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Tax Revenue Instability in sub-Saharan Africa: Consequences and Remedies

Christian EBEKE[*], Hélène EHRHART*

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[*] International Monetary Fund (IMF) and Auvergne University, Center for Studies and Research on International Development (CERDI).

* Banque de France. Email: helene.ehrhart@banque-france.fr

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Résumé – Cet article analyse les sources et les conséquences de l'instabilité des recettes fiscales dans les pays d'Afrique sub-saharienne. Nous utilisons une base de données unique et riche sur la composition des recettes fiscales de 37 pays sur la période 1980-2005 et trouvons deux résultats majeurs. Premièrement, l'instabilité des recettes fiscales engendre une instabilité des dépenses de consommation et d'investissement public et réduit le niveau d'investissement public. Deuxièmement, une structure fiscale reposant davantage sur les taxes indirectes intérieures présente un effet stabilisateur des recettes fiscales.

Mots- clés : Instabilité des recettes fiscales, composition des recettes, dépenses publiques, Afrique sub-saharienne.
Codes JEL *:* H20, E32, O11.

Abstract – This paper focuses on the sources and consequences of the instability of tax revenue in Sub-Saharan African countries. We took advantage of a unique and extraordinarily rich dataset on the composition of tax revenues for a large number of countries. Using panel data for 37 countries observed over the period 1980-2005, our results are twofold. First, the instability of government tax revenue leads to the instability of both public investment and government consumption, and also reduces the level of public investment. Second, the reliance on domestic indirect taxation-based systems appears to have a robust stabilising effect.

Keywords: Tax instability; tax composition; public spending; Sub-Saharan Africa
JEL classification*:* H20, E32, O11.

1. INTRODUCTION

Tax revenue mobilisation in Sub-Saharan Africa (SSA) is not only low compared to spending needs (Stotsky and Woldemariam, 1997; Keen and Mansour, 2010) but also suffers from a high level of instability (Brun et al., 2006). Tax revenue instability has been documented as particularly important in Sub-Saharan Africa and, from the tax instability measures presented in Table 1, one can note that countries did not succeed in eliminating this instability over the period 1980-2005. Since the beginning of the 2000s, there has been a small decrease in tax instability, but it remains an ongoing issue that needs to be seriously addressed. As far as the components of tax revenue are concerned, we can highlight some stylised facts. Corporate taxes were the most unstable taxes during the period 1980-2005, whereas indirect taxes have become slightly less volatile than trade taxes since the 1990s.

Table 1: Tax revenue instability and public spending instability in Sub-Saharan Africa.

	1980/1985	1986/1990	1991/1995	1996/2000	2001/2005
Total tax revenue	2.59	2.77	2.64	2.49	2.22
Trade tax revenue	3.04	3.18	3.14	3.07	2.79
Indirect tax revenue	3.22	3.26	3.08	3.06	2.64
Income tax revenue	3.03	2.91	2.83	2.78	2.61
Corporate tax revenue	3.32	3.37	3.34	3.41	3.17
Individual income tax revenue	3.06	2.96	3.09	2.8	2.73
Public investment	2.92	3.30	3.15	3.30	3.22
Government consumption	2.24	2.37	2.36	2.42	2.37

Note: instability is measured as the standard deviation of the log difference of the variables. Instability is in logarithmic terms.

The primary concern which is linked with tax revenue instability is that it may result in public spending instability, which is a grave concern for SSA countries as it has been found to be detrimental to growth and welfare (Guillaumont et al., 1999; Fatas and Mihov, 2003; Furceri, 2007; Loayza et al., 2007). Indeed, unstable revenues are costly, because they may force the government to consequently cut public spending, leading to public spending instability. According to the instability measures in Table 1, the instability of both public investment and government consumption has not decreased

compared to the levels from the 1980s, and assessing the extent to which this fact is due to revenue instability is therefore crucial.

It is worth noting that the public investment ratio seems to be less stable than the government consumption ratio in our sample. This is not very surprising, as government consumption contains some items such as wages and salaries which are renewed every year.

Only two studies, to our knowledge, have thus far tackled the problem of tax revenue instability. Lim (1983) estimated that tax revenue instability was the major cause of expenditure instability in less developed countries in the period from 1965 to 1973. He therefore called for further research investigating ways in which the degree of tax revenue instability could be reduced. Bleaney et al. (1995) analysed the sources and the consequences of revenue instability in developing countries. They found that tax revenue instability is more common in poor, more open and more inflationary economies. Moreover, the cross-sectional evidence shows that countries with high tax revenue instability also tend to have high total expenditure instability.

Given this background, the aim of this paper is to implement a thorough analysis of tax revenue instability in a panel of Sub-Saharan African countries for the period 1980-2005, judging its impact on both public investment and government consumption instability and the level of public investment. This paper then aims to derive concrete solutions to deal with these issues.

This study takes advantage of a recent and unique dataset on the composition of tax revenues over a long time period which was compiled by Keen and Mansour (2010). We first assessed the consequences of tax revenue instability on the volatility of both public investment and government consumption and on levels of public investment, which is one of the most crucial components of public spending for economic growth in developing countries. In a second step, we investigated the means available to governments wishing to address the issue of tax revenue instability.

