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TAX REVENUE INSTABILITY IN SUB-SAHARAN AFRICA: CONSEQUENCES AND REMEDIES

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Summary. – This paper focuses on the sources and consequences of the instability of tax revenue in Sub-Saharan African countries. We take advantage of a unique and extraordinarily rich dataset on the composition of tax revenues for a large number of countries. Using panel data for 39 countries observed over the period 1980-2005, our results are threefold. Firstly, the instability of government tax revenue leads to an instability of both the public investment and government consumption, and finally, reduces the level of public investment. Secondly, foreign aid inflows appear to be an effective insurance mechanism against the instability of tax revenue by lowering the sensitivity of public investment with respect to tax revenue shocks. Finally, the reliance on domestic indirect taxation-based systems seems more stabilizing than the dependency on trade tax revenue.

Keywords: Tax Instability, Tax Composition, Public Spending, Foreign Aid, Sub-Saharan Africa

1 - INTRODUCTION

Tax revenue mobilization in Sub-Saharan Africa (SSA) is not only low compared to spending needs (Stotsky and Woldemariam, 1997; Keen and Mansour, 2009) but also suffers from high instability (Brun, Chambas and Combes, 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 well in eliminating this instability over the period 1980-2005. Since the beginning of the 2000's, a small decrease in tax instability has been occurring but it still remains an ongoing issue that need 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 instable taxes during the entire period whereas indirect taxes have became slightly less volatile than trade taxes since the 90's.

Table 1: Instability of tax revenues and spending 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 by the standard-deviation of the growth rates of the corresponding variables (in % of GDP) over 5-year overlapping sub-periods. Instability is in logarithmic terms.

The primary concern linked with tax revenues instability is that it may result in public spending instability which is of deep concern for Sub-Saharan African countries since it was found to be detrimental for growth and welfare (Guillaumont et al. 1999; Fatas and Mihov, 2003; Furceri, 2007; Loayza et al., 2007). Indeed, instable revenues are costly because they might 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 have not

decreased compared to their levels in the 1980's and assessing to what extent this fact is due to revenue instability is therefore crucial.

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

Only two studies, to our knowledge, tackled the problem of tax revenue instability. Lim (1983) estimated that tax revenues instability was the major cause of expenditure instability in less developed countries in the period going from 1965 to 1973. He therefore urged for further research investigating how to reduce the degree of tax revenue instability. Bleaney, Gemmel and Greenaway (1995) analysed the sources and the consequences of revenues instability in developing countries. They found that tax revenue instability is more common in poor, more open and more inflationary economies. Moreover, the cross-section evidence shows that countries with high tax revenue instability tend also 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 over the period 1980-2005, judging its impact on both public investment and government consumption instability and public investment level and deriving concrete solutions to deal with that.

This study takes advantage of a recent and unique dataset on the composition of the tax revenues in a long time period compiled by Keen and Mansour (2009). We will first of all assess 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 will investigate the two means available to governments to deal with the tax revenue instability.

We focus solely on African countries because these countries are often unable to resort to financial markets (domestic or international) to smooth their revenue. Finding alternative ways of dealing with revenue instability in these countries is therefore of foremost importance. At the same time, African countries are the recipients of large amounts of external development assistance. We will thus check whether and how foreign aid, as an alternative way of financing public spending, can help

decreasing the public investment instability and can offset the detrimental effect of tax revenues instability. Moreover, countries can also enhance their risk preparedness by analysing the determinants of the instability of tax revenue and especially investigating whether a specific tax structure can limit the instability of the total tax revenue ratio.

To preview our findings, we established that tax revenues instability in Sub-Saharan Africa is leading to public investment and government consumption instability which in turn generates lower public investment ratio and is therefore detrimental to the long term economic growth.

Our study reveals that there are two main means of dealing with this issue. On the one hand, when tax revenues are instable, foreign aid can offset the positive effect of the instability of tax revenue on the public investment. On the other hand, we find that the departure from trade taxes toward indirect domestic taxes, a reform which is currently occurring in developing countries, is beneficial for limiting tax revenue instability.

In the next section, we discuss the impacts of the instability of tax revenue on both the public consumption and investment in Sub-Saharan Africa. Section 3 is devoted to the analysis of the ways to deal with tax revenue instability by investigating the role of foreign aid as a risk coping mechanism and the stabilizing effect of the reliance on domestic indirect taxation mechanisms rather than the dependency on trade tax revenues. Section 4 concludes on the policy implications for African countries which can be derived from our results.

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 analyse the impact of tax instability on the instability of both public investment and government consumption. In a second step, we analyse what is the effect of this instability of public spending on the level of public spending. Nevertheless, for the impact on the level, our interest relies only on public investment which is one of the productive components of public spending crucial for long-term growth (Barro, 1990; Ramirez and Nazmi, 2003). As depicted in Figure 1, we are expecting a positive association between tax instability and public

spending instability and a negative one between public investment instability and the level of public investment. Altogether, we are interested in a relationship between tax revenue instability and public expenditures which looks like communicating vessels: tax revenue instability leads to an increase in the instability of public investment and the instability of public investment lowers the level of public capital spending.

