1. Introduction

The adverse effects of trade liberalization on public revenue, including through lower international trade tax revenue[1] have raised serious concerns among policymakers in developing countries about how to replace the tax revenue losses to at least maintain the level of public revenue or eventually increase it. In light of the importance of ensuring a sustainable stream of tax revenue so as to finance development needs in developing countries (e.g., Brautigam et al., 2008), international organizations such as the International Monetary Fund (IMF) and the World Bank as well as many researchers (Ebrill et al., 2001; Khattry, 2003; Chambas, 2005; Keen, 2012; Brun and Chambas, 2014) have advised that policymakers in developing countries should adopt a revenue replacement strategy. This strategy involves a tax reform - also referred to as "tax transition reform" (e.g., Chambas, 2005; Brun and Chambas, 2014) that entails a change in the tax structure in favour of domestic tax revenue, and at the expense of international trade tax revenue, as it is the case for developed countries (old industrialized countries). The proposed tax reform would therefore lead to a tax structure in developing countries that would be similar to that of developed countries. Few studies (e.g., Baunsgaard and Keen, 2010; Waglé, 2011; and Crivelli, 2016; Moller, 2016) have examined whether developing countries have been able to recoup the lost international trade tax revenue through domestic public revenue. For example, Baunsgaard and Keen (2010) have obtained empirical evidence that middle-income countries and high-income countries have recouped the lost trade tax revenue from other sources. However, for low-income countries (LICs), the replacement rate is still low, although signs of recovery vary across these countries. Waglé (2011) has obtained that the tax recovery in LICs is much more robust than shown by Baunsgaard and Keen (2010), although long term replacement is statistically significant only for few LICs. Moller (2016) has reported that low-income countries that have enjoyed a significant tax recovery are those that have simultaneously initiated a process of democratization. Using a sample of transition economies in Eastern Europe, the former Soviet Union, and North Africa and the Middle East, Crivelli (2016) has obtained empirical evidence in support for the strong revenue replacement of total domestic tax revenue with trade tax revenue lost, including through the Value-added Tax (VAT), and the personal income tax (PIT). Even though these findings provide an insight into whether the replacement strategy has been successful or not, they do not provide a clear sense of the empirical effect of the tax transition reform (which for the sake

[1] Several studies have reported empirical evidence or emphasized the negative effects of trade liberalization on public revenue, including through international trade tax revenue (e.g., Bevan, 1995; Khattry, 2001; Khattry and Rao, 2002; Keen and Ligthart, 2002; Berg and Krueger, 2003; Keen and Simone, 2004; Aizenman and Jinjarak, 2009; Longoni, 2009; Baunsgaard and Keen, 2010; Castanheira, Nicodème and Profeta, 2011; Waglé, 2011; Hisali, 2012; Crivelli, 2016; Moller, 2016; Cagé and Gadenne, 2018).

of simplicity, is henceforth referred to as "tax reform") on public revenue. To the best of our knowledge, the empirical question as to whether tax reform yields higher tax revenue remains unaddressed in the empirical literature.

On another note, the few existing studies on the instability of public revenue in developing countries (e.g., Lim, 1983; Bleaney et al., 1995; Ebeke and Ehrhart, 2012; Ebeke, 2014) have reported that public revenue instability translates into higher instability of public expenditure, higher instability of both public investment and government consumption, as well as lower public investment. One could therefore question whether in addition to its possible effect on the level of tax revenue, tax reform also helps dampen the instability of public revenue, with a view to ensuring a stable and sustainable public revenue in developing countries. To the best of our knowledge, this question has not been addressed from an empirical perspective.

The dependence of many developing countries on development aid (also known as official development assistance - ODA) for their economic performance, including tax performance, has led many studies to investigate the effect of development aid on tax revenue performance (e.g. Knack and Rahman, 2007; Brun et al. 2011; Remmer, 2004; Benedek et al. 2012; Ouattara, 2006; Clist, 2016; Morrissey et al. 2014; Yohou et al. 2016; Gnangnon and Brun, 2017). While these studies have not reached a clear-cut conclusion as to the direction in which development aid influences public revenue performance in developing countries, one study (Gbewopo et al. 2009) among the few existing studies[2] on the determinants of tax reform in developing countries has reported that development aid inflows promote tax (transition) reform in recipient-countries. This might therefore suggest that development aid could matter for the influence of tax reform on tax revenue performance in developing countries. Additionally, as the instability of public revenue is a major concern for policymakers in developing countries, one could also question whether the volatility of development aid would not only matter for the instability of public revenue, but also for the effect that tax reform might have on public revenue instability in developing countries. To the best of our knowledge, this question has not been addressed in the empirical literature. Its relevance lies on the possible negative effects of aid volatility on recipient economies, including through undermining the capacity of policymakers in recipient-countries to finance and execute planned investments, and ultimately adversely affect countries' development prospects (e.g., Bulíř and Hamman, 2001; 2003, 2008; Hudson, 2015; Agénor, 2016).

[2] These studies include for example Mahon (2004); Sánchez (2006); Di John (2006); Castanheira et al. (2011); Lora (2012); Focanti et al. (2013); and Adandohoin (2018).

In light of the foregoing, the current article addresses empirically four questions:

(i) How does tax reform affect public revenue performance in developing countries?

(ii) Does the impact of tax reform on public revenue performance (if any at all) depend on the amount of development aid flows that accrue to developing countries?

(iii) How does tax reform affect public revenue instability in developing countries?

(iv) Does the effect (if any at all) of tax reform on public revenue instability in developing countries depend on the degree of development aid volatility?

To address these questions, we use the total tax revenue-to-GDP ratio as the measure of public revenue performance. The choice of tax revenue-to-GDP ratio rather than total public revenue (which encompasses both tax revenue and non-tax revenue) to perform the empirical analysis rests on the fact that non-tax revenue is much more exogenous (and is less under the control of governments) than tax revenue. Additionally, tax reform is likely to influence mainly tax revenue. The empirical exercise has been conducted on a panel dataset containing 95 developing countries covering the period 1981-2015, and has used the two-step system Generalized Methods of Moments as the main estimator. Empirical findings are quite interesting. They suggest that tax reform is positively and significantly associated with tax revenue-to-GDP ratio. In addition, development aid flows influence positively the tax revenue-to-GDP ratio, and the higher the amount of aid flows that accrue to developing countries, the greater is the magnitude of the positive effect of tax reform on tax revenue-to-GDP ratio. In other words, development aid flows enhance the positive impact of tax reform on tax revenue-to-GDP ratio in developing countries. On another note, while tax reform exerts a reducing and significant effect on the instability of tax revenue, the volatility of development aid inflows appears to enhance the instability of tax revenue. Furthermore, the magnitude of the reducing effect of tax reform on tax revenue instability diminishes as the degree of development aid volatility increases, and beyond a certain level of development aid volatility, tax reform enhances the instability of tax revenue.

The remaining of the article is organized as follows. Section 2 discusses how tax reform could influence tax revenue performance in developing countries and the extent to which development aid could influence the effect of tax reform on tax revenue performance in these countries. This section also elaborates on how tax reform could affect the instability of tax revenue, and whether this effect could be influenced by the volatility of aid flows. Section 3 presents the measurement of tax reform. Section 4 presents the model specification concerning the effect of tax reform on tax revenue, while Section 5 displays the model specification concerns the effect of tax reform on tax revenue instability. Section 6 discusses the econometric approach to estimate these models. Section 7 interprets empirical results, while Section 8 concludes.

2. Discussion on the effect of tax reform on tax revenue and tax revenue instability: to what extent development aid and its volatility matter?

2.1 Tax reform, development aid and tax revenue

From a theoretical perspective, the effect of tax reform on tax revenue seems straightforward. Tax transition reform would be associated with higher tax revenue performance in developing countries if it genuinely more than compensate for the international trade tax revenue losses (due to a greater trade openness). However, if for some reasons some countries, in spite of effort to implement the tax reform, are not able to more than recoup the trade tax revenue lost, then the implemented tax reform might not generate higher tax revenue, including tax revenue-to-GDP ratio. For example, even though tax reform helps strengthens the capacity of tax administration, including in terms of human capacity to devise appropriate tax policy and the efficiency of the tax administration in collecting tax revenue, it might be difficult to expand the domestic tax base, particularly in poor countries (for example Least Developed Countries). This is because in these countries, structural characteristics such as lower real per capita income, higher concentration of the production structure in primary products, and the rise in the population size, might make it difficult to significantly raise public revenue in the course of a tax reform.

Nevertheless, one may expect that development aid inflows would help overcome the adverse effects of these structural impediments on public revenue raising in the course of tax reform. In fact, the literature remains inconclusive as to the direction in which development aid influences tax revenue in recipient-countries: the findings have suggested that development aid could crowd out tax revenue performance, improve it, or exerts an effect on public revenue that could be conditional on the institutional quality prevailing in the recipient-country. Theoretically, the negative effect of development aid on tax revenue could arise from adverse incentives, the economic instability and difficulties in public administration of recipient countries. According to Azam et al. (1999), aid might reduce incentives of recipient governments to adopt good policies and build an efficient tax system. Similarly, according to Marteens et al. (2002) and Svensson (2006), recipient-countries could be motivated to satisfy donors rather than being accountable vis-à-vis their citizen concerning the utilization of the aid flows received. Authors such as Knack and Rahman (2007) and Brun et al. (2011) have noted that the absence of coordination among multiple donors can further enhance the aforementioned adverse effects of development aid on public administration. On the other side, development aid could positively influence tax revenue in the recipient-economy through its direct positive incentives and positive impacts on public

administration, including tax administrations, as well as through its indirect positive effects on the economy. For example, Morrissey (2015) has argued that the effectiveness of public expenditure on human development and tax compliance could be enhanced thanks to higher development aid inflows. Along the same lines, Brun et al. (2011) have argued that the above-mentioned adverse effects of development aid on tax revenue could prompt aid-recipient governments to improve their tax performance, with a view to reducing their dependence on development aid. Additionally, development aid could help strengthen tax and customs administration capacities in recipient-countries, and hence promote tax reforms. The empirical findings of the tax revenue impact of development aid is mixed and reflects the diversity of the theoretical expectations concerning this impact. Heller (1975), Gupta et al. (2004), Remmer (2004), and Benedek et al., (2012) have reported a negative effect of development aid on tax revenue. In contrast, Khan and Hoshino (1992), Gupta (2007), and Clist (2016) have obtained a positive effect of development aid on tax revenue. At the same time, Ouattara (2006); Mavrotas and Ouattara (2007); Morrissey et al., (2014) have found a statistically nil effect of development aid on tax revenue. Yohou et al. (2016) have reported that the effect of development aid on tax revenue performance is conditional on government stability: while aid directly lowers tax revenue performance, it enhances it for higher levels of government stability. Gnangnon and Brun (2017) have examined whether the sustainability of the impact of development aid on non-resource tax revenue performance of recipient-countries. They have obtained evidence that the sustainability of this impact depends on countries' development level. Specifically, for Least developed countries, the impact of development aid on non-resource tax revenue is yet positive, but not sustainable over time. In light of the foregoing, the effect of development aid on tax revenue remains an empirical matter. Nevertheless, if development aid could help expand the tax base, including by contributing to the expansion of productive capacities (that could help generate higher value added in the manufactured products) and possibly promoting economic growth in the recipient-countries[3], then it would help generate higher tax revenue in these countries.

We postulate here that if development aid contributes to enhancing tax revenue performance in recipient-countries, including through the above-mentioned channels, it would enhance the expected positive effect of tax reform on tax revenue performance. Otherwise, we would expect that the eventual positive effect of tax reform on tax revenue performance would diminish as

[3] Some studies (Levy, 1988; Burnside and Dollar, 2000; Hansen and Tarp, 2000; Dalgaard et al., 2004; Gomanee et al., 2005; Karras, 2006; Galiani et al. 2016; Chauvet and Ehrhart, 2018; Harb and Hall, 2019) have reported that development aid could influence positively economic growth in recipient-countries.

developing countries enjoy higher development aid inflows, in particular if such aid provides disincentives to pursue the tax (transition) reform.