We focused solely on African countries because these countries are often unable to resort to financial markets (domestic or international) in order to smooth out their revenue. Finding alternative ways of dealing with revenue instability in these countries is therefore of the utmost importance. Countries can enhance their risk preparedness by analysing the determinants of tax revenue instability

and especially by investigating whether a specific tax structure can limit the instability of the total tax revenue ratio.

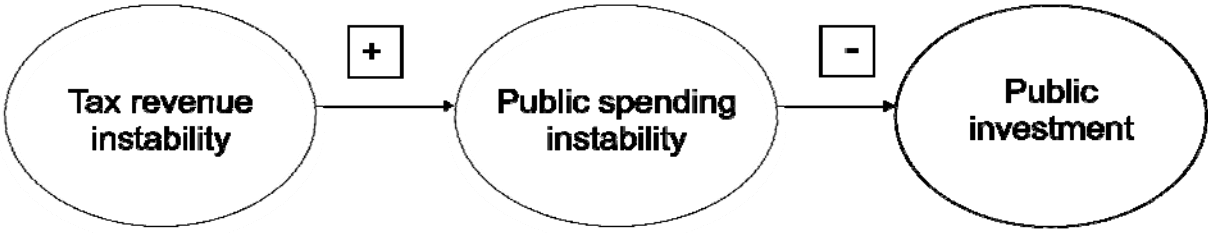
To summarise our findings, we established that tax revenue instability in Sub-Saharan Africa leads to public investment and government consumption instability, which in turn generates a lower public investment ratio. Our study revealed that the departure from trade taxes toward indirect domestic taxes, a reform which is currently occurring in developing countries, is beneficial with regard to limiting tax revenue instability.

In the next section, we will discuss the impact of the instability of tax revenue on both public consumption and investment in Sub-Saharan Africa. Section 3 is devoted to an analysis of various ways to deal with tax revenue instability by investigating the stabilising effect of reliance upon domestic indirect taxation mechanisms, as opposed to dependence on trade tax revenues. Last, Section 4 presents the conclusion.

2. CONSEQUENCES OF TAX REVENUE INSTABILITY IN THE SSA REGION

The principal objective of this empirical section is to establish the consequences of the high level of tax revenue instability in the Sub-Saharan region. We will analyse the impact of tax instability on the instability of both public investment and government consumption. In a second step, we will assess the effect of this public spending instability on the level of public spending. Nevertheless, for the impact on the level of public spending, our interest lies solely in public investment, which is one of the productive components of public spending and is crucial for long-term growth (Barro, 1990; Ramirez and Nazmi, 2003). As depicted in Figure 1, we expected to find a positive association between tax instability and public spending instability and a negative association between public investment instability and the level of public investment. Overall, we are interested in the relationship between tax revenue instability and public expenditures which look like communicating vessels: tax revenue instability leads to an increase in the instability of public investment, and public investment instability lowers the level of public capital spending.

Figure 1: Influence of tax revenue instability on public spending instability and public investment level



It is plausible to think that the ability of public authorities to provide public goods is weakened by the volatility of their revenues. One could argue that if the variation in the tax revenue ratio is perceived as temporary by the government, then they should not change the level of public spending as a result. As recommended by Barro (1979), public spending should be smoothed out and based on the permanent component of revenue. According to this view, public spending should not be affected by tax revenue cycles. However, as shown by Akitoby et al. (2006), the public investment component is the most erratic category of public expenditure in developing countries. This can be explained by two factors. On the one hand, governments face political pressures which mean that during booms, they can easily increase their spending, but during downturns, it becomes more difficult to sustain the effort. On the other hand, governments may be affected by 'myopia' and thus are not always able to identify whether revenue shocks will be temporary or permanent. We therefore expect a significantly positive effect of tax instability on both public investment and government consumption instability.

This instability of government expenditure in developing countries (Talvi, 2005; Akitoby et al., 2007; Thornton, 2008; Diallo, 2009) may contribute to reducing the mean level of public spending. This hypothesis may seem to be counterintuitive, as several papers have underlined the existence of a positive relationship between procyclical fiscal policy and the size of the government, namely the voracity and the cyclical ratcheting effects (Collier and Gunning, 1999; Tornell and Lane, 1999; Akitoby et al., 2006). However, the category of expenditure which is most affected by these effects is current public expenditure (government consumption). With regard to the public investment category, things appear to be relatively different. Indeed, recent papers have pointed to the fact that the governments of developing countries tend to cut capital expenditure more easily during recessions than other spending categories (Akitoby et al., 2006). This can be partly explained by the lower

political cost of a reduction of public investment than a reduction of spending on wages and salaries or on current goods and services. Conversely, during booms, public investment may not be increased proportionally. We therefore expect a negative association between public investment instability and the level of public investment, which is detrimental to long-term capital accumulation.

A. The transmission of the instability of the tax revenue ratio to the instability of public spending ratios

As far as the relationship between tax revenue instability and the instability of public spending is concerned, Lim (1983) provided the first empirical test. The author concluded that one of the main consequences of the instability of tax revenues is increased instability of aggregate public spending. By using recent econometric techniques and datasets, we will be able to provide and quantify the intensity of this positive relationship. The estimated econometric model is as follows:

$$\textbf{Model [1]}: \log\left(\sigma_{i,t}^{s}\right) = \alpha + \theta \log\left(\sigma_{i,t}^{t}\right) + \mathbf{X}'_{i,t-4}\,\gamma + u_i + \eta_t + \varepsilon_{i,t}$$

where the superscripts *s* and *t* refer to the public spending variable (either public investment or government consumption) and to the tax variable respectively. σ is the measure of public spending and tax revenue instability.