Figure 1: Transmission of Tax Revenues instability on Public Spending Instability and on 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 oppose the idea that if the variation in the tax revenue ratio is perceived as temporary by the governments, they should not move consequently the level of public spending. As recommended by Barro (1979), public spending should be smoothed and be based on the permanent component of revenue. In 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 such that during boom episodes, they can easily increase their spending but during downturns, it becomes more difficult to sustain the effort. On the second hand, governments might be affected by 'myopia' and thus are not always able to identify whether the revenue shocks will be temporary or permanent. We can therefore expect a significant positive effect of tax instability on both public investment instability and government consumption.

This instability of government expenditures in developing countries (Talvi, 2005; Akitoby et al., 2007; Thorthon, 2008; Diallo, 2009) might contribute to reduce the mean level of public spending. This hypothesis might seem counterintuitive since several papers 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 expenditure category which is mostly affected by these effects is the current public expenditures (government consumption). For the public investment category, things appear relatively different. Indeed, recent papers point the fact that governments of developing countries tend to cut more easily capital expenditures during recessions than the other spending categories (Akitoby et al. 2006). This can be partly explained by the lower political cost of a reduction of public investments than a reduction of spending on wages and salaries or on current goods and services. We can therefore expect a negative association between public investment instability and its level, what is detrimental for the long-term capital accumulation.

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

As far as the relationship between the instability of tax revenue 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 to increase the instability of the aggregate public spending. By using recent econometric techniques and datasets, we will then be able to provide and quantify the intensity of this positive relationship. The estimated econometric model is the following:

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

where the superscripts *s* and *t* refer to the public spending variables, either public investment or government consumption, and to the tax variable respectively. σ is the measure of public spending and tax revenue instability. As in Bekaert et al. (2006), we measure it as the 5-year rolling standard deviation of the growth rate of the corresponding series expressed as part of GDP.[3] Thus, we have yearly data on these measures of instability. Because of the way instability is computed, there is a suspicion of serial correlation in $\varepsilon_{i,t}$. We will therefore use an OLS estimator with Newey-West

[3] We have not retained the 5-year non overlapping sub-periods as measure of instability because of the limited number of observations that this computation generates.

standard-errors where the error structure is assumed to be heteroskedastic 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 two indicators of the availability of external sources of funding at the government level, namely foreign aid per capita and the external debt as part of GDP (in log terms). We expect that both GDP per capita, external debt and foreign aid should be negatively correlated to the instability of public spending. u_i and η_t are the country and year fixed-effects which allows controlling for the cross-sectional time-invariant heterogeneity and the common shocks, respectively. Our hypothesis tested is that $\theta > 0$.

The models are estimated over the period 1980-2005 with yearly data. Data on tax revenue are drawn from the recent work of Keen and Mansour (2009). The public investment ratio is the public gross fixed capital formation as part of GDP which is drawn from the IMF World Economic Outlook database. Government Consumption as part of GDP represents current spending of the government and is drawn from the World Development Indicator (WDI). All the other control variables are also extracted from 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 two columns present the results for the public investment instability whereas in the two subsequent columns, results are for the government consumption. In columns 1 and 3, we present the results with a unique control variable, GDP per capita, and in columns 2 and 4 we add the levels of foreign aid per capita and external debt. The results show that the level of economic development is negatively correlated with the instability of public spending. We notice also that foreign aid smoothes the public investment ratio whereas external debt has no effect.

- Table 2 -

Regarding now the variable of interest, the results confirm the hypothesis that the instability of tax revenue is translated into instability of public spending. The coefficients are highly significant at 1% level and remain robust after the introduction of additional control variables. The coefficient measuring the impact of the instability of tax revenue is higher for public investment than for government consumption traducing the fact that public investment is the component more prone to a decrease than the current spending during bust periods. Having established that the instability of tax revenue results in the instability of both public investment and government consumption, we will now assess the impact of public investment instability on the level of public investment.

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

The model [2] tests the hypothesis that there might be a negative association between the instability of public investment and its level $(\beta < 0)$.

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

This can be due to the fact that episodes of booms and busts in the dynamics of public spending reduce the level of public spending observed in the end of the period. On contrary, when the public spending is relatively stable over time, it results in a higher level of spending than in the previous scenario.

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 urbanization rate and the level of inflation.[4] The former is included to capture the positive association between income and the government size (the Wagner law) while the second variable controls for the existence of economies of scale in a context of high urbanization rate. The dependant variable *s* represents the ratio of public investment as part of GDP.

In the model [2], the coefficient β identifies the correlation between the instability of public investment and its level. While the model [1] informed us that this instability of spending takes its

[4] These variables are often used as main determinants of capital and social spending in developing countries (Dreher, 2008; Fosu, 2007).

source in the instability of tax revenue, it seems more interesting to directly measure the contribution of the instability of tax revenue on the level of public spending, which passes through the channel of public spending instability. This task is devoted to the model [3]. To evaluate the importance of the instability of tax revenue on the level of public spending, we use the instability tax instability as an instrument for public investment instability.

$$\textbf{Model [3]: } \log\left(s_{i,t}\right) = \alpha + \beta_2 \, \widehat{z}^{s}_{i,t} + \mathbf{Y}'_{i,t} \, \lambda + u_i + \eta_t + \varepsilon_{i,t}$$

where z represents the prediction of the log term of the instability of public investment from a first stage regression with the tax revenue instability being the instrumental variable.[5]

In the model [3], β_2 quantifies the effect of the instability of public spending induced by the instability of tax revenue. The comparison between β in the model [2] and β_2 in the model [3] is interesting. Indeed, β measures the effect of the instability of government spending on the level of spending while β_2 measures the effect of the component of the instability of government spending explained by the instability of tax revenue.