2.2 Tax reform, development aid volatility and tax revenue instability

It is important to recall at the outset that the objective of the tax reform is to minimize the international trade tax revenue component of tax revenue in the tax structure. For many developing countries, imported products included machineries and consumption goods whose prices are set by the exporting countries, and that can fluctuate subject depending on the vagaries of the international market. As a result, the instability of the import tariff revenue (that would contribute to total tax revenue instability) would increase further to the volatility of import prices. Likewise, those developing countries that collect export tax revenue (as part of trade tax revenue) do not generally control the prices of those export products, as many of the products are primary commodities (or at least on low-value added products whose prices are subject to the vagaries of the international market), whose prices significantly fluctuate in the international trade market. Hence, these countries are subject to important fluctuations of import and export prices, and hence of their terms of trade, would experience an enhancement of the instability of international trade tax revenue, and consequently the instability of total tax revenue. As a result, by minimizing the share of international trade tax revenue in total tax revenue, tax reform would help reduce one important channel of the transmission of shocks to the tax revenue, i.e. international trade tax revenue (that would induce tax revenue instability). In this context, we could expect that a higher extent of tax reform would contribute to dampening tax revenue instability, as it would reduce one component of the tax structure subject to high instability.

In the meantime, the literature has underlined the high volatility[4] of development aid. For example, Bulír and Hamann (2001, 2003, 2008) have shown that aid is more volatile than fiscal revenues, particularly in highly aid-dependent countries. The high volatility of development aid, as well as its adverse economic effects have been underlined in the literature by authors such as Lensink and Morrissey (2001), Tressel and Prati (2006); Cohen et al. (2008), Hudson and Mosley (2008a, 2008b), Chauvet and Guillaumont (2009), and Hudson (2015). In particular, Bulír and Hamann (2001) have underlined that the typical pattern of aid disbursements tends to enhance

[4] It is worth emphasizing that the concept of development aid volatility is different from that of aid unpredictability. Celasun et al. (2008) have argued that aid volatility is an ex-post description of the variability in aid disbursements over time, whereas predictability of aid refers to the difference between disbursements expected ex-ante, and actual disbursements, during a given time-period. This, therefore, suggests that aid predictability reflects the confidence of aid-recipient-countries about the amount and timing of aid disbursements, while volatile aid reflects the significant ups and downs movements of development aid between two-time periods.

budgetary instability, and eventually overall economic instability, and reduce welfare. In the same vein, authors such as Cohen et al. (2008) and Hudson and Mosley (2008a) have reported a negative effect of development aid volatility on macroeconomic volatility. In light of the foregoing, we expect that higher development aid volatility would be associated with higher tax revenue instability. Furthermore, by enhancing economic growth volatility, higher aid volatility would result in higher tax revenue instability, as elements of tax base would experience a higher instability due to the economic growth instability.

Overall, we expect tax reform would lead to lower tax revenue instability, whereas development aid volatility would enhance tax revenue instability. On another note, development aid volatility could make it difficult for countries to implement efficiently the tax reform. This could therefore lead tax reform to be associated with higher tax revenue instability in the context of higher development aid volatility. Additionally, the positive effect of development aid volatility on tax revenue instability could more than offset the reducing effect of tax reform on tax revenue instability, so that in a context of development aid volatility, tax reform might ultimately result in higher tax revenue instability. Put differently, while tax reform could contribute to reducing tax revenue instability including in the context of higher volatility of development aid, there might be a degree of development aid volatility which tax reform would induce higher tax revenue instability.

3. Measure of tax reform

To measure the extent of tax reform, we use an indicator that reflects the degree of convergence of developing countries' tax structure towards the tax structure of developed countries (qualified as "old industrialized countries"). To do so, we utilize the semi-metric Bray-Curtis dissimilarity index (Bray & Curtis, 1957). The index is defined as: $d_{XY} = \frac{\sum_j |X_j - Y_j|}{\sum_j |X_j + Y_j|}$, where X and Y are two different countries identified by j components of tax structure (direct tax revenue share; indirect tax revenue share; and international trade tax revenue share). Specifically, in the context of the current analysis, X represents a given developing country, Y refers to the developed countries (old industrialized countries), and the symbol "| |" refers to the absolute value. The index is a bounded measure comprising between 0 and 1 (or 0 and 100). It is worth emphasizing that the semi-metric Bray-Curtis dissimilarity index is largely used in the natural sciences as well as in other disciplines such as international trade (see for example, Finger and Kreinin, 1979; De Benedictis and Tajoli, 2007, 2008). This index has the advantages of not increasing in the number of sectors (or components) considered; of being invariant to proportional sub-classifications of the n sectors (or components) considered; and of not being subject to the double-zeros paradox.

It is also appropriate in the presence of skewed distribution (e.g., De Benedictis and Tajoli, 2007, 2008).

To obtain the index of convergence in tax structure of developing countries towards the tax structure of developed countries, we consider on the one hand the aforementioned components of tax structure (direct tax revenue share; indirect tax revenue share; and international trade tax revenue share) for a given developing country in a year t, which we compare to the average of the same components in the tax structure of developed countries. Thus, the dissimilarity index of tax structure for a given developing country (in a given year) is determined by:

$$d_{it} = \frac{|DIRTAX_{it} - DIRTAXAve_t| + |INDIRTAX_{it} - INDIRTAXAve_t| + |TRTAX_{it} - TRTAXAve_t|}{[(DIRTAX_{it} + DIRTAXAve_t) + (INDIRTAX_{it} + INDIRTAXAve_t) + (TRTAX_{it} + TRTAXAve_t)]} \quad (1)$$

where for a given developing country, DIRTAX, INDIRTAX, and TRTAX are respectively, the direct tax revenue share; the indirect tax revenue share; and the trade tax revenue share. For developed countries, DIRTAXAve, INDIRTAXAve, and TRTAXAve are respectively the average (over all developed countries, i.e., old industrialized countries, in a given year) of the direct tax revenue share; the indirect tax revenue share; and the trade tax revenue share. The indicator of tax reform for a given developing country in a given year, is calculated as follows: $TAXREF = (1 - d_{it}) * 100$, where d_{it} is the Bray-Curtis dissimilarity index previously described. A rise in the values of TAXREF reflects a greater extent of tax reform, i.e, a convergence of the tax structure of developing countries towards the tax structure of developed countries. Inversely, a decline in the values of this index indicates a lower extent of tax reform, that is, a divergence between the tax structure of developing countries and the tax structure of developed countries. Appendix 1 contains the list of developed countries used as benchmark in the calculation of the indicator of tax reform.

4. Model specification on the effect of tax reform on tax revenue

To investigate whether development aid matters for the effect of tax reform on tax revenue, we draw on previous studies concerning the structural determinants of public revenue, including those that have assessed, *inter alia*, the public revenue effect of development aid (e.g., Ouattara, 2006; Knack and Rahman, 2007; Bird et al. 2008; Baunsgaard and Keen, 2010; Brun et al. 2011; Benedek et al. 2012; Brun et al. 2015; Crivelli and Gupta, 2014; Morrissey et al. 2014; Clist, 2016; Crivelli, 2016; Yohou et al. 2016; Gnangnon and Brun, 2017) and postulate the following dynamic model:

$$Log(TAXREV)_{it} = \alpha_0 + \alpha_1 \text{Log(TAXREV)}_{it-1} + \alpha_2 \text{Log(TAXREF)}_{it} + \alpha_3 \text{Log(NAT)}_{it} + \alpha_4([\text{Log(TAXREF)}_{it}] * [\text{Log(NAT)}_{it}]) + \alpha_5 \text{Log(OPEN)}_{it} + \alpha_6 \text{Log(GDPC)}_{it} + \alpha_7 \text{POLITY2}_{it} + \alpha_8 \text{SHVANONAGRI}_{it} + \alpha_9 \text{INFL}_{it} + \alpha_{10} \text{Log(TERMS)}_{it} + \alpha_{11} \text{Log(POP)}_{it} + \mu_i + \omega_{it} \quad (2)$$

where $TAXREV_{it}$ represents the total tax revenue performance of a given country i in a period t. It is measured by the ratio of total tax revenue-to-GDP ratio. The use of total tax revenue-to-GDP ratio rather than total public revenue (which includes both tax revenue and non-tax revenue) rests on the idea that non-tax revenue is less under the control of governments than tax revenue, and tax reform is likely to influence mainly tax revenue.

TAXREF stands for the index capturing the extent of tax reform for a given country in a given period. The analysis has used an unbalanced panel dataset (based on available data) containing 95 developing countries over the period 1981-2015. Data has been averaged over non-overlapping sub-periods of 5-year so as to smooth out the effect of business cycles on variables. These sub-periods are 1981-1985, 1986-1990, 1991-1995, 1996-2000, 2001-2005, 2006-2010 and 2011-2015. α_0 to α_{11} are parameters to be estimated. μ_i are countries' fixed effects; ω_{it} is a well-behaving error term.

Appendix 2 presents the description and source of the variables introduced in model (2). The standard descriptive statistics on these variables are provided in Appendix 3. The list of developing countries used in the analysis is displayed in Appendix 4.

The variable "OPEN" stands for the standard measure of trade openness level, i.e., the share of the sum of exports and imports of goods and services in GDP. From a theoretical perspective, the effect of trade openness on tax revenue depends on numerous factors, including the structure of trade liberalization and the effect of the latter on each component of public revenue. These involve the extent to which quantitative restrictions have been replaced with tariffs, how tariff reduction affects imports, the price elasticity of demand for imports, the price elasticity of supply of import substitutes and how exports respond to trade liberalization measures (e.g., Ebrill et al. 1999; Agbeyegbe et al. 2006). While in this context, it might be difficult to predict the effect of trade openness on tax revenue, one could expect on the one hand that trade openness could exert a positive effect on tax revenue, given that trade tax revenue could be easily collected. On the other hand, as countries will sooner or later further open up to international trade, including by significantly reducing tariffs on imports, international trade tax revenue would decline. As a result, total tax revenue would decline if no revenue replacement strategy has been developed. In this scenario, higher trade openness would be negatively associated with total tax revenue. Incidentally,

there could be an indirect effect of trade openness on tax revenue, notably through its effect on the manufacturing sector performance as well as on economic growth. Indeed, trade openness could contribute to higher value added on the manufacturing products in developing countries (e.g., Weiss, 1991; Wong, 2007; Njikam and Cockburn, 2011; Ackah et al, 2012; Bigsten et al., 2016; Mukherjee and Chanda, 2017). In turn, higher value added on manufacturing products (or lower share of value added in the agricultural sector) generates higher tax revenue (e.g., Balh, 2003; Bird et al., 2008; Thomas and Treviño, 2013; Crivelli and Gupta, 2014; Brun, Chambas and Mansour, 2015; Crivelli, 2016; Gnangnon and Brun, 2017), including higher domestic tax revenue. Likewise, greater trade openness could help promote growth (e.g., Kneller et al., 2008; Wacziard and Welch, 2008; Chang et al. 2009; Christiansen et al. 2013; Camarero et al., 2016; Naito, 2017) and expand the tax base, which in turn, would enhance the positive effect of tax reform on tax revenue. In light of the foregoing, we conclude that the effect of trade openness on tax revenue to-GDP ratio is an empirical matter.

"NAT" represents the net aid transfers (in constant $US 2015 prices). The effect of development aid on tax revenue performance in recipient-countries has already been discussed above in Section 2. At this stage of the analysis, it is difficult to anticipate the direction in which development aid would affect tax revenue in recipient-countries.

"GDPC" represents the real per capita income, which captures the development level. We expect the development level to exert a positive impact on tax revenue performance (e.g., Crivelli and Gupta, 2014; Brun et al., 2015) because its rise goes hand in hand with an increase in the demand of public services, and a higher degree of economic and institutional sophistication.

"POLITY2" measures the level of democracy in a given country, and acts for a proxy for institutional quality. A better institutional quality is expected to induce higher tax revenue, including through a direct effect on tax revenue collection, and an indirect effect through the enhancement of the efficiency of tax administration in collecting public revenue (e.g., Ghura, 1998; Bird et al. 2004; Bird et al. 2008).

The variable "SHVANONAGRI" represents the share of value added in non-agricultural sector in the total output. This variable has been introduced in model (2) following previous studies on the determinants of tax revenue performance. Many of the studies highlighted above on the determinants of tax revenue have shown that a rise in the agriculture share in total output results

in lower tax revenue performance because it is difficult to tax the agriculture sector. Additionally, for political reasons, some countries exempt a large share of agricultural activities from taxes (Bird et al. 2008). Therefore, we expect a rise in the share of value added on non-agriculture sector in total output to be positively associated with tax revenue performance.