There are several ways to measure the instability of a variable, and we will therefore implement several of them in order to ensure the robustness of all our estimates. The use of the standard deviation to assess instability is widely approved in the literature. Our first instability measure is therefore the standard deviation of the variable, either tax revenue over GDP or public spending over GDP. Second, as Nelson and Plosser (1982) highlighted the presence of a trend in the macroeconomic data, we apply the first-difference operator to these data in order to ensure that they are stationary before measuring their standard deviation. Hence, the second measure of instability is therefore the standard deviation of the change in the variable, as in Bleaney et al. (1995). Lastly, we first log-linearise our variables, namely the tax revenue, public investment and government consumption ratios, in order to normalise the distribution and avoid issues relating to outliers. We then took the first-difference (change) of the

logarithm of these variables prior to applying the standard deviation operator to them. This final measure was implemented recently by Brun et al. (2006) and Aghion et al. (2009) as a measure of the instability of the tax revenue ratio and the real effective exchange rate, respectively.

For all these measures, we followed the advice of Bekaert et al. (2006) and measured the standard deviation over five-year rolling windows.[1] Therefore, we had yearly data regarding these measures of instability. However, we need to precise that because volatility is measured over five-year periods (t-4, … t-1, t), all the explanatory variables in the econometric models are evaluated at their value at t-4 in order to ensure that they are exogenous. Due to the way instability is computed, there is a suspicion of a serial correlation in $\varepsilon_{i,t}$. We therefore use an Ordinary Least Square (OLS) estimator with Newey-West standard-errors where the error structure is assumed to be heteroscedastic and first-order autocorrelated. **X** is the matrix of basic control variables. It includes the proxy for the level of development (GDP per capita in log terms) and three indicators of the availability of sources of funding at the government level, namely foreign aid per capita, external debt as part of GDP and domestic claims on government as part of GDP (all in log terms). We expect that GDP per capita, external debt, domestic public debt and foreign aid would be negatively correlated with the instability of public spending. We also include political and social factors which could affect spending instability. The dummy variable of executive election from the Database of Political Institutions takes the value of one for the year when a presidential election occurred and zero for the other years. This captures fiscal instability due to the existence of politically-driven budget cycles in developing countries, where before elections, public spending increases while revenues fall (Block, 2002; Shi and Svensson, 2006; Ehrhart, 2010, among others). The occurrence of armed conflicts can also be a contributing factor to the high instability of fiscal variables. We introduce the variable of conflict, taken from the UCDP/PRIO Armed Conflict Dataset (Gleditsch et al., 2002), which measures the number of active internal conflicts in a given year in a country. The error terms u_i and η_t are the country and year fixed-effects which allow us to control for cross-sectional time-invariant heterogeneity and common shocks, respectively. Our hypothesis tested is that $\theta > 0$.

[1] We have not retained the five-year non-overlapping sub-periods as a measure of instability because of the limited number of observations that this computation generates.

The models are estimated for the period 1980-2005 with yearly data. Data on tax revenues were drawn from the recent work of Keen and Mansour (2010). Public investment is the public gross fixed capital formation as ratio of GDP, which was extracted from the IMF World Economic Outlook database. Government consumption as part of GDP represents current government spending and was drawn from the World Development Indicator (WDI). All the remaining control variables were also extracted from the WDI. Descriptive statistics of all the variables used in the paper are presented in Appendix A.

Results

Table 2 shows the estimation of the model [1]. The first three columns present the results for public investment instability with the three instability measures, whereas in the three subsequent columns, the results represent government consumption.

The results confirm the hypothesis that, whatever the measure of instability retained, tax revenue instability is translated into public spending instability. The coefficients are highly significant at the 1% level and the 5% level, and remain robust regardless of the instability measure used. The coefficient measuring the impact of the instability of tax revenues is slightly higher for public investment than for government consumption, revealing the fact that public investment is more prone to decreasing than current spending during bust periods.

Table 2: Impact of tax revenue instability on public spending instability, 1980-2005

Dependent Variable:	Public Investment Instability			Governement Consumption Instability		
Instability measured as the standard deviation of	*the variable*	*the change in the variable*	*the change in the log of the variable*	*the variable*	*the change in the variable*	*the change in the log of the variable*
	(1)	(2)	(3)	(4)	(5)	(6)
Tax revenue instability	0.140**	0.140**	0.219***	0.126**	0.186***	0.215***
	(0.0626)	(0.0704)	(0.0631)	(0.0545)	(0.0609)	(0.0471)
GDP per capita	0.136	-0.0602	-0.111	-0.442*	-0.318	-0.101
	(0.270)	(0.275)	(0.260)	(0.253)	(0.248)	(0.167)
Foreign aid per capita	0.177	0.0698	-0.123	0.0430	0.0847	-0.0277
	(0.142)	(0.129)	(0.120)	(0.101)	(0.0984)	(0.0968)
External debt	0.205	0.285**	0.0682	-0.0111	-0.0332	-0.131
	(0.135)	(0.135)	(0.131)	(0.0961)	(0.0959)	(0.0843)
Domestic claims on government	-0.0408	0.204	0.511***	-0.133	0.203	0.280
	(0.221)	(0.200)	(0.195)	(0.322)	(0.322)	(0.230)
Conflict	0.238**	0.108	0.0570	0.212***	0.238***	0.124*
	(0.0989)	(0.0948)	(0.0987)	(0.0763)	(0.0776)	(0.0696)
Elections	0.00390	0.0234	-0.0735	0.0893	0.0305	0.00919
	(0.104)	(0.0962)	(0.0997)	(0.0636)	(0.0660)	(0.0593)
Observations	730	729	726	735	733	733
Number of countries	37	37	37	37	37	37

Note: Robust standard errors in parentheses. All the variables are expressed in logarithmic terms except conflict and elections. The OLS estimator with Newey-West standard-errors and country and year fixed effects is used. *** p<0.01, ** p<0.05, * p<0.1.

