENA
Belize	Middle income	LAC	Madagascar	Low income	SSA
Benin	Low income	SSA	Malaysia	Middle income	EAP
Bhutan	Low income	SA	Maldives	Low income	SA
Bolivia	Middle income	LAC	Mali	Low income	SSA
Botswana	Middle income	SSA	Mauritania	Middle income	SSA
Brazil	Middle income	LAC	Mauritius	Middle income	SSA
Burundi	Low income	SSA	Mexico	Middle income	LAC
Cabo Verde	Middle income	SSA	Morocco	Middle income	MENA
Cambodia	Middle income	EAP	Mozambique	Low income	SSA
Cameroon	Middle income	SSA	Myanmar	Middle income	EAP
CAR	Low income	SSA	Nepal	Low income	SA
Chad	Low income	SSA	Nicaragua	Middle income	LAC
China	Middle income	EAP	Niger	Low income	SSA
Comoros	Low income	SSA	Nigeria	Middle income	SSA
Congo, Rep.	Middle income	SSA	Pakistan	Low income	SA
Cote d'Ivoire	Middle income	SSA	Panama	Middle income	LAC
Djibouti	Middle income	MENA	Paraguay	Middle income	LAC
Ecuador	Middle income	LAC	Philippines	Middle income	EAP
Egypt	Middle income	MENA	Rwanda	Low income	SSA
El Salvador	Middle income	LAC	Samoa	Middle income	EAP
Equatorial Guinea	Middle income	SSA	Sierra Leone	Low income	SSA
Eswatini	Middle income	SSA	Solomon Islands	Middle income	EAP
Fiji	Middle income	EAP	South Africa	Middle income	SSA
Gabon	Middle income	SSA	South Sudan	Low income	SSA

Gambia, The	Low income	SSA	Sri Lanka	Low income	SA
Georgia	Middle income	ECA	Sudan	Middle income	SSA
Ghana	Middle income	SSA	Suriname	Middle income	LAC
Guatemala	Middle income	LAC	Syria	Middle income	MENA
Guinea	Low income	SSA	Tajikistan	Middle income	ECA
Guinea-Bissau	Low income	SSA	Tanzania	Low income	SSA
Haiti	Low income	LAC	Thailand	Middle income	EAP
Honduras	Middle income	LAC	Togo	Low income	SSA
India	Low income	SA	Tonga	Middle income	EAP
Indonesia	Middle income	EAP	Tunisia	Middle income	MENA
Iran	Middle income	MENA	Uganda	Low income	SSA
Iraq	Middle income	MENA	Uzbekistan	Middle income	ECA
Jamaica	Middle income	LAC	Vanuatu	Middle income	EAP
Jordan	Middle income	MENA	Viet Nam	Middle income	EAP
Kazakhstan	Middle income	ECA	Yemen	Middle income	MENA
Kenya	Middle income	SSA	Zambia	Middle income	SSA
Kyrgyzstan	Middle income	ECA	Zimbabwe	Low income	SSA

Note: MENA, Middle East and North Africa; PDR, People's Democratic Republic; EAP, East Asia and the Pacific; SSA, sub-Saharan Africa; ECA, Europe and Central Asia; SA, South Asia; LAC, Latin America and the Caribbean.

Source: authors' compilation.

Table A2: Summary statistics

Variables	Observation	Mean	SD	Min	Max
Aid fragmentation index	1,134	0.69	0.124	0.15806	0.95137
Total tax	1,134	0.13	0.065	0.00612	0.609464
Income tax	917	0.05	0.029	0.00507	0.17128
PIT	705	0.02	0.020	0.0000	0.1338039
CIT	700	0.03	0.016	0.0029547	0.1041779
Indirect tax	1,018	0.09	0.044	0.0025108	0.4861849
Taxes on G&S	990	0.07	0.035	0.003426	0.1675025
VAT	654	0.05	0.024	0.0000	0.1116649
Trade tax	992	0.02	0.032	−0.0158212	0.4086095
Direct tax	1,000	0.05	0.029	0.002815	0.1744217
Domestic credit to private sector (% of GDP)	1,134	34.74	31.573	0.0078254	157.8121
Aid received	1,134	0.00	0.000	1.09e−08	0.0000586
Trade (% of GDP)	1,134	76.95	38.138	1.377797	347.9965
Agriculture value added (% GDP)	1,134	16.86	11.893	0.8926961	60.61109
Resources rent (% GDP)	1,134	8.09	10.569	0.0012602	67.91761
Government effectiveness	1,134	−0.53	0.597	−2.270754	1.267115
Political stability	1,133	−0.50	0.796	−2.82731	1.384696
Rule of law	1,134	−0.59	0.568	−1.855509	1.07713
Regulatory quality	1,134	−0.50	0.558	−2.625506	1.12727
Voice accountability	1,134	−0.52	0.697	−2.000246	0.9700963
Control of corruption	1,134	−0.59	0.565	−1.815811	1.640953
Personal remittances, received (% of GDP)	1,119	5.96	7.483	0.0000	44.12622
School enrolment, primary (% gross)	926	104.84	16.493	39.53921	149.9568
Inflation	1,085	6.20	6.004	−18.10863	53.23096
Log total population	1,134	16.17	1.876	11.50311	21.06171
Foreign direct investment, net inflows (% of GDP)	1,134	3.89	4.808	−6.369877	46.27524
GDP per capita, PPP (current international dollars)	1,128	6,680.86	5,799.107	541.7639	38,407.92

Note: PIT, personal income tax; CIT, corporate income tax; G&S, goods and services tax; GDP, gross domestic product; PPP, purchasing power parity.

Source: authors' calculations based on data from UNU-WIDER (2021), OECD DAC (OECD 2021), the World Development Indicators (World Bank 2020a) and the World Governance Indicators (World Bank 2020b).

Table A3: Data sources and descriptions

Variables	Definition	Source
AFI	Aid fragmentation index	Authors' calculation
Tax revenue diversification	Tax revenue diversification index	Compaoré et al. (2020)
Aid received	Total net official development assistance (net of loan repayments) from official donors.	OECD DAC (OECD 2021)
Total tax	Total non-resource tax revenue excluding grants and social contributions (% GDP)	UNU-WIDER (2021)
Direct taxes	Direct taxes excluding social contributions and resource revenue (% GDP)	
Income tax	Taxes on income, profits, and capital gains (% GDP)	
CIT	Corporate income tax (% GDP)	
PIT	Personal income tax (% GDP)	
Indirect taxes	Indirect taxes (% GDP)	
VAT	Value-added tax (% GDP)	
Trade taxes	Taxes on international trade and transactions (% GDP)	
Taxes on G&S	Taxes on goods and services (% GDP)	
Financial sector development	Domestic credit to the private sector (% GDP)	World Bank (2022a)
Trade	Sum of total imports and exports (% GDP)	
Share of agriculture	Agriculture value added (% GDP)	
Resources rent	Sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents (% GDP)	
Remittances	Personal remittances received (% GDP)	
Education	School enrolment, primary (% gross)	
Inflation	Inflation, average consumer prices	
Population	Total population	
Foreign direct investment	Foreign direct investment, net inflows (% GDP)	
Level of development	GDP per capita, PPP (current international dollars)	
Political stability	Political stability	World Bank (2022b)
Rule of law	Rule of law	
Government effectiveness	Government effectiveness	
Regulatory quality	Regulatory quality	
Voice accountability	Voice accountability	
Control of corruption	Control of corruption	

Source: authors' compilation.