"INFL" has been calculated using the following formula (see Yeyati et al. 2007): $INFL = sign(INFLATION) * \log(1 + |INFLATION|)$ (2), where $|INFLATION|$ refers to the absolute value of the annual inflation rate (%), denoted "INFLATION". Higher inflation rates could generate lower tax revenue performance (Tanzi, 1977), and even more so if the tax system is not protected from inflation. Therefore, we expect that higher inflation rates would result in lower tax revenue performance.

"TERMS" is the measure of terms of trade. We expect terms of trade improvement to exert a positive effect on tax revenue, as this would reflect a higher profitability for export industries and hence generate higher income tax revenue, higher corporate tax revenue (including for firms involved in international trade activities), and possibly higher trade tax revenue (when tariff revenue is collected on imported inputs) (see Agbeyegbe et al., 2006).

"POP" is the size of the population in a given country. It has been introduced in model (2) to control for the effect of countries' demographic characteristics on tax revenue performance. In fact, Bahl (2003) has argued that in countries that experience faster growing populations, the tax systems may lag behind in governments' ability to capture new taxpayers. In this context, a rise in the population size would lead to lower tax revenue share. However, larger population size could lead to higher domestic consumption, eventually higher individual income, and hence result in higher tax revenue share.

5. Model specification on the effect of tax reform on tax revenue instability

The extent to which the effect of tax reform on tax revenue instability depends on the degree of development aid volatility is assessed by postulating model (3), which builds on previous few studies on the determinants of instability of public revenue (Lim, 1983; Bleaney et al., 1995 and Ebeke and Ehrhart, 2012). Model (3)[5] is as follows:

[5] In model (3), we have included time dummies, but there were not statistically significant. Therefore, we have removed them from regressions.

$$\text{Log(TAXREVINST)}_{it} = \beta_0 + \beta_1 \text{Log(TAXREVINST)}_{it-1} + \beta_2 \text{Log(TAXREF)}_{it} + \beta_3 \text{Log(NATVOL)}_{it} + \beta_4([\text{Log(TAXREF)}_{it}] * [\text{Log(NATVOL)}_{it}]) + \beta_5 \text{Log(NAT)}_{it} + \beta_6 \text{Log(OPEN)}_{it} + \beta_7 \text{Log(GRVOL)}_{it} + \beta_8 \text{Log(GDPC)}_{it} + \beta_9 \text{INFL}_{it} + \beta_{10} \text{Log(INFLVOL)}_{it} + \beta_{11} \text{Log(TERMSVOL)}_{it} + \sigma_i + \tau_{it} \quad (3)$$

where the subscript i represents a developing country; and t the time-period. The same panel dataset used to estimate model (2) has been used to estimate model (3): it contains 95 developing countries over non-overlapping sub-periods of 5-year average data (1981-1985, 1986-1990, 1991-1995, 1996-2000, 2001-2005, 2006-2010 and 2011-2015). β_0 to β_{11} are parameters to be estimated. σ_i are countries' fixed effects; τ_{it} is a well-behaving error term.

The dependent variable TAXREVINST is the measure of tax revenue instability. The one-period lag of the dependent variable has been included in this specification so as to capture the potential state-dependence nature of the instability in tax revenue. In fact, Bond (2002) has argued that even if the coefficient of the lagged dependent variable (s) is not the main coefficient of interest in the analysis, allowing for dynamics in the underlying process may be crucial for recovering consistent estimates of other parameters in the model.

The variables TAXREF, OPEN, NAT, GDPC, and INFL are as defined in the previous section. NATVOL represents the volatility of real net aid transfers. It has been calculated as the standard deviation of annual growth of real net aid transfers over the above-mentioned non-overlapping sub-periods. GRVOL, INFLVOL, and TERMSVOL are respectively the measures of volatility of real economic growth, the volatility of inflation, and the volatility of terms of trade. The economic growth volatility has been computed as the standard deviation of annual economic growth rate (growth rate of real GDP) over the afore-mentioned non-overlapping sub-periods. Inflation volatility has been computed as the standard deviation of annual inflation rate over non-overlapping sub-periods. The volatility of terms of trade has been calculated as the standard deviation of the annual growth of terms of trade the over non-overlapping sub-periods of 5-year data. The effect of the volatility of development aid on tax revenue has already been discussed in Section 2. As for some other control variables, we expect higher inflation, as well as higher inflation volatility, economic growth volatility, and terms of trade volatility to be associated with higher tax revenue instability. The variable "GDPC", which stands for countries' real per capita income, (and represents countries' development level) has been included in model (3) to account for the fact that all countries do not have the same level of tax revenue instability. We do expect that countries with a higher development level would likely experience a lower tax revenue instability compared to other developing countries, given their capacity (in terms of human resources and institutions) to mitigate the effect of shocks on tax revenue, i.e., to reduce tax revenue instability.

The variable "NAT" represents the net aid transfers, in constant 2015 US dollars prices. Collier and Goderis (2008) have shown that development aid flows substantially reduces the adverse growth effect of commodity export price shocks in commodity-dependent countries. Along the same lines, Guillaumont and Wagner (2012) have reported evidence that development aid enhances growth acceleration in countries that experience a high structural vulnerability, including higher levels of shocks and higher exposure to shocks. As shocks could lead to higher instability in tax revenue, we can postulate on the basis of these studies that development aid flows would contribute to reducing the tax revenue instability. Dabla-Norris et al. (2015) have also shown, *inter alia*, that development aid flows are procyclical with respect to recipient-countries' business cycles, but become countercyclical when recipients experience large macroeconomic shocks. As macroeconomic shocks could induce tax revenue instability, we could argue that development aid would result in lower tax revenue instability. Overall, we expect higher development aid flows to be associated with lower tax revenue instability.

Concerning the trade openness variable ("OPEN"), the literature has established that there could be significant benefits associated with trade openness. These include stimulative effects on knowledge spillovers and investments in innovation (Grossman and Helpman 1991), higher productivity thanks to intra-industry trade (Melitz 2003) or intra-firm trade (Bernard, Redding and Schott 2006), efficient resource reallocation, and the reduction in a country's vulnerability to idiosyncratic sectoral shocks through production and export diversification (Acemoglu and Zilibotti 1997; Haddad et al. 2011). For example, Haddad et al. (2011) have argued that trade openness can reduce countries' exposure to shocks by enhancing the possibility of international risk sharing, through better integration into a broader range of global value chains as well as implicit and explicit insurance schemes such as joint ventures, international lending, production diversification and formal insurance contracts. Through these channels, including the ones highlighted by Acemoglu and Zilibotti (1997) and Haddad et al. (2011), trade openness could result in lower tax revenue instability. All these different channels would contribute to dampening the impact of eventual external shocks that could affect an economy and, therefore help mitigate the transmission of these shocks to public revenue. In the meantime, trade openness can have a destabilizing effect on the economy through several channels (see Montalbano, 2011: page 1490). These include the apparent asymmetry between the process of increasing specialization and the presence of random, undiversifiable shocks in the export markets of open economies (e.g., Koren and Tenreyro, 2007); the volatility of commodity prices, especially in developing countries (in particular poor countries) whose exports are heavily concentrated in primary products (e.g., Malik and Temple, 2009); the difficulty of traditional coping mechanisms and local market structures to

cope with the shocks prevailing in open markets (e.g., Dercon, 2001); the occurrence of boom-bust cycles of investment associated with higher trade openness in countries with inadequate infrastructures and shortages of skilled labor (Razin et al., 2003); and the high risk of policy management resulting from the response to new incentives induced by trade openness in weak political institutions (Rodrik, 1999; Acemoglu et al., 2003; Fatas and Mihov, 2003). In addition, some studies (Raddatz, 2007; Loayza and Raddatz, 2007; di Giovanni and Levchenko, 2009; Haddad et al., 2011, 2013) have reported that higher trade openness is associated with increased volatility of a number of outcome variables (aggregate income, consumption, employment, salaries, and prices), notably in developing countries, that affect directly the tax base, including through a higher volatility of the elements of the tax base. This would ultimately result in higher tax revenue instability. It has also been demonstrated that trade openness, in spite of its benefits, could contribute to triggering "sudden stops" (e.g., Cavallo and Frankel, 2008) or serve as a channel for spreading out crises, including in regional contexts (Glick and Rose, 1999; Easterly and Kraay, 2000). These channels can contribute to enhancing the volatility of the previously cited variables and hence, the tax revenue instability. Some studies such as Calderon, et al. (2005) and Kose and Yi (2006) have nevertheless reported no significant impact of a rise in the degree of trade interdependence on domestic macroeconomic volatility. In this scenario, trade openness would not be associated with higher tax revenue instability.

6. Econometric strategy

At the outset, we estimate by means of the within fixed effects estimator (denoted "FE-DK"), static versions of models (2) and (3) (i.e., these two models without the dependent variable as a right-hand side variable), and without the interaction variables. The purpose of such estimations is to get a first insight into the effect of tax reform on tax revenue and tax revenue instability. In using the within fixed effects estimator, standard errors have been corrected for serial correlation, heteroscedasticity and cross-sectional dependence in the dataset. The results of these estimations are provided in column [1] of Table 1 and column [1] of Table 2, respectively for models (2) and (3). However, as many variables of these two models are likely endogenous mainly because of the bias associated with the bi-directional causality between the dependent variables and some regressors, the outcomes based on the FE-DK estimator could be biased. In addition, the static versions of models (2) and (3) may suffer from the omission of the one period lag of the dependent variable as a regressor. Even for the dynamic nature of models (2) and (3), the presence of the one-period lag of the dependent variable in these models would induce a correlation between the lagged dependent variable and specific effects. Against this background, we use the

two-step system Generalized Methods of Moments (GMM) approach proposed by Blundell and Bond (1998) to estimate dynamic models (2) and (3). This estimator combines the equation in differences with the equation in levels, with lagged first differences being used as instruments for the levels equation and lagged levels being used as instruments for the first-difference equation. This estimator is preferred to the first-difference GMM estimator suggested by Arellano and Bond (1991) when cross-sectional variability dominates time variability and when there is a strong persistence in the time series under investigation (Blundell and Bond, 1998). Additionally, the two-step system is recommended in the context of unbalanced panel dataset, as the difference GMM estimator has a weakness of magnifying gaps (Roodman, 2009). Regressors considered as endogenous in model (2) due to the simultaneity bias include TAXREF, NAT, GDPC, POLITY2. For example, while tax reform is expected to influence the level of tax revenue-to-GDP ratio, countries that experience lower tax revenue due, for example, to greater trade openness might be incentivized to engage in greater extent of tax reform. Similarly, countries with a relatively low level of tax revenue-to-GDP ratio are likely to receive higher real net aid transfers than other countries. Potential endogenous variables in model (3) include TAXREF, NAT, NATVOL, GDPC, OPEN, GRVOL. In fact, we expect here that higher instability of tax revenue could influence the level and volatility of real net aid transfers, the real per capita income, the degree of openness, and the volatility of economic growth. The validity of the two-step system GMM estimator is assessed using a number of diagnostic tests, including the standard Sargan (OID) test of over-identifying restrictions, the Arellano–Bond (AB) test of the presence of first-order serial correlation in the error term (denoted AR(1)) and no second-order autocorrelation in the error term (denoted AR(2)). Furthermore, we have reported the number of instruments used in the regressions because too many instruments could reduce the power of the above-mentioned tests (e.g., Ziliak, 1997; Bowsher, 2002; Roodman, 2009). All regressions have used 2 lags of the dependent variable as instruments and 2 lags of the endogenous variables as instruments.