We estimated the effect of current tax revenue instability on the present instability of public spending, but it could also be hypothesised that it is the past level of tax instability which affects government spending decisions and thus current spending instability. Table 3 present the results obtained by including the lagged value of tax instability (measured over t-5 to t-1) rather than the current value of tax instability.

We find that lagged tax instability also significantly increases current public spending instability. The coefficients of past tax revenue instability appear, however, to be slightly smaller than those of current tax instability, according to Table 2.

Table 3: Impact of the lagged tax revenue instability on public spending instability, 1980-2005

Dependent Variable:	Public Investment Instability			Governement Consumption Instability		
Instability measured as the standard deviation of	*the variable*	*the change in the variable*	*the change in the log of the variable*	*the variable*	*the change in the variable*	*the change in the log of the variable*
	(1)	(2)	(3)	(4)	(5)	(6)
Tax revenue instability (lag)	0.108*	0.126*	0.182***	0.104*	0.137**	0.178***
	(0.0578)	(0.0719)	(0.0597)	(0.0550)	(0.0595)	(0.0450)
GDP per capita (log)	0.218	-0.0533	-0.00422	-0.435	-0.247	0.00431
	(0.242)	(0.239)	(0.235)	(0.266)	(0.265)	(0.174)
Foreign aid per capita	0.160	0.0846	-0.0978	0.0563	0.0990	-0.0131
	(0.136)	(0.103)	(0.122)	(0.101)	(0.0979)	(0.0953)
External debt	0.252*	0.224**	0.0913	-0.0272	-0.0142	-0.118
	(0.131)	(0.106)	(0.127)	(0.102)	(0.100)	(0.0862)
Domestic claims on government	-0.127	0.289	0.425**	-0.131	0.218	0.312
	(0.221)	(0.178)	(0.198)	(0.331)	(0.335)	(0.240)
Conflict	0.279***	0.112	0.0886	0.230***	0.268***	0.153**
	(0.0959)	(0.0940)	(0.0991)	(0.0754)	(0.0774)	(0.0684)
Elections	0.0997	0.0775	-0.0148	0.112*	0.0215	-0.00713
	(0.0755)	(0.0697)	(0.0775)	(0.0637)	(0.0660)	(0.0586)
Observations	704	703	700	708	706	706
Number of countries	37	37	37	37	37	37

Note: See notes to Table 2.

Having established that tax revenue instability results in the instability of both public investment and government consumption, we will assess, in the next sub-section, the impact of public investment instability on the level of public investment.

B. The detrimental effect of the instability of public investment on the level of public investment

We test the hypothesis that there is a negative association between the instability of public investment and the level of this investment. This could be due to the fact that booms and busts in the dynamics of public spending reduce the level of public spending observed at the end of the period. On the contrary, when public spending is relatively stable over time, it results in a higher level of spending than in the previous scenario. While model [1] informed us that the instability of spending originates from the instability of tax revenues, it is interesting to directly measure the contribution of tax revenue

instability to the level of public investment, which passes through the channel of public spending instability. This task is assigned to model [2]. In order to evaluate the importance of the instability of tax revenues on the level of public spending, we regress the level of public investment on the component of public investment instability which is induced by tax revenue instability.[2]

$$\textbf{Model [2]: } \log\left(s_{i,t}\right) = \alpha + \beta \ \ \hat{z}^{s}_{i,t} + \mathbf{Y}'_{i,t}\,\lambda + u_i + \eta_t + \varepsilon_{i,t}$$

where *z* represents the prediction of the log term of the instability of public investment from an auxiliary regression of public investment instability on tax revenue instability and control variables.[3] In model [2], β quantifies the effect of the instability of public spending induced by the instability of tax revenue. Following the literature on the determinants of government expenditure in developing countries (Dreher, 2008; Fielding, 1997; Fosu, 2007), the matrix **Y** of control variables includes the level of economic development, the level of foreign aid per capita, the level of external debt, the level of domestic claims on the government, the population density, the conflict variable, the occurrence of elections and the level of inflation. The dependent variable *s* represents the ratio of public investment as part of GDP.

Results

Table 4 presents the results of the estimations of model [2]. With regard to the first instability measure in column 1, the results obtained with country and year fixed effects suggest a negative but non-significant relationship at the 10% threshold between the instability of public investment and the level of public investment.

[2] Identifying the transmission channels through this two stage procedure is now common in the literature (see Fatas and Mihov, 2003; Gomanee et al., 2005).

[3] The auxiliary equation and model [2] are jointly estimated in order to ensure that the standard error associated with the coefficient β is not affected by the well-known bias in the case of generated regressors.

Table 4: How does tax revenue instability lower the level of public investment through public investment instability?

Dependent Variable:	Public Investment Ratio		
Instability measured as the standard deviation of	*the variable*	*the change in the variable*	*the change in the log of the variable*
	(1)	(2)	(3)
Public investment instability [a]	-0.255	-0.881*	-0.825***
	(0.321)	(0.536)	(0.232)
GDP per capita	0.329**	0.401*	0.217
	(0.149)	(0.216)	(0.172)
Population density	-0.00636**	-0.00927**	-0.00705**
	(0.00310)	(0.00438)	(0.00329)
Inflation	-0.196	-0.421*	0.257
	(0.163)	(0.252)	(0.232)
Domestic claims on government	-0.207	-0.175	0.230
	(0.149)	(0.194)	(0.212)
External debt	0.581***	0.904**	0.504***
	(0.215)	(0.357)	(0.121)
Foreign aid per capita	0.0570	-0.0735	0.0102
	(0.0841)	(0.153)	(0.109)
Conflict	-0.0123	0.0877	0.142
	(0.0873)	(0.144)	(0.102)
Elections	0.134**	0.125	0.0479
	(0.0675)	(0.105)	(0.0966)
Observations	665	664	661
Number of countries	35	35	35

Note: Robust standard errors with Newey-West correction for autocorrelation in parentheses. Country and year fixed effects included in all estimations All the variables are expressed in logarithmic terms except conflict and elections . *** p<0.01, ** p<0.05, * p<0.1.

[a] This variable is the component of public investment instability solely induced by tax instability.

However, in columns 2 and 3, with regard to the two different measures of instability, public investment instability induced by tax instability appears to have a negative and statistically significant effect on the level of public investment. These results confirm the idea that one channel through which the instability of tax revenue reduces public investment is the instability of spending. The control variables included in the models exhibit the expected signs. The population density is negatively linked to the level of public investment, whereas external debt is positively correlated with the public investment ratio in Sub-Saharan Africa.

Having established that tax revenue instability results in the instability of both public investment and government consumption and that this, in turn, decreases the level of public investment, we will

assess in the next section how governments could address the issue of tax instability and its detrimental effects.

3. HOW TO DEAL WITH TAX REVENUE INSTABILITY

This section is devoted to an analysis of the solutions available to governments to help them to cope with tax revenue instability. First, we will investigate the stabilising effect of dependence upon a domestic taxation-based system and second, we will derive policy recommendations and present country case studies.

A. Does tax composition affect revenue instability?

This section is devoted to forming an understanding of the sources of tax revenue instability in Sub-Saharan Africa and of the ways to reduce it. We take advantage of the new dataset released by Keen and Mansour (2010), which includes disaggregated tax data on international trade taxes, indirect taxes (VAT, sales taxes and excises) and income taxes (individual and corporate income taxes) which are expressed as a percentage of GDP.

We focus primarily on the stabilising effect of the domestic taxation-based systems vis-à-vis the dependence on trade tax revenues. The hypothesis which is tested is that a greater dependence on trade taxes rather than on domestic taxes (indirect or direct) leads to increased revenue instability because trade taxes are more vulnerable to external shocks (Bleaney et al., 1995). In contrast, the dependence upon domestic indirect taxes should be associated with lower tax revenue instability, because the corresponding tax base, which is mainly made up of private consumption, is more stable and less likely to be affected by the business cycle.[4]

This analysis of the stabilising effect of the reliance on domestic taxes is also a valuable contribution to the recent literature which has analysed the effectiveness of domestic tax instruments in the recovery of tax revenue losses following trade liberalisation in many developing countries

[4] Even though, on average, about 55 percent of VAT is collected at the border on imports (Ebrill et al., 2001), the remaining 45 percent relies on domestic consumption and is therefore more likely to be stable.

(Baunsgaard and Keen, 2010). Our paper therefore adds to this literature another relevant motive to enhance the efficiency of domestic tax instruments by looking not at their effect on the level of the tax revenues collected, but at the stability of this level.

In order to quantify the differential effects of the different categories of tax on tax instability, several specifications can be retained.

The estimation of the effects of the dependence on trade taxes vis-à-vis the dependence on domestic taxes cannot be done by additively introducing the two variables into the same equation because of the high and negative collinearity between these two variables (the sum of the two is 100%).

We tackle this potential issue by introducing a new variable *R*, which is the ratio of domestic tax revenues to trade tax revenues, in order to approximate the structure of the taxation system in each country. Therefore, an increase in this ratio should be associated with a decrease in the instability of government tax revenues according to our hypothesis, meaning that reliance on a domestic taxation system has a stabilising effect. The specification derived from this is presented in model [3]:

$$\textbf{Model [3]: } \log\left(\sigma_{i,t}\right) = \alpha + \mathbf{X}'_{i,t-4}\,\delta + \theta_1 \log\left(R_{i,t-4}\right) + u_i + \eta_t + \varepsilon_{i,t}$$

where $\sigma_{i,t}$ is the instability measure of the total tax revenue and **X** is the matrix of the control variables.