The empirical analysis based on the two-step system GMM technique proceeds as follows. First, we estimate models (2) and (3) without the interaction variable, with a view to analysing the effect of tax reform on tax revenue and tax revenue instability. The results of the estimations of these models are presented in column [2] of Tables 1 and 2, respectively for model (2) and model (3). We also check whether this effect is similar for poor countries and non-poor countries in the full sample. We follow the United Nations categorization of countries and consider least developed countries[6] (LDCs) as poor countries. To perform the analysis, we define a dummy variable

[6] The UN has defined LDCs as the poorest and most vulnerable countries in the world. For further information on LDCs, see online at: http://unohrlls.org/about-ldcs/

(denoted "LDC"), which takes the value "1" for countries in the LDC category, and "0", otherwise. This dummy variable along with its interaction with the variable TAXREF are then introduced in the specifications of models (2) and (3) (without the interaction variables between TAXREF and NAT in model (2) on the one hand, and between TAXREF and NATVOL in model (3) on the other hand). The outcomes of the estimations of these models are displayed in column [3] of Tables 1 and 2, respectively for model (2) and model (3). Table 3 reports the estimates of model (2) as it stands, that is to investigate whether the effect of tax reform on tax revenue depends on development aid. Likewise, Table 4 displays the outcomes of the estimation of model (3) (as it stands), which allows examining the extent to which the effect of tax reform on tax revenue instability depends on the volatility of development aid.

To provide a first insight into the relationship between key variables of interest in the analysis, we present in Figure 1 the development over time of the indicator of tax reform (TAXREF) and the tax revenue to GDP ratio (TAXREV), and in Figure 2, the development over time of tax revenue instability index (TAXREVINST) and TAXREF. Figure 3 shows the correlation pattern between TAXREV and TAXREF on the one hand (see the left-hand side graph), and TAXREVINST and TAXREF on the other hand (see the right-hand side graph). These different graphs have been performed using the dataset of 95 developing countries over non-overlapping sub-periods of 5-year average data. It could be observed from Figure 1 that TAXREV has remained relatively stable around 12.7% over from 1981-1985 to 2001-2005, but substantially increased over the rest of the period to reach 15.22% in 2011-2015. At the same time, TAXREF has steadily increased from 55.9 points in 1981-1985 to 56.2 points 1996-2000. However, it has substantially increased over the rest of the period, to reach 64.6 points in 2011-2015. In summary, tax reform and tax revenue-to-GDP ratio have evolved in the same direction. Figure 2 suggests rather that tax reform and tax revenue instability have moved in opposite directions over the period 1981-2015. Concerning Figure 3, we note from the right-hand side graph that tax reform is strongly and positively correlated with tax revenue-to-GDP ratio, while the right-hand side graph of this Figure indicates a strong negative correlation pattern between tax reform and tax revenue instability in developing countries.

7. Interpretation of results

Results (based on the FE-DK) in column [1] of Table 1 suggest that tax reform exerts a positive and significant effect (at the 1% level) on the tax revenue-to-GDP ratio. With respect to results related to control variables in this column, we note that net aid transfers flows and inflation

do not affect significantly tax revenue performance in recipient-countries. Better institutional quality, proxied by the degree of democracy is positively and significantly associated with tax revenue, which is consistent with the theoretical expectation. Trade openness influences negatively and significantly tax revenue performance, while higher development level (proxied by the real per capita income) and the share of value added in non-agricultural production (in total output) are positively and significantly related to tax revenue-to-GDP ratio. The population size and terms of trade improvements influence negatively tax revenue, but their effect is loosely significant, i.e., statistically significant only at the 10% level.

Let us now consider results reported in columns [2] and [3] of Table 1 (results based on the two-step system GMM estimator). Before interpreting these results, it is important to discuss the outcomes concerning the diagnostic tests that help assess the validity of the two-step system GMM estimator. We note from these two columns of Table 1 (as well as from columns [2] and [3] of Table 2, and Tables 3 and 4) that the coefficient of the one-period lag of the dependent variable is always positive and significant at the 1% level, thereby indicating the state-dependence nature of tax revenue-to-GDP ratio (for results in Tables 1 and 3) and the state dependence nature of the instability of tax revenue (for results in Tables 2 and 4). These confirm the relevance of considering a dynamic specification of models (2) and (3). Results reported at the bottom of the columns of all these Tables indicate, as expected, that the p-values related to the AR(1) test are 0 (i.e., lower than 10% level, as expected), and the p-values associated with the AR(2) test are all higher than 10%. Additionally, the p-values of the Sargan statistics are always higher than 10%. Incidentally, across all columns of Tables where results are based on the two-step system GMM estimator, the number of instruments is consistently lower than the number of countries. Overall, the two-step system GMM approach has passed with success all the afore-mentioned diagnostic tests, and is therefore appropriate for the empirical exercise.

Taking up now results in column [2] of Table 1, we find that the coefficient of TAXREF is positive and statistically significant, although its magnitude is well below that of the coefficient of the same variable in column [1] of the Table 1. This result suggests that tax reform generates higher tax revenue in developing countries: a 1 percentage increase in the index of tax reform leads to a 0.543 percentage rise in the tax revenue-to GDP ratio. At the same time, results in column [3] indicate that the coefficient of the interaction variable "LDC*[Log(TAXREF)]" is negative and statistically significant at the 1% level. This signifies that tax reform exerts a lower effect on tax revenue performance in LDCs than in NonLDCs. Nevertheless, the net effect of tax reform on revenue-to-GDP ratio is positive and given by 0.46 (=0.920-0.460), thereby suggesting that in LDCs, a 1 percentage increase in the index of tax reform leads to a 0.46 percentage rise in the tax

revenue-to-GDP ratio. In NonLDCs, a 1 percentage increase in the index of tax reform leads to a 0.92 percentage rise in the tax revenue-to-GDP ratio. Concerning control variables, we note that estimates reported in columns [2] and [3] are quite similar. Focusing specifically on estimates in column [2], we obtain that higher net aid transfers flows are positively and significantly associated with tax revenue performance in recipient-countries, while real per capita income and terms of trade improvements exert no significant effect on tax revenue. At the 5% level, the other positive drivers of tax revenue performance in developing countries include a better institutional quality, lower trade openness, lower inflation rates, higher share of value added on non-agricultural production in total output, and lower size of the population.

As for results in Table 2, we observe in column [1] (results based on the FE-DK estimator) that tax reform exerts a negative and significant effect (at the 1% level) on the instability of tax revenue in developing countries. This outcome is confirmed in column [2], although with a lower magnitude of the effect. Focusing specifically on results in column [2] (which is based on the preferred estimator), we obtain that a 1 percentage increase in the index of tax reform leads to a 0.505 percentage fall in the values of the index of tax revenue instability. In column [3], we note that tax reform exerts a higher reducing effect on the tax revenue instability in NonLDCs compared to LDCs (the interaction term of the variable "LDC*[Log(TAXREF)]" is positive and statistically significant at the 1% level), although the net effect of tax reform on tax revenue instability appears to be negative and significant, and amounts to -0.356 (= -0.797+0.441). Hence, a 1 percentage increase in the index of tax reform leads to a 0.356 percentage decline in the index of tax revenue instability in LDCs, and -0.797 percentage decline in the index of tax revenue instability in NonLDCs. Estimates associated with control variables in columns [2] and [3] are quite similar notably in terms of the direction of the effects, although the magnitude of these effects could be different across the two columns. Focusing on the estimates associated with control variables reported in column [2], we obtain that while real values of net aid transfers inflows do not influence significantly tax revenue instability, higher volatility of net aid transfers flows does exert a positive and statistically significant (at the 1% level) effect on tax revenue instability. At the same time, relatively advanced developing countries experience a lower degree of tax revenue instability than less advanced countries (for example poor countries). This is because the coefficient of real per capita income variable is negative and statistically significant at the 1% level. The other positive drivers of tax revenue instability in developing countries include higher level of trade openness, higher economic growth volatility, higher inflation volatility, and higher inflation rates, as well as higher terms of trade instability.

Let us now consider results displayed in Table 3. To recall, these results aim to examine whether (and if so) development aid flows matter for the effect of tax reform on tax revenue. We note from this Table that the coefficient of the interaction variable ([Log(TAXREF)]*[Log(NAT)]) is positive and statistically significant at the 1% level, while the coefficient of TAXREF variable is negative and statistically significant at the 5% level. These two outcomes suggest that there is a threshold of development aid flows about which the effect of tax reform on tax revenue-to GDP ratio becomes positive. Below this threshold, this effect is negative. This threshold of development aid amounts to $US 198581.1 [= exponential (0.932/0.0764)]. It is worth recalling that values of NAT range between $US 2528334 and $US 3.70e+09. These suggest that when values of NAT received are lower than $US 198581.1, recipient-countries experience a negative and significant effect of tax reform on tax revenue performance. As all values of NAT appear to be higher than this threshold, we do conclude that irrespective of the amount of net aid transfers that accrue to developing countries, the latter always experience a positive and significant effect of development aid on tax revenue-to-GDP ratio. This outcome is well reflected in Figure 4, which shows, at the 95 per cent confidence intervals, the evolution of the marginal impact of TAXREF on TAXREV for varying levels of net aid transfers flows that accrue to countries. The statistically significant marginal impacts at the 95 per cent confidence intervals are those encompassing only the upper and lower bounds of the confidence interval that are either above or below the zero line. Figure 4 shows that the marginal effect of tax reform on tax revenue is always positive, and consistently increases as recipient-countries experience higher net aid transfers inflows. This suggests that not only development aid enhances the positive effect of tax reform on tax revenue, but this positive effect increases as the amount of development aid flows that accrue to these countries increase.

Let us now take up estimates presented in Table 4. We find that the coefficient of TAXREF is negative and statistically significant at the 1% level, the interaction term related to the variable ([Log(TAXREF)]*[Log(NATVOL)]) is positive and statistically significant at the 1% level. The combination of these two results indicate that on the one hand, tax reform exerts a reducing effect on tax revenue instability, and the magnitude of this reducing effect diminishes as the degree of development aid volatility increases. However, there appears to be a level of development aid volatility above which the effect of tax reform on tax revenue instability becomes positive, i.e., tax reform enhances tax revenue performance. This threshold of development aid volatility amounts to 4.55 [= exponential (1.034/0.0827)]. To recall, descriptive statistics reported in Appendix 3 show that values of the volatility of net aid transfers range between 0.029 and 122.3, with an average of 0.96 and a standard deviation amounting to 5.59. Countries with a degree of development aid volatility lower than 4.55 experience a reducing effect of tax reform on tax

revenue instability, and for these countries, the lower the degree of development aid volatility, the higher the magnitude of the reducing effect of tax reform on tax revenue instability. However, for countries that experience a degree of aid volatility higher than 4.55, tax reform exerts a positive effect on tax revenue instability and, the higher the degree of aid volatility, the higher is the magnitude of the enhancing effect of tax reform on tax revenue instability. The extent to which development aid volatility matters for the effect of tax reform on tax revenue instability is better illustrated in Figure 5, which shows, at the 95 per cent confidence intervals, the evolution of the marginal impact of TAXREF on TAXREVINST for varying levels of the volatility of net aid transfers. Figure 5 suggests that the marginal effect of tax reform on tax revenue instability increases as aid recipient countries experience higher volatility of net aid transfers inflows. However, the values of these marginal effects could be negative and positive, and are not always statistically significant. Specifically, this marginal impact is statistically significant for values of development aid instability lower than (or equal to) 2.64 [= exponential (0.9699125)] and strictly higher than 8.48 [= exponential (2.137615)]. Thus, countries with a degree of aid volatility lower than 2.64 experience a negative effect of tax reform on tax revenue instability. In other words, for these countries, higher aid volatility reduces the instability of tax revenue, but the higher the degree of aid volatility, the lower is the magnitude of the reducing effect of tax reform on tax revenue instability. In contrast, when the level of development aid volatility exceeds the threshold 8.48 (for countries that experience aid volatility higher than this threshold), tax reform consistently induces higher tax revenue instability, and the higher the level of aid volatility, the greater is the magnitude of the positive effect of tax reform on tax revenue instability. Finally, countries with a level of aid volatility ranging between 2.64 and 8.48, experience no significant effect of tax reform on tax revenue instability.

Results concerning control variables are to a large extent in line with those reported in Table 2. Note that even though tax revenue-to-GDP ratio is our main measure of public revenue performance, we have also performed all the regressions above using total public revenue-to-GDP ratio as the dependent variable. The empirical results obtained are qualitatively similar to the ones so far obtained above.