Second, we break down the domestic tax revenues into the indirect tax and the direct tax revenue ratios in order to assess their respective impact on the instability of government tax revenue in Africa. In model [4], we introduce both the logarithm of the trade tax dependence *ttx* and the logarithm of the direct taxes dependence *directtx* in order to quantify their differential effect. Then, in model [5], in order to compare the effect of the dependence on trade tax revenue with that of the domestic indirect tax dependence, the same model is estimated by replacing *directtx* by the logarithm of the domestic indirect tax revenue dependence *indirecttx*.

$$\textbf{Model [4]: } \log\left(\sigma_{i,t}\right) = \alpha + \mathbf{X}'_{i,t-4}\,\delta + \theta_2 ttx_{i,t-4} + \theta_3 directtx_{i,t-4} + u_i + \eta_t + \varepsilon_{i,t}$$

$$\textbf{Model [5]: } \log\left(\sigma_{i,t}\right) = \alpha + \mathbf{X}'_{i,t-4}\,\delta + \theta_3 ttx_{i,t-4} + \theta_5 indirecttx_{i,t-4} + u_i + \eta_t + \varepsilon_{i,t}$$

However, there may be an issue with collinearity. Indeed, as mentioned by Bleaney et al. (1995), the two tax variables in model [4] (trade tax dependence and direct tax dependence) are by necessity negatively correlated with the domestic indirect tax ratio (the sum of the three is 100 percent), and an arithmetical transformation is needed to reduce the collinearity problem. As a solution, we follow Bleaney et al. (1995) by computing the dependence on the direct tax revenues and on the domestic indirect tax revenues as the level of these tax revenues divided by the level of the total tax revenue excluding trade taxes.

The matrix of control variables includes the standard determinants of the instability of taxes (see Lim, 1983; Bleaney et al., 1995) and other potential correlates. Among the structural factors is GDP per capita, trade openness and the level of natural resource rent. The other determinants are GDP per capita instability, the presence of elections and the existence of internal conflicts. We expect that the instability of the tax base (GDP per capita instability), the occurrence of elections and the existence of internal conflicts would be positively correlated with the instability of the total tax revenues. The level of economic development (GDP per capita) we predicted would be negatively associated with the instability of taxes because it is a proxy for the degree of risk management and the diversification of production activities, which can lower the degree of volatility. The contribution of trade openness to tax instability is less striking. On the one hand, trade openness may act as a proxy for an openness policy, behind which there exists a willingness to provide better management of economic affairs as well as good institutions and policies for competitiveness. On the other hand, trade openness may be a proxy for the "natural openness" which increases the vulnerability of a small open economy to external shocks. Overall, the sign of the coefficient of the trade openness variable (exports plus imports divided by the GDP) is ambiguous. Finally, we expect to find a positive association between the levels of natural resource rent and tax revenue instability, because the price of natural resources is known to be highly volatile.

The measure of natural resource rent was calculated using environmental economic data from the World Bank, which included the cost of production and global prices, the election variable was taken from the Database of Political Institutions, the conflict variable from the UCDP/PRIO Armed Conflict

Dataset and all of the other control variables drawn from the World Development Indicators (2009). The estimation concerns the period 1980-2005, and the estimator is a two-way fixed-effects OLS method with Newey-West standard errors accounting for a heteroscedastic and first-order autoregressive error structure in the residuals.

Results

Table 5 shows the estimation of the coefficients associated with the tax structure variables. In columns 1, 4 and 7, using our three alternative measures of instability, the coefficient associated with the ratio of domestic taxes to trade taxes appears to be significantly negative. This means that a greater dependence on domestic as opposed to trade taxes has a stabilising effect on government tax revenue in SSA.

Domestic taxes are composed of both direct taxes on personal or company income and indirect taxes, such as VAT or excises, and so we investigate in the remaining columns of Table 5 whether the stabilising effect of a greater reliance on domestic taxes is due to direct taxes or to domestic indirect taxes (models [4] and [5]).

In columns 2, 5 and 8, the coefficient associated with dependence on direct taxes exhibits a significantly positive sign, revealing the fact that dependence on direct taxes leads to the increased volatility of tax revenues. Corporate income, which is the main base of direct taxes, is strongly related to the business cycle and is therefore highly volatile. In contrast, we can see in columns 3, 6 and 9 that a greater dependence on domestic indirect taxes is significantly associated with decreased tax instability, whatever the instability measure we retained.

Table 5: Effect of the tax composition on tax revenue instability

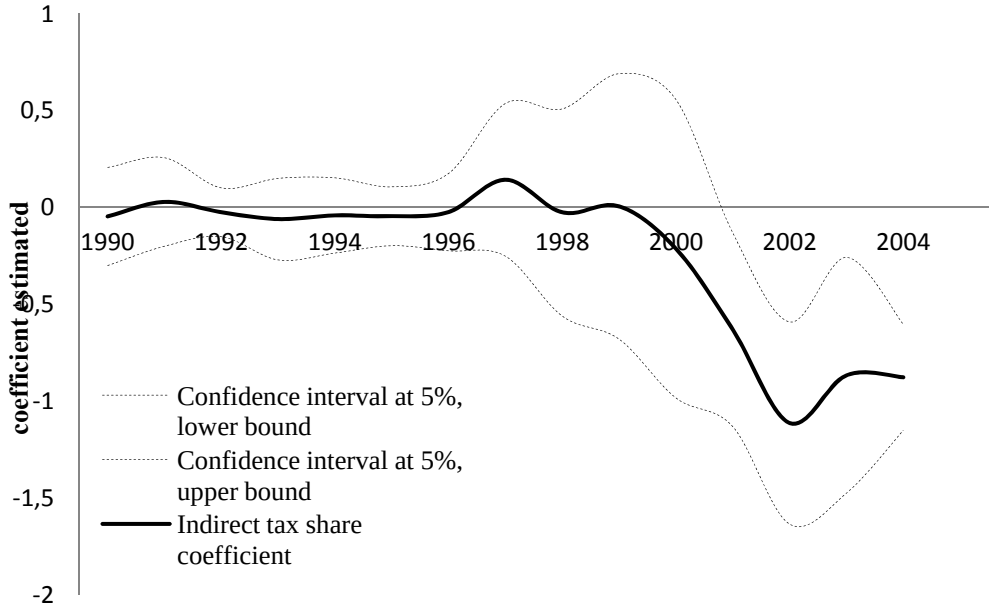
Dependent variable: Total tax revenue instability									
Instability measured as the standard deviation of	*the variable*			*the change of the variable*			*the change of the log of the variable*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Tax composition variables									
Ratio Domestic/Trade taxes	-0.0844**			-0.135**			-0.155***		
	(0.0381)			(0.0561)			(0.0458)		
Trade taxes dependence		-0.00703	0.0488		0.00856	0.0562		0.0956	0.160**
		(0.0655)	(0.0608)		(0.0681)	(0.0619)		(0.0830)	(0.0736)
Direct taxes dependence		0.245**			0.213**			0.284**	
		(0.108)			(0.0992)			(0.131)	
Domestic Indirect taxes			-0.180***			-0.135**			-0.163**
Dependence			(0.0623)			(0.0561)			(0.0733)
Structural factors									
GDP per capita	-0.219	-0.185	-0.195	-0.318**	-0.296**	-0.291*	-0.302*	-0.236	-0.253
	(0.151)	(0.158)	(0.161)	(0.140)	(0.147)	(0.153)	(0.159)	(0.167)	(0.169)
Trade openness	0.111	0.127	0.112	0.138	0.149	0.142	-0.225**	-0.220**	-0.226**
	(0.109)	(0.105)	(0.108)	(0.0972)	(0.0950)	(0.0965)	(0.103)	(0.100)	(0.103)
Natural resource rent	1.292***	1.570***	0.744	0.617	0.895**	0.239	0.823	1.313***	0.517
	(0.432)	(0.430)	(0.502)	(0.457)	(0.441)	(0.530)	(0.528)	(0.491)	(0.620)
Shock variables									
GDP per capita instability	0.178***	0.182***	0.163***	0.261***	0.268***	0.253***	0.286***	0.296***	0.275***
	(0.0356)	(0.0355)	(0.0357)	(0.0347)	(0.0344)	(0.0352)	(0.0419)	(0.0406)	(0.0419)
Election	-0.0173	-0.0329	-0.0219	-0.0579	-0.0719	-0.0624	-0.0694	-0.0861	-0.0752
	(0.0560)	(0.0557)	(0.0554)	(0.0510)	(0.0509)	(0.0514)	(0.0587)	(0.0580)	(0.0594)
Conflict	0.0280	0.0342	0.0290	0.0239	0.0281	0.0232	-0.00968	-0.00167	-0.00805
	(0.0582)	(0.0574)	(0.0565)	(0.0570)	(0.0555)	(0.0554)	(0.0629)	(0.0622)	(0.0622)
Observations	775	780	774	775	780	774	775	780	774
Countries	37	37	37	37	37	37	37	37	37

Note: Robust standard errors in parentheses. OLS with Newey-West standard-errors and country and year fixed-effects is used. All the variables are expressed in logarithmic terms except conflict and elections. *** p<0.01, ** p<0.05, * p<0.1.

As domestic indirect taxes underwent several reforms in developing countries over the period 1980-2005, the impact of domestic indirect taxes on tax revenue instability may not be constant over the entire period. Put differently, it is possible that the effect of domestic indirect taxes varies over time and thus has become more significant in the recent period, a period characterised by peaks in the VAT adoption in Sub-Saharan Africa and by several reforms which have been implemented in order to improve tax administration. The era of VAT adoption in developing countries is associated with significantly more domestic indirect tax revenue being collected (Keen and Lockwood, 2010), and we investigate whether this has led to more stable tax revenues in Sub-Saharan African countries.

In order to tackle this issue, we perform cross-sectional rolling regressions year by year to assess the distinctive impact of dependence on domestic indirect taxes on the instability of tax revenues in each year. Figure 2 depicts the evolution of the coefficient associated with the indirect tax revenue variable. A greater dependence on domestic indirect taxes significantly decreased the instability of tax revenues, mainly since the end of the 1990s in Sub-Saharan Africa.