8. Conclusion

This paper investigates two main questions. The first question relates to whether the effect (if any at all) of tax reform on public revenue performance in developing countries depends on the level of development aid that accrue to these countries. The second question is whether development aid volatility enhances or dampens the effect (if any at all) of tax reform on public revenue instability in developing countries. The empirical analysis has shown that tax reform is positively and significantly associated with tax revenue-to-GDP ratio, with the magnitude of this positive effect being lower for LDCs than for NonLDCs. Furthermore, the magnitude of this positive effect of tax reform on tax revenue-to-GDP ratio increases as countries receive higher amount of the aid flows. Incidentally, tax reform appears to influence negatively and significantly tax revenue instability, with the magnitude of this negative effect being lower for LDCs than for NonLDCs. In addition, the magnitude of this reducing effect of tax reform on tax revenue instability diminishes as the degree of development aid volatility increases and, beyond a certain level of development aid volatility, tax reform enhances tax revenue instability. Overall, these findings suggest that while donors should be encouraged to supply higher development aid flows to developing countries, they should also further cooperate with recipient-countries in order to reduce the volatility of such aid. Higher development aid flows and lower volatility of this aid allow tax reform to induce both higher tax revenue-to GDP ratio and lower instability of tax revenue.

References

Acemoglu, K. D., and Zilibotti, F. (1997). Was Prometheus Unbound by Chance? Risk, Diversification, and Growth. Journal of Political Economy, 105(4), 709-751.

Acemoglu, D., Johnson, S., Robinson, J., and Thaicharoen, Y. (2003). Institutional causes, macroeconomic symptoms: Volatility, crises and growth. Journal of Monetary Economics, 5(1), 49-123.

Adandohoin, K. (2018). Tax transition in developing countries: Do VAT and excises really work? Munich Personal RePEc Archive (MPRA) Paper No. 91522, Munich University, Munich Germany.

Agénor, P-R. (2016). Promises, Promises: Aid Volatility and Economic Growth. Fondation pour les Études et Recherches sur le Développement International. Policy Brief, n° 148, FERDI, Clermont-Ferrand, France.

Aizenman, J., and Jinjarak, Y. (2009). Globalisation and developing countries – A shrinking tax base. Journal of Development Studies, 45(5), 653-671.

Aryeetey, E. and Morrissey, O. (2012). Trade, Trade Policy and Total Factor Productivity: The Case of Ghanaian Manufacturing Firms, in Charles A. and E. Aryeetey(Ed.). Globalization, Trade and Poverty in Ghana. Accra: Sub-Saharan Publishers.

African Trade Policy Centre (2004). Fiscal Implications of Trade Liberalisation on African Countries, ATPC Work in Progress No.5.

Agbeyegbe, T. D., Stotsky, J. and WoldeMariam, A. (2006). Trade liberalization, exchange rate changes, and tax revenue in Sub-Saharan Africa. Journal of Asian Economics, 17(2): 261-284.

Arellano, M., and Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. Review of Economic Studies, 58, 277–297.

Azam, J.-P., Devarajan S., and O'Connell S. A. (1999). Aid Dependence Reconsidered. Policy Research Working Paper, 2144, Washington, D.C, World Bank.

Bahl, R. W. (2003). 'Reaching the Hardest to Tax: Consequences and Possibilities'. Paper presented at the 'Hard to Tax: An International Perspective' conference, Andrew Young School of Policy Studies, Georgia State University, May 15-16.

Baunsgaard, T., and Keen, M. (2010). Tax Revenue and (or?) Trade Liberalization. Journal of Public Economics, 94(9-10), 563-577.

Benedek, D., Crivelli E., Gupta S., Muthoora, P. S. (2012). Foreign Aid and Revenue: Still a Crowding Out Effect? Working Papers, WP/12/186, International Monetary Fund, Washington, D.C.

Berg, A., and Krueger, A. O. (2003). Trade, growth, and poverty: A selective survey (IMF Working Paper No. 03/30). International Monetary Fund (IMF), Washington, D.C.

Bevan, D. (1995). Fiscal implications of trade liberalization. IMF Working Paper(95/50), International Monetary Fund (IMF), Washington, D.C.

Bigsten, A., Gebreeyesus, M., and Söderbom, M. (2016). Tariffs and Firm Performance in Ethiopia. Journal of Development Studies, 52(7), 986-1001.

Bird, R. M., Martinez-Vazquez, J. and Torgler, B. (2008). Tax Effort in Developing Countries and High-Income Countries: The Impact of Corruption, Voice and Accountability, Economic Analysis and Policy, 38(1), 55-71.

Bird, R. M., Martinez-Vazquez, J., and Torgler, B. (2004). Societal institutions and tax effort in developing countries. International Studies Program Working Paper, 04-06.

Bleaney, M., Gemmell, N. and Greenaway, D. (1995). Tax revenue instability, with particular reference to Sub-Saharan Africa. Journal of Development Studies, 31, 883-902.

Blundell, R., and Bond, S. (1998). Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. Journal of Econometrics, 87, 115–143.

Bond, S.R. (2002). Dynamic panel data models: a guide to micro data methods and practice. Portuguese Economic Journal, 1(2), 141-162.

Bowsher, C.G. (2002). On testing overidentifying restrictions in dynamic panel data models. Economics Letters 77(2), 211-220.

Brautigam, D., Fjeldstad, O.-H., and Moore, M. (2008). Taxation and State-Building in Developing Countries: Capacity and Consent. Cambridge University Press.

Bray, J.R., and Curtis, J.T. (1957). An ordination of the upland forest communities of Southern Wisconsin. Ecological Monographies 27, 325-349.

Brun J.-F., Chambas G., Guerineau S. (2011). Aide et Mobilisation Fiscale dans les pays en Développement, Jumbo, 21, 1-53.

Brun, J-F., and Chambas, G. (2014). How do tax systems transform as countries structurally transform themselves? Background Paper for the European Development Report 2015, Overseas Development Institute (ODI), London.

Brun J.F., Chambas, G., and Mansour, M. (2015). "Tax Effort of Developing Countries: An Alternative Measure", In: Financing Sustainable Development Addressing Vulnerabilities, Chapter 11. Edited by Boussichas, M., and Guillaumont, P., Economica. FERDI.

Bulír, A., and Hamann, A. J. (2001). How volatile and unpredictable are aid flows and what are the policy implications? IMF working paper 01/167. International Monetary Fund, Washington, D.C.

Bulír, A., and Hamann, A. J. (2003). Aid volatility: An empirical assessment. IMF Staff Papers, 50(1), 64–89.

Bulír, A., and Hamann, A. J. (2008). Volatility of development aid: From the frying pan into the fire. World Development, 36(10), 2048-2066.

Burnside, C., and Dollar, D. (2000). Aid, Policies, and Growth. The American Economic Review, 90, 847-868.
Cagé, J., and Gadenne, L. (2018). Tax revenues and the fiscal cost of trade liberalization, 1792–2006, 1792-2006. Explorations in Economic History, 70, 1-24.

Camarero, M., Martínez-Zarzoso, I., Nowak-Lehmann, F., and Tamarit, C. (2016). Trade Openness and Income: A Tale of Two Regions. The World Economy, 39(3), 386-408.

Castanheira, M., Nicodème, G., and Profeta, P. (2011). On the Political Economics of Tax Reforms. CESifo Working Paper 3538. Munich, Germany: CESifo Group Munich.

Cavallo, E. A., and Frankel, J. A. (2008). Does openness to trade make countries more vulnerable to sudden stops, or less? Using gravity to establish causality. Journal of International Money and Finance, 27(8), 1430-1452.

Celasun, O., and Walliser, J. (2008). Predictability of aid: Do fickle donors undermine aid effectiveness? Economic Policy, 23(55), 545-594.

Chauvet, L., and Guillaumont, P. (2009). Aid, Volatility, and Growth Again: When Aid Volatility Matters and When it Does Not. Review of Development Economics, Special Issue on: Development Aid: Theory, Policies and Performance, Guest Editor: George Mavrotas, 13(3), 452-463.

Chambas, G. (2005). Afrique au sud du sahara:quelle stratégie de transition fiscale? Afrique Contemporaine (1), 133-163.

Chang, R., Kaltani, L., and Loayza, N.V. (2009). Openness can be good for growth: The role of policy complementarities. Journal of Development Economics, 90(1), 33-49.

Chauvet, L., and Ehrhart, H. (2018). Aid and growth: evidence from firm-level data. Journal of Development Economics, 135, 461-477.

Clist, P. (2016). Foreign aid and domestic taxation: multiple sources, one conclusion. Development Policy Review, 34(3), 365–383

Christiansen, L., Schindler, M., and Tressel T. (2013). Growth and structural reforms: A new assessment. Journal of International Economics, 89(2), 347-356.

Cohen, D., Valadier, C., Borensztein, E., and Cagé, J. (2008). Aid volatility and macroeconomic risks in Low Income Countries. OECD Working Paper N° 273, Paris.

Collier, P., and Goderis, B. (2008). Does Aid Mitigate External Shocks? UNU-WIDER Working Paper 6/2008, United Nations University-World Institute for Development Economics Research, Helsinki, Finland.

Crivelli, E. (2016). Trade liberalization and tax revenue in transition: an empirical analysis of the replacement strategy. Eurasian Economic Review, 6,1-25.

Crivelli, E. and Gupta, S. (2014). Resource blessing, revenue curse? Domestic revenue effort in resource-rich countries. European Journal of Political Economy, 35, 88–101.

Dabla-Norris, E., Minoiu, C., and Zanna, L-F. (2015). Business cycle fluctuations, large macroeconomic shocks, and development aid. World Development, 69, 44-61.

Dalgaard, C. J., Hansen, H., and Tarp, F. (2004). On the empirics of foreign aid and growth. The Economic Journal, 114, 191-216.

De Benedictis, L., and Tajoli, L. (2007). Economic integration and similarity in trade structures. Empirica, 34, 117-137.

De Benedictis, L., and Tajoli, L. (2008). Similarity in trade structures, integration and catching-up. 16(2), 165-182.

Dercon, S. (2001). Assessing vulnerability to poverty. Oxford: Mimeo, Jesus College and CSAE, Department of Economics, Oxford University, London.

di Giovanni, J., and Levchenko, A. A. (2009). Trade openness and volatility. Review of Economics and Statistics, 91(3), 558–585.

Di John, J. (2006). The Political Economy of Taxation and Tax Reform in Developing Countries. UNU-WIDER Research Paper 2006/74. United Nations University, World Institute for Development Economics Research, Helsinki, Finland.

Easterly, W. R., and Kraay, A. (2000). Small states. Small problem? Income, growth, and volatility in small states. World Development, 28(11), 2013-2027.

Ebeke, C., and Ehrhart, H. (2012). Tax Revenue Instability in Sub-Saharan Africa: Consequences and Remedies. Journal of African Economies, 21(1), 1-27.

Ebeke, C.H. (2014). Do International Remittances affect the level and the volatility of government tax revenue? Journal of International Development, 26(7), 1039-1053.

Ebrill, L. P., Keen, M., and Bodin, J. P. (2001). The modern VAT. International Monetary Fund. Washington, D.C.

Ebrill, L., Stotsky, J., and Gropp, R. (1999). Revenue Implications of Trade Liberalization, Occasional Paper 180. International Monetary Fund, Washington, D.C.

Fatas, A., and Mihov, I. (2003). The case for restricting fiscal policy discretion. Quarterly Journal of Economics, 118(4), 1419-1447.

Finger, J.M., and Kreinin, M.E. (1979). A measure of export similarity and its possible uses, Economic Journal, 89(356), 905-912.

Focanti, D M Hallerberg, C Scartascini (2013). Tax Reforms in Latin America in an Era of Democracy, IDB Working Paper Series No. IDB-WP-457.

Galiani, S., Knack, S., Xu, L. C., and Zou, B. (2016). The effect of aid on growth: evidence from a quasi-experiment. National Bureau of Economic Research (NBER) Working Paper No. 22164. Cambridge.

Gbewopo, A., Chambas, G. and Combes, J-L. (2009). Official Development Assistance and Tax Transition, CERDI, Etudes et Documents, E 2009.01, University of Clermont I, CERDI-UMR CNRS, France.

Ghura, H. (1998). Tax Revenue in sub-Sahara Africa: Effects of economic policies and corruption. International Monetary Fund (WP/98/135. Washington D.C).

Glick, R., and Rose, A. (1999). Contagion and trade. Why are currency crises regional. Journal of International Money and Finance, 18(4), 630-636.

Gnangnon, S.K., and Brun, J.F. (2017). Impact of export upgrading on tax revenue in developing and high-income countries. Oxford Development Studies, 45(4), 542-561.

Gnangnon, S.K., and Brun, J.F. (2018). Is the impact of development aid on government revenue sustainable? An empirical assessment. The Quarterly Review of Economics and Finance, 67, 311-325.

Gomanee, K., Girma, S., and Morrissey, O. (2005). Aid and growth in sub-Saharan Africa: Accounting for transmission mechanisms. Journal of International Development, 17, 105-1075.

Grossman, G. M. and Helpman, E. (1991). Innovation and Growth in the Global Economy. Cambridge, MA: MIT Press.

Guillaumont, P., and Wagner, L. (2012). Aid and Growth Accelerations: Vulnerability Matters. Working Paper No. 2012/31, United Nations University-World Institute for Development Economics Research, Helsinki, Finland.

Gupta, S. (2007). Determinants of Tax Revenue Efforts in Developing Countries. IMF Working Paper 07/184. Washington: International Monetary Fund.

Gupta, S., Clements, B., Pivovarsky, A., and Tiongson, E. (2004). Foreign aid and revenue response: Does the composition of aid matter?. In S. Gupta, B. Clements, & G. Inchauste (Eds.), Helping countries develop: The role of fiscal policy (pp. 385–406). Washington, DC: International Monetary Fund.

Haddad, M., Lim J. J., Munro L., Saborowski C., and Shepherd B. (2011). Volatility, Export, Diversification, and Policy", Chapter 11, In Managing Openness: Trade and Outward-Oriented Growth after the Crisis. World Bank, Washington, D.C.

Haddad, M., Lim, J. J., Pancaro, C., and Saborowski, C. (2013). Trade openness reduces growth volatility when countries are well diversified. Canadian Journal of Economics 46(2), 765-790.

Hansen, H. and Tarp, F. (2000). Aid and Growth Regressions. Journal of Development Economics, 64, 547-570.

Harb, N., and Hall, S.G. (2019). Does foreign aid play a role in the maintenance of economic growth? A non-linear analysis. The Quarterly Review of Economics and Finance, https://doi.org/10.1016/j.qref.2018.12.002

Heller, P. S. (1975). A Equation of Public Fiscal Behaviour in Developing Countries: Aid, Investment and Taxation. American Economic Review, 65, 429-45.

Hisali, E. (2012). Trade policy reform and international trade tax revenue in Uganda. Economic Modelling, 29 (6), 2144-2154.

Hudson, J. (2015). Consequences of Aid Volatility for Macroeconomic Management and Aid Effectiveness. World Development, 69, 62-74.

Hudson, J., and Mosley, P. (2008a). The Macroeconomic Impact of Aid Volatility. Economics Letters, 99(3), 486-489.

Hudson, J., and Mosley, P. (2008b). Aid Volatility, Policy and Development. World Development, 36(10), 2082-2102.

Karras, G. (2006). Foreign aid and long run economic growth: Empirical evidence for a panel of developing countries. Journal of International Development, 18, 15-28.

Khan, H. A., Hoshino E. (1992). Impact of Foreign Aid on the Fiscal Behaviour of LDC. World Development, 20: 1481–8.

Keen, M. (2012). 'Taxation and development – again'. IMF Working Paper 12–220. Washington, DC: International Monetary Fund.

Keen, M., and Ligthart, J. (2002). Coordinating tariff reduction and domestic tax reform. Journal of International Economics, 56(2), 489-507.

Keen, M., and Simone, A. (2004). Tax policy in developing countries: some lessons from the 1990s and some challenges ahead. Helping countries develop: The role of fiscal policy, 302-52.

Khattry, B. (2003). Trade Liberalization and the Fiscal Squeeze: Implications for Public Investment. Development and Change, 34(3), 401-424.

Khattry, B., and Rao, J.M. (2002) Fiscal Faux Pas?: An analysis of the revenue implications of trade liberalization. World Development 30 (8), 1431–1444.

Knack, S., and Rahman A. (2007). Donor Fragmentation and Bureaucratic Quality in Aid Recipients. Journal of Development Economics, 83, 176–97.

Kneller, R., Morgan, C. W. and Kanchanahatakij, S. (2008). Trade Liberalisation and Economic Growth. The World Economy, 31(6), 701-719.

Koren, M. and Tenreyro, S. (2007). Volatility and development. Quarterly Journal of Economics, 122(1), 243-287.

Kose, M. A., and Yi, K. M. (2006). Can the standard international business cycle model explain the relation between trade and comovement?. Journal of International Economics, 68, 267-295.

Loayza, N., and Raddatz, V. C. (2007). The structural determinants of external vulnerability. The World Bank Economic Review, 21(3), 359-387.

Lensink, R., and Morrissey, O. (2001). Aid Instability as a Measure of Uncertainty and the Positive Impact of Aid on Growth, Journal of Development Studies, 36(3), 31-49.

Levy, V. (1988). Aid and growth in sub-Saharan Africa: the recent experience. European Economic Review, 32, 1777-1795.

Lim, D. (1983). Instability of Government Revenue and Expenditure in Less Developed Countries. World Development, 11(5), 447-50.

Loayza, N. and Schmidt-Hebbel, K., (2005). Does openness imply greater exposure?" World Bank Policy Research Working Papers 3733, World Bank, Washington D.C.

Longoni, E. (2009). Trade Liberalization and Trade Tax Revenues in African Countries, Working paper n° 158, University of Milan Bicocca, Italy.

Lora, E (2012). Structural Reforms in Latin America: What Has Been Reformed and How to Measure It. (Updated version.) IDB WP-346. Washington, DC, United States: Inter-American Development Bank.

Mahon, J E Jr (2004). Causes of Tax Reform in Latin America, 1977-95. Latin American Research Review 39(1), 3-30.

Marshall, M.G. and Jaggers, K. (2009). Polity IV Project Country Reports, CIDUM, University of Maryland, College Park, MD.

Martens, B., Mummert U., Murrell P., and Seabright, P. (2002). The Institutional Economics of Foreign Aid. Cambridge: Cambridge University Press.

Mavrotas, G., and Ouattara, B. (2007). Aid Modalities and Budgetary Response: Panel Data Evidence, Review of World Economics, 143 (4), 720-741.

Melitz, M. J. (2003). The Impact of Trade on Intra-Industry Allocations and Aggregate Industry Productivity. Econometrica, 71(6), 1695-1725.

Moller, L. (2016). Tax revenue implications of trade liberalization in low-income countries. WIDER Working Paper 2016/173, United Nations University World Institute for Development Economics Research (UNU-WIDER), Finland.

Montalbano, P. (2011). Trade Openness and Developing Countries' Vulnerability: Concepts, Misconceptions, and Directions for Research. World Development, 39(9), 1489-1502.

Morrissey O. (2015). Aid and Government Fiscal Behavior: Assessing Recent Evidence. World Development, 69, 98-105.

Morrissey, O., Prichard, W. and Torrance, S. (2014). Aid and Taxation: Exploring the Relationship Using New Data, ICTD Working Paper 21, Brighton: International Centre for Tax and Development.

Mukherjee, S., and Chanda, R. (2017). Differential effects of trade openness on Indian manufacturing firms. Economic Modelling, 61, 273-292.
Naito, T. (2017). An asymmetric Melitz model of trade and growth. Economics Letters, 158, 80-83.

Njikam, O., and Cockburn, J. (2011). Trade Liberalization and Productivity Growth: Firm-Level Evidence from Cameroon. The Journal of Developing Areas 44 (2), 279-302.

Ouattara, B. (2006). Foreign Aid and Government Fiscal Behaviour in Developing Countries: Panel Data Evidence. Economic Modelling, 23, 506-14.

Raddatz, C. (2007). Are external shocks responsible for the instability of output in low-income countries?. Journal of Development Economics, 84(1), 155–187.

Razin, A., Sadka, E., and Coury, T. (2003). Trade openness, investment instability and terms-of-trade volatility. Journal of International Economics, 61, 285–306.

Remmer K. L. (2004). Does Foreign Aid Promote the Expansion of Government?. American Journal of Political Science, 48, 77–92.

Rodrik, D. (1999). Where did all the growth go? External shocks, social conflict, and growth collapses. Journal of Economic Growth, 4(4), 385-412.

Roodman, D. M. (2009). A note on the theme of too many instruments, Oxford Bulletin of Economic and Statistics, 71 (1), 135–158.

Sánchez, O. (2006). Tax System Reform in Latin America: Domestic and International Causes. Review of International Political Economy 13(5), 772-801.

Svensson, J. (2006). The Institutional Economics of Foreign Aid. Swedish Economic Policy Review, 13, 115.

Tanzi, V. (1977). Inflation, Lags in Collection, and the Real Value of Tax Revenue. Staff Papers. International Monetary Fund, 26, 154-67, Washington D.C.

Tanzi, V. (1992). Structural factors and tax revenue in developing countries: a decade of evidence. In: Open Economies: Structural Adjustment and Agriculture, ed. by Goldin, I. and Winters, L. A. Cambridge University Press, chap. Structural factors and tax revenue in developing countries: a decade of evidence, pp. 267-281. (ISBN: 0521420563).

Tanzi, V., and Zee, H. H. (2000). Tax policy for emerging markets: developing countries. National tax journal, 299-322.

Thomas, A., and Treviño, J.P. (2013). Resource Dependence and Fiscal Effort in Sub-Saharan Africa. IMF Working Paper, WP/13/188, International Monetary Fund, Washington, DC.

Tressel T., and Prati, A. (2006). Aid Volatility and Dutch Disease: Is There a Role for Macroeconomic Policies? International Monetary Fund, Washington D.C.

Wacziarg, R. and Welch, K. (2008). Trade liberalisation and growth: New evidence. World Bank Economic Review, 22(2), 187-231.

Waglé, S. (2011). Coordinating Tax Reforms in the Poorest Countries: Can Lost Tariffs be Recouped? Policy Research Working Paper 5919. The World Bank, Washington, DC.

Weiss, J. (1991). Industry in Developing Countries: Theory, Policy and Evidence, Routledge, London.

Winters, A., Cirera, X., and McCulloch, N. (2001). Trade Liberalization and Poverty: A Handbook. Centre for Economic Policy Research (CEPR), United Kingdom.

Wong, S. A. (2007). Market-Discipline Effects of Trade Liberalization: Micro-Level Evidence from Ecuador, 1997-2003. Journal of Applied Econometrics and International Development, 7(2), 121-134.

Yeyati, E. L., Panizza U, and Stein, E (2007). The cyclical nature of North-South FDI flows. Journal of International Money and Finance, 26, 104-130.

Yohou, H., Goujon, D., Michaël, M., and Ouattara, W. (2016). Heterogeneous Aid Effects on Tax Revenues: Accounting for Government Stability in WAEMU Countries. Journal of African Economies, 25(3), 468-49.

Zee, H. H. (1996). Empirics of cross-country tax revenue comparisons. World development, 24(10), 1659-1671.

Ziliak, J.P. (1997). Efficient estimation with panel data when instruments are predetermined: an empirical comparison of moment-condition estimators. Journal of Business and Economic Statistics, 15(4), 419-431.