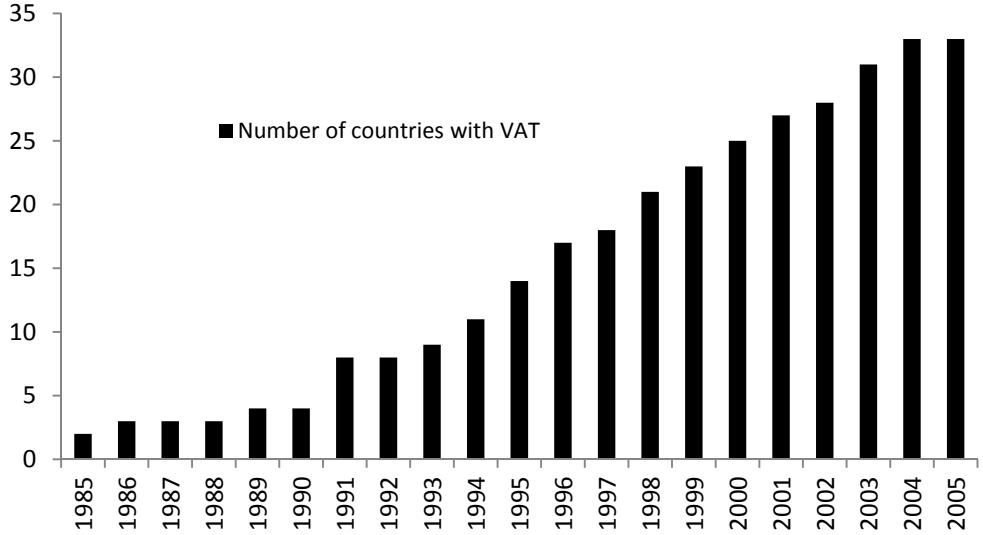
Figure 2. Coefficient of the domestic indirect tax share variable



Source: Authors' calculations
Note: Instability of tax revenue is measured as the standard deviation of the log difference of the tax revenue ratio. The results are similar for the other two measures.

The reinforced negative effect of dependence on indirect taxes on government revenue instability in the recent period coincides with the period in which more SSA countries adopted VAT (Figure 3).

Figure 3. The number of african countries with VAT



Source: Authors' calculations and Ebrill et al. (2001)

Beyond the stabilising effect of increased dependence on domestic indirect taxes, other variables are also significant determinants of tax instability on which governments should focus. The instability of the aggregate tax base (GDP per capita instability) is significantly and positively associated with the instability of tax revenues. This result highlights the importance of macroeconomic stability as one of the main policy with which to reduce the instability of government tax revenues in Africa. Moreover, the level of natural resource rents also appears to be positively correlated with the instability of government revenues in Africa. This can be explained by the instability of oil prices, which is transferred to government revenues, thereby reinforcing macroeconomic uncertainty and the difficulties for these countries in the implementation of fiscal and developmental policies.

4. CONCLUSION

Tax revenue instability has proved to be a crucial issue for decades in Sub-Saharan Africa and therefore really needs to be addressed. In this paper, we investigated the consequences of tax revenue instability for a panel of 37 Sub-Saharan African countries for the period 1980-2005 and derived solutions in order to mitigate these consequences. Tax revenue instability in SSA is not only high, but also highly detrimental, as we found that it leads to increased public spending volatility. Moreover, we found evidence that the instability of public investment induced by tax revenue instability has a negative impact on the level of public investment.

Given these negative consequences of tax revenue instability, we studied the ways in which governments could manage the instability of tax revenues. We found that tax composition is an important factor. A higher dependence on domestic indirect taxes leads to significantly lower levels of tax revenue instability. Therefore, the move from trade taxes towards indirect domestic taxes, which is currently occurring in developing countries, is beneficial in terms of limiting tax revenue instability. The presentation of various countries' experiences supported this policy recommendation, as countries with the lowest levels of tax instability during the period 1980-2005 relied highly on domestic indirect taxes.

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APPENDICES

Appendix 1 – Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Total tax revenue instability[a]	730	.320	.770	-1.917	2.529
Public investment instability[a]	730	.203	1.028	-6.709	3.711
Government consumption instability[a]	730	.347	.801	-1.988	2.803
GDP per capita instability[a]	730	1.076	.853	-1.608	3.829
Total tax revenue instability[b]	774	.499	.781	-1.760	2.611
Public investment instability[b]	769	.398	1.018	-6.043	3.035
Government consumption instability[b]	774	.434	.845	-2.036	3.142
GDP per capita instability[b]	774	2.507	1.127	-.232	6.504
Total tax revenue instability[c]	726	2.484	.707	.350	5.466
Public investment instability[c]	726	3.187	.911	-3.788	5.729
Government consumption instability[c]	725	2.425	.760	.191	4.304
GDP per capita instability[c]	726	1.071	.833	-1.594	3.434
Ratio Domestic/Trade taxes	774	5.137	.913	1.949	10.531
Trade Tax dependence	774	3.318	.686	-1.385	4.504
Direct Tax dependence	774	3.508	.572	.881	4.526
Indirect Domestic Tax Dependence	774	3.507	.871	-1.013	4.463
Public investment ratio	732	1.808	.667	-1.558	4.550
Inflation	688	4.726	.183	4.465	6.277
Natural Resource Rent	774	.045	.0883	0	.865
Population density	774	76.958	108.326	2.006	612.44
Openness	774	4.086	.506	1.844	5.618
GDP per capita	774	6.035	.929	4.662	8.601
External debt (%GNI)	740	4.309	.728	2.050	6.219
Number of Conflicts	774	.182	.437	0	3
Claims on government	743	.053	.199	-2.001	.625
Executive Elections	774	.121	.327	0	1
Foreign aid per capita	762	4.012	.552	2.594	5.806

Notes: all the variables are expressed in logarithmic terms except conflict and elections.
a instability measured as the standard deviation of the variable
b instability measured as the standard deviation of the change in the variable
c instability measured as the standard deviation of the change in the log of the variable

Appendix 2 – List of countries (37 Sub-Saharan African Countries)

Benin, Burundi, Burkina Faso, Botswana, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo Republic, Côte d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritius, Mozambique, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe.

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