TABLES and APPENDICES

Table 1: Impact of tax reform on public revenue
Estimators: FE-DK and Two-step System GMM

	FE-DK	**Two-step System GMM**	
VARIABLES	**Log(TAXREV)**	**Log(TAXREV)**	**Log(TAXREV)**
	(1)	**(2)**	**(3)**
$Log(TAXREV)_{t-1}$		0.570***	0.526***
		(0.0324)	(0.0310)
Log(TAXREF)	1.050***	0.543***	0.920***
	(0.0439)	(0.0427)	(0.0717)
LDC*[Log(TAXREF)]			-0.460***
			(0.0639)
LDC			1.849***
			(0.269)
Log(NAT)	-1.34e-05	0.0559***	0.0745***
	(0.00497)	(0.0119)	(0.0113)
Log(OPEN)	-0.0501***	-0.0951***	-0.0889***
	(0.00601)	(0.0117)	(0.0100)
Log(GDPC)	0.0906**	0.0342	-0.0316
	(0.0376)	(0.0223)	(0.0240)
POLITY2	0.00459***	0.00565***	0.00325**
	(0.00151)	(0.00157)	(0.00156)
Log(SHVANONAGRI)	0.155**	0.244**	0.546***
	(0.0742)	(0.106)	(0.112)
INFL	-0.00357	-0.0284***	-0.0192***
	(0.00520)	(0.00731)	(0.00700)
Log(TERMS)	-0.0220*	-0.00441	0.000787
	(0.0121)	(0.0141)	(0.0141)
Log(POP)	-0.0776*	-0.0599***	-0.0440***
	(0.0409)	(0.0111)	(0.0106)
Constant	-6.145***	-4.059***	-7.209***
	(0.548)	(0.354)	(0.519)
Observations - Countries	498 - 95	444 - 95	444 - 95
Within R-squared	0.7722		
Number of Instruments		60	70
AR1 (P-Value)		0.0000	0.0000
AR2 (P-Value)		0.9096	0.6654
OID (P-Value)		0.1740	0.1921

*Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust Standard Errors are in parenthesis. In the two-step system GMM estimations, the variables TAXREF, NAT, GDPC, POLITY2 have been considered as endogenous. The other variables have been considered as exogenous. The regressions have used 2 lags of the dependent variable as instruments and 2 lags of the endogenous variables as instruments.*

Table 2: Impact of tax reform on public revenue instability
Estimators: FE-DK and Two-step System GMM

	FE-DK	**Two-step System GMM**	
VARIABLES	**Log(TAXREVINST)**	**Log(TAXREVINST)**	**Log(TAXREVINST)**
	(1)	**(2)**	**(3)**
$Log(TAXREVINST)_{t-1}$		0.0819***	0.0660***
		(0.0177)	(0.0195)
Log(TAXREF)	-0.742***	-0.505***	-0.797***
	(0.222)	(0.0704)	(0.138)
LDC*[Log(TAXREF)]			0.441***
			(0.162)
LDC			-1.937***
			(0.661)
Log(NATVOL)	0.0435*	0.100***	0.0951**
	(0.0252)	(0.0376)	(0.0408)
Log(NAT)	-0.0469	-0.0342	-0.0422
	(0.0717)	(0.0394)	(0.0341)
Log(OPEN)	-0.00511	0.179***	0.219***
	(0.0611)	(0.0482)	(0.0495)
Log(GRVOL)	0.0814***	0.180***	0.169***
	(0.0209)	(0.0461)	(0.0460)
Log(GDPC)	0.0729	-0.0766**	-0.128**
	(0.0616)	(0.0355)	(0.0502)
INFL	0.0735	0.175***	0.182***
	(0.0630)	(0.0264)	(0.0270)
Log(INFLVOL)	0.151***	0.0779***	0.0837***
	(0.0342)	(0.0183)	(0.0207)
Log(TERMSVOL)	0.0825***	0.137***	0.131***
	(0.0239)	(0.0217)	(0.0234)
Constant	0.662	-0.0803	1.477*
	(0.901)	(0.704)	(0.787)
Observations - Countries	475 - 95	419 - 95	419 - 95
Within R-squared	0.2718		
Number of Instruments		78	79
AR1 (P-Value)		0.0000	0.0000
AR2 (P-Value)		0.3137	0.2599
OID (P-Value)		0.5701	0.5557

*Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust Standard Errors are in parenthesis. In the two-step system GMM estimations, the variables TAXREF, NAT, NATVOL, GDPC, OPEN, GRVOL have been considered as endogenous. The other variables have been considered as exogenous. The regressions have used 2 lags of the dependent variable as instruments and 2 lags of the endogenous variables as instruments.*

Table 3: Does the impact of tax reform on tax revenue depend on development aid flows?
Estimator: Two-step System GMM

VARIABLES	**Log(TAXREV)**
	(1)
$Log(TAXREV)_{t-1}$	0.594***
	(0.0269)
Log(TAXREF)	-0.932***
	(0.334)
[Log(TAXREF)]*[Log(NAT)]	0.0764***
	(0.0182)
Log(NAT)	-0.254***
	(0.0743)
Log(OPEN)	-0.0982***
	(0.0113)
Log(GDPC)	-0.0154
	(0.0196)
POLITY2	0.00537***
	(0.00151)
Log(SHVANONAGRI)	0.370***
	(0.101)
INFL	-0.0266***
	(0.00666)
Log(TERMS)	-0.0171
	(0.0121)
Log(POP)	-0.0438***
	(0.00765)
Constant	1.605
	(1.376)
Observations - Countries	444 - 95
Number of Instruments	70
AR1 (P-Value)	0.0001
AR2 (P-Value)	0.9337
OID (P-Value)	0.2232

*Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust Standard Errors are in parenthesis. In the two-step system GMM estimations, the variables TAXREF, NAT, GDPC, POLITY2 have been considered as endogenous. The other variables have been considered as exogenous. The regressions have used 2 lags of the dependent variable as instruments and 2 lags of the endogenous variables as instruments.*

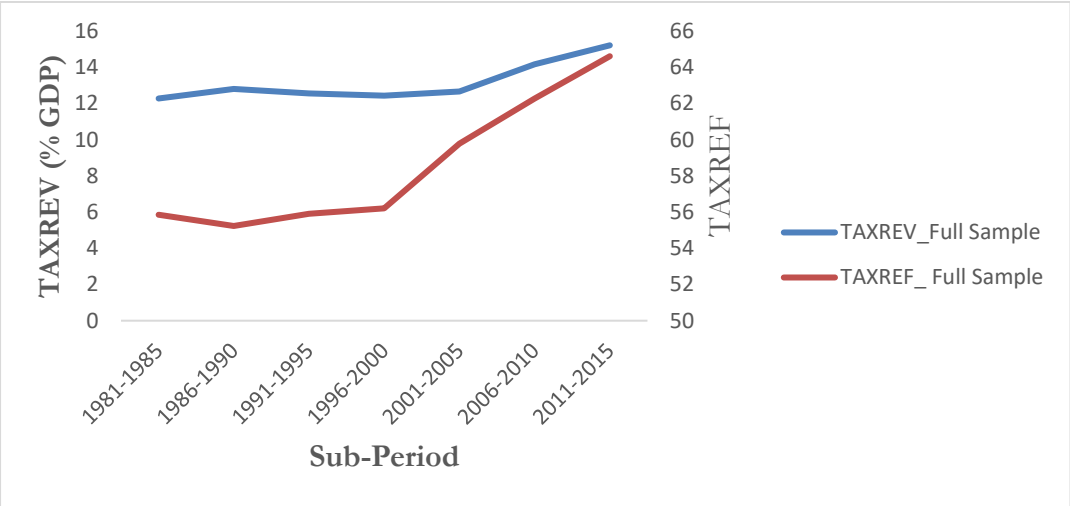
Table 4: Does the impact of tax reform on public revenue instability depend on development aid? ***Estimator***. Two-step System GMM

VARIABLES	**Log(TAXREVINST)**
	(1)
$Log(TAXREVINST)_{t-1}$	0.0923***
	(0.0114)
Log(TAXREF)	-0.376***
	(0.0511)
Log(NATVOL)	-0.888***
	(0.0780)
[Log(TAXREF)]*[Log(NATVOL)]	0.248***
	(0.0202)
Log(NAT)	-0.0237
	(0.0227)
Log(OPEN)	0.0453
	(0.0444)
Log(GRVOL)	0.137***
	(0.0358)
Log(GDPC)	-0.0350
	(0.0292)
INFL	0.0865***
	(0.0177)
Log(INFLVOL)	0.105***
	(0.0128)
Log(TERMSVOL)	0.131***
	(0.0199)
Constant	-0.288
	(0.431)
Observations - Countries	419 - 95
Number of Instruments	88
AR1 (P-Value)	0.0000
AR2 (P-Value)	0.2014
OID (P-Value)	0.7436

*Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust Standard Errors are in parenthesis. In the two-step system GMM estimations, the variables TAXREF, NAT, NATVOL, GDPC, OPEN, GRVOL have been considered as endogenous. The other variables have been considered as exogenous. The regressions have used 2 lags of the dependent variable as instruments and 2 lags of the endogenous variables as instruments.*

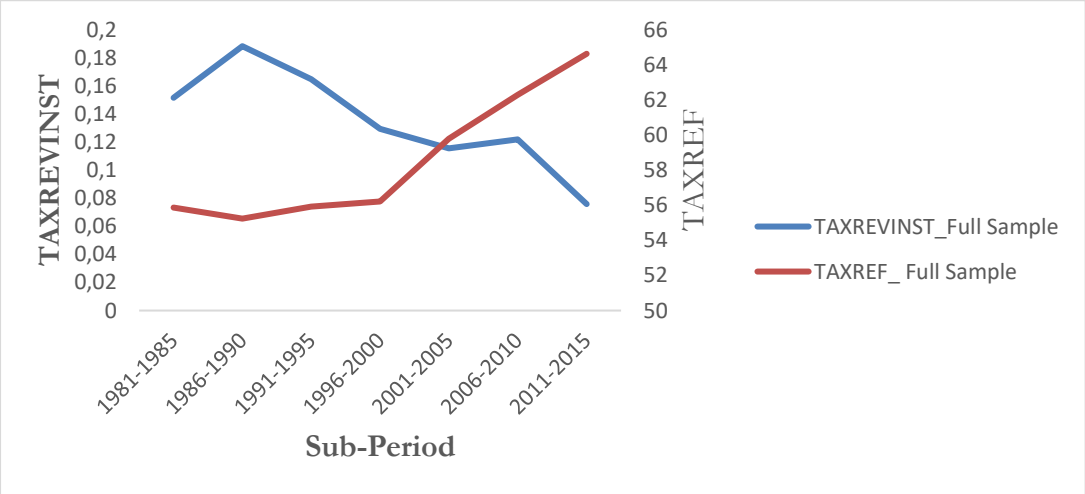
FIGURES

Figure 1: Evolution of TAXREV and TAXREF_Over the Full Sample



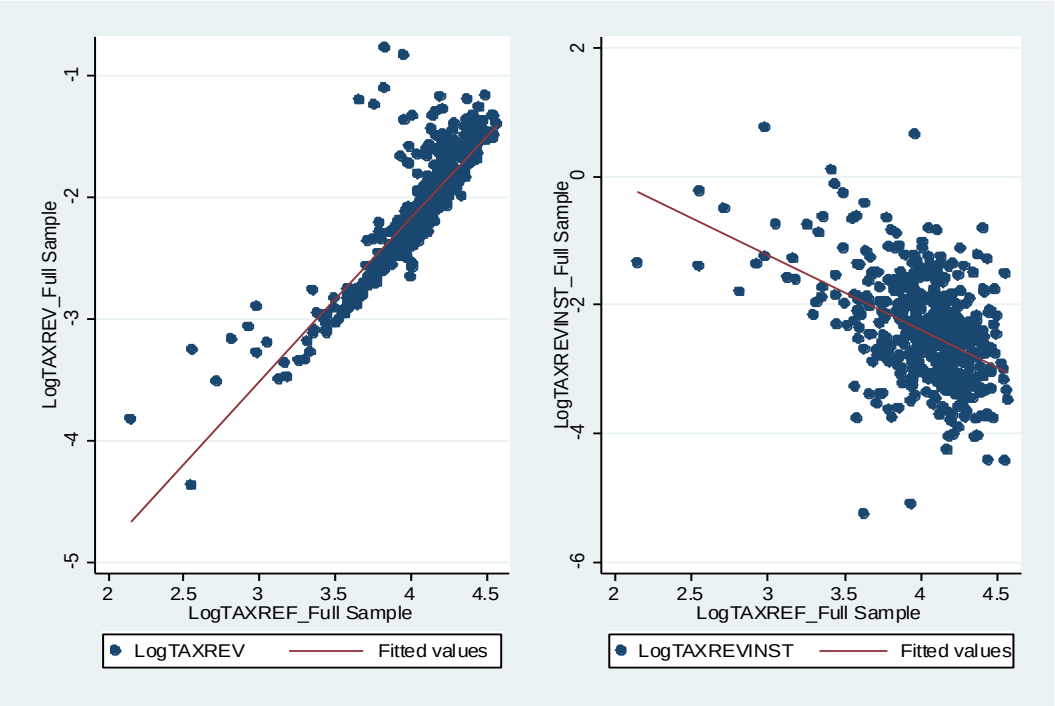
Source: Authors
Note: TAXREV is expressed in percentage of GDP.

Figure 2: Evolution of TAXREVINST and TAXREF_Over the Full Sample



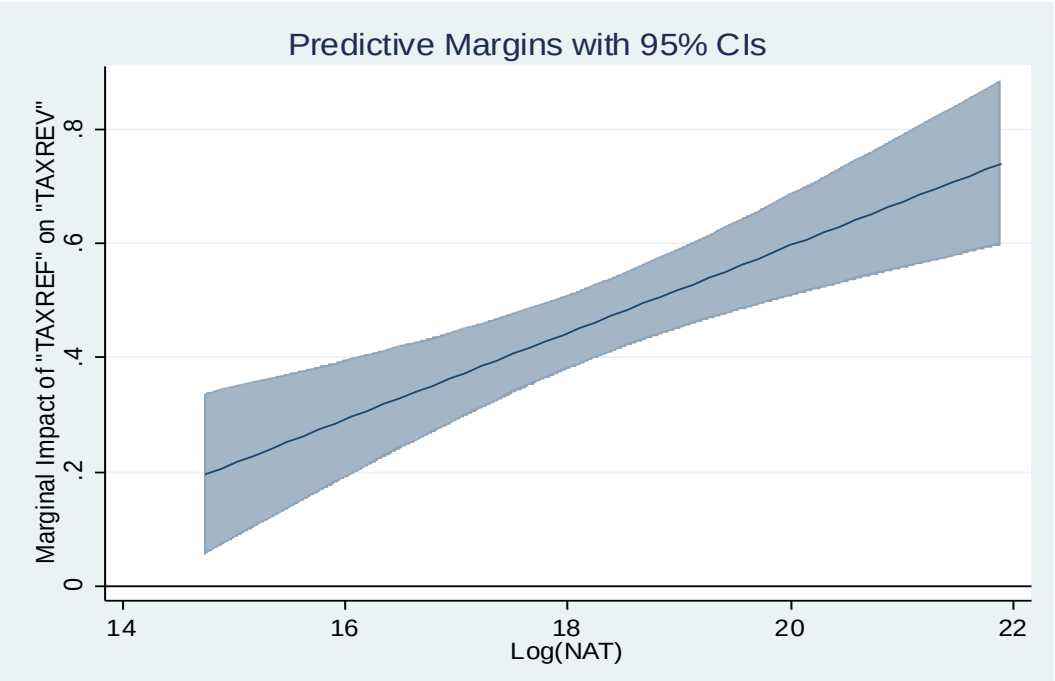
Source: Authors

Figure 3: Correlation pattern between TAXREF, TAXREV and TAXREVINST



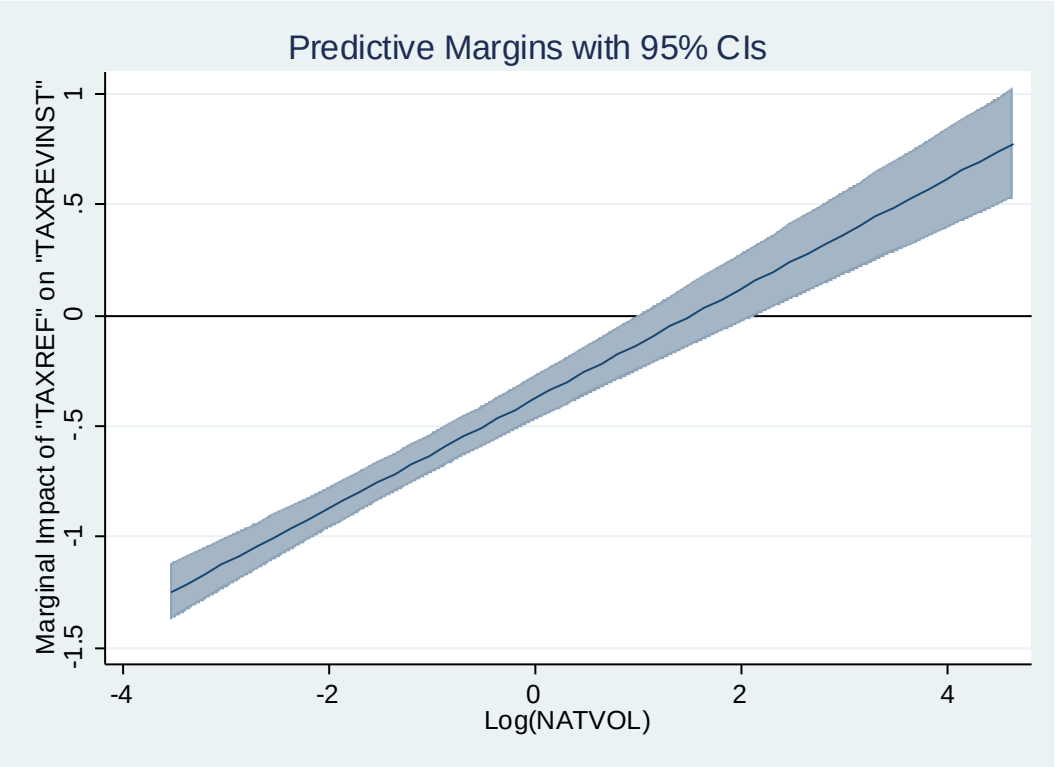
Source: Authors

Figure 4: Marginal Impact of "TAXREF" on "TAXREV", for varying levels of development aid flows



Source: Authors

Figure 5: Marginal Impact of "TAXREF" on "TAXREVINST", for varying levels of development aid flows



Source: Authors

Appendix 1: List of developed countries (Old Industrialized countries) used to compute the index of convergence in tax structure index for developing countries in the analysis

Developed Countries	
Australia	Japan
Austria	Luxembourg
Belgium	Netherlands
Canada	New Zealand
Denmark	Norway
Finland	Portugal
France	Spain
Germany	Sweden
Greece	Switzerland

Appendix 2: Definition and Source of variables

Variables	Definition	Source
TAXREV	This is the ratio of tax revenue to GDP, which represents the difference between the ratio of the total public revenue to GDP and the ratio of non-tax revenue to GDP.	ICTD Public Revenue Dataset. See online: https://www.wider.unu.edu/project/government-revenue-dataset
TAXREVINST	This is the measure of the tax revenue instability. It has been calculated as the standard deviation of annual growth rate of tax revenue-to-GDP ratio over non-overlapping sub-periods of 5-year data.	Author's calculation based on data from the ICTD database.
TAXREF	This the index of convergence of the tax structure of a given developing country towards the developed countries' tax structure. Its values range between 0 and 100, with a rise in these values reflecting greater tax structure convergence, i.e., greater tax reforms.	Author's computation (see Section 3) based on data extracted from the ICTD Public Revenue Dataset. See online: http://www.ictd.ac/index.php/dataset#core-dataset
TERMS	This is the measure of terms of trade. Terms of trade represent the ratio of the export price index to import price index.	Authors' calculation based on data from the World Development Indicators (WDI) of the World Bank
TERMSVOL	This is the measure of terms of trade instability. Terms of trade represent the ratio of the export price index to import price index. Terms of trade volatility has been calculated as the standard deviation of annual terms of trade growth over 5-year non-overlapping sub-periods.	Authors' calculation based on terms of trade data previously described.
INFL	The variable "INFL" has been calculated using the following formula (see Yeyati et al. 2007): INFL $= sign(INFLATION) * \log(1 + \|INFLATION\|)$ (2), where $\|INFLATION\|$ refers to the absolute value of the annual inflation rate (%), denoted "INFLATION". The annual inflation rate (%) is based on Consumer Price Index -CPI- (annual %) where missing values has been replaced with values of the GDP Deflator (annual %).	Authors' calculation based on data from the WDI.
INFLVOL	Inflation volatility, calculated as the standard deviation of inflation rate over 5-year non-overlapping sub-periods.	Authors' calculation based on inflation data extracted from the WDI

GRVOL	This is the measure of the volatility of economic growth rate. It has been calculated as the standard deviation of annual economic growth rate (growth rate of real GDP) over non-overlapping sub-periods of 5-year.	Authors' calculation based on economic growth rate data extracted from the WDI
OPEN	This is the measure of trade openness (de facto trade openness). It is calculated as the sum of exports and imports, in % GDP	WDI
GDPC	GDP per capita (constant 2010 US$)	WDI
NAT	This is the Net Aid Transfers (NAT), in Constant 2015 US$ prices. This is the net Official Development Assistance (ODA), from which are subtracted principal payments are received on ODA loans, interest received on such loans and debt relief.	NAT data (in current prices) are extracted from the database compiled by David Roodman (see online: http://davidroodman.com/data/)
NATVOL	This is the measure of the volatility of the Net Aid Transfers. It has been calculated as the standard deviation of the growth rate of the Net Aid Transfers over non-overlapping sub-periods of 5-year.	Authors' calculation
SHVANONAGRI	Share of Value Added in non-Agriculture, in % of total output value added.	United Nations Database
POLITY2	This is an index extracted from Polity IV Database (Marshall and Jaggers, 2009). It represents the degree of democracy based on competitiveness of political participation, the openness and competitiveness of executive recruitment and constraints on the chief executive. Its values range between -10 and +10, with lower values reflecting autocratic regimes, and greater values indicating democratic regimes. Specifically, the value +10 for this index represents a strong democratic regime, while the value -10 stands for strong autocratic regime.	Polity IV Database (Marshall and Jaggers, 2009)
POP	Total Population	WDI

Appendix 3: Standard Descriptive statistics on the variables used in the analysis

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
TAXREV	594	0.132	0.615	0.127	0.461
TAXREF	519	58.903	15.295	8.573	96.195
TAXREVINST	567	0.133	0.203	0.004	2.971
NAT	630	4.64e+08	5.10e+08	2528334	3.70e+09
OPEN	613	75.280	39.768	0.198	419.408
GDPC	624	2515.565	2685.778	157.150	15381.560
SHVANONAGRI	638	77.555	13.635	34.478	98.817
INFLATION	629	60.350	361.001	-4.253	5438.696
TERMS	625	106.205	66.745	13.347	762.396
POP	648	3.04e+07	1.04e+08	253041.2	1.18e+09
POLITY2	633	0.179	5.691	-10.000	10.000
GRVOL	616	4.056	5.411	0.144	70.380
INFLVOL	626	84.743	692.385	0.239	10795.530
TERMSVOL	607	0.246	0.499	0.014	9.808
NATVOL	613	0.962	5.586	0.029	122.321

Appendix 4: List of countries in the full sample and the sub-sample of LDCs

Full Sample			LDCs	
Albania	Georgia	Namibia	Angola	Sudan
Algeria	Guatemala	Nepal	Bangladesh	Tanzania
Angola	Guinea	Niger	Benin	Uganda
Armenia	Guinea-Bissau	Nigeria	Bhutan	Yemen, Rep.
Azerbaijan	Guyana	Pakistan	Burkina Faso	Zambia
Bangladesh	Haiti	Panama	Burundi	
Benin	Honduras	Papua New Guinea	Cambodia	
Bhutan	India	Paraguay	Central African Republic	
Bolivia	Indonesia	Peru	Chad	
Botswana	Iran, Islamic Rep.	Philippines	Comoros	
Brazil	Jamaica	Romania	Congo, Dem. Rep.	
Bulgaria	Jordan	Rwanda	Equatorial Guinea	
Burkina Faso	Kazakhstan	Senegal	Eritrea	
Burundi	Kenya	Sierra Leone	Ethiopia	
Cambodia	Kyrgyz Republic	Solomon Islands	Gambia, The	
Cameroon	Lao PDR	South Africa	Guinea	
Cape Verde	Lebanon	Sri Lanka	Guinea-Bissau	
Central African Republic	Lesotho	Sudan	Haiti	
Chad	Liberia	Suriname	Lao PDR	
Comoros	Libya	Swaziland	Lesotho	
Congo, Dem. Rep.	Macedonia, FYR	Tajikistan	Liberia	
Congo, Rep.	Madagascar	Tanzania	Madagascar	
Costa Rica	Malawi	Thailand	Malawi	
Cote d'Ivoire	Malaysia	Tunisia	Mauritania	
Dominican Republic	Mauritania	Uganda	Mozambique	
El Salvador	Mauritius	Ukraine	Myanmar	
Equatorial Guinea	Mexico	Uzbekistan	Nepal	
Eritrea	Moldova	Venezuela, RB	Niger	
Ethiopia	Mongolia	Yemen, Rep.	Rwanda	
Fiji	Morocco	Zambia	Senegal	
Gabon	Mozambique	Zimbabwe	Sierra Leone	
Gambia, The	Myanmar		Solomon Islands	