The models [2] and [3] can also be represented in a dynamic form in which the lagged value of the dependent variable is accounted for. This is justified by the fact that government spending is often characterized by a strong inertia and controlling for the lagged value of the dependent variable allows taking into account this dynamic property of the dependent variable. However, this leads to a bias in the estimation of the coefficient associated with the lagged dependent variable in the presence of country fixed-effects.

The estimator of the generalized method of moments (GMM) designed for dynamic panel data is useful is this context. We therefore use the two-step System-GMM estimator (Blundell and Bond,

[5] Identifying the transmission channels with the instrumental variables techniques is now common in the literature. Fatas and Mihov (2003) used a similar approach to investigate how the discretionary fiscal policy can reduce economic growth through the channel of the instability of growth. One may argue that tax instability is not a proper exclusion restriction in this model but we are only interested in assessing whether the public investment instability component induced solely by the instability of tax revenue is significantly related to the ratio of public investment.

1998) with the Windmeijer (2005) correction of standard errors to estimate the dynamic specifications of models [2] and [3].[6]

Results

Table 3 presents the results of the estimations of models 2 and 3. In the first column, the results obtained by the ordinarily least squares (OLS) with country and year fixed effects, suggest a negative and significant relationship between the instability of the public investment ratio and the public investment ratio.

- Table 3 -

In column 2, the instability of public investment is instrumented by the instability of tax revenue in order to account for the transmission channel of the effect of the instability of tax revenue. The coefficient of the instability of public investment increases in absolute term and is ten times larger than in column 1. This result reinforces the idea that one channel through which the instability of tax revenue reduces public investment is the instability of spending. The story remains the same even when a dynamic panel specification is estimated by the System-GMM-IV method (column 3). Once again, after instrumenting the instability of spending by the instability of taxes, the negative contribution of the former remains.

The control variables included in the models exhibit the expected signs. Foreign aid and the external debt are positively correlated with the public investment ratio in Sub-Saharan Africa.

[6] The System-GMM allows the instrumentation of potential endogenous variables by their lagged values. It combines equation in levels and equations in first differences in a system which is estimated jointly. Two tests are presented in order to validate the specification. Firstly, the autocorrelation test of order two of the residuals in differences (Arellano and Bond, 1991) and secondly, the test of over-identification (Hansen test).

3. HOW TO DEAL WITH TAX REVENUES INSTABILITY?

This section is devoted to the analysis of two solutions available to governments in order to cope with or to manage the tax revenue instability. Firstly, we expose the stabilizing role of foreign aid and secondly, we investigate the stabilizing effect of the dependency on a domestic taxation-based system.

A. How does foreign aid smooth public capital spending?

Three main channels can be identified to explain how foreign aid might decrease the extent to which tax revenue instability is translated into public spending instability. First, foreign aid inflows can be countercyclical and, in presence of tax revenue shocks, permit to smooth public spending. Second, if public investment is largely financed by foreign aid then the public investment sensitivity to the tax revenue shocks might be lowered. Lastly, foreign aid can stabilize the overall economy (the tax base) and then the government tax revenue, and by this way, may reduce the instability of public investment.

Foreign aid: a risk coping mechanism?

We evaluate the potential of foreign aid to act as an effective insurance mechanism to which governments of Sub-Saharan African countries can resort to smooth their total revenues and then their developmental spending. More precisely, we examine the effect of foreign aid on the elasticity of public investment instability with respect to tax revenue instability. The following model is then specified to quantify the insurance effect played by foreign aid:

Model [4]:

$$\log\left(\sigma_{i,t}^{s}\right)=\alpha+\theta_1\log\left(\sigma_{i,t}^{t}\right)+\theta_2\log\left(\sigma_{i,t}^{t}\right)*\log\left(A_{i,t}\right)+\theta_3\log\left(A_{i,t}\right)+\mathbf{X}_{i,t}'\,\gamma+u_i+\eta_t+\varepsilon_{i,t}$$

where ***A*** is foreign aid per capita. The insurance role of foreign aid is validated when $\theta_1>0$ and $\theta_2<0$. This implies that the total effect of the instability of tax revenue on public investment

instability is strongly reduced at high levels of foreign aid per capita received. Because we expect the two coefficients to have opposite signs, the threshold level of foreign aid (in $US per capita terms) which fully stabilizes (offsets) the effect of tax instability is given by the following formula:

$$A^* = \exp\left(-\frac{\hat{\theta}_1}{\hat{\theta}_2}\right).$$

- Table 4 -

The results show that there is a nonlinear effect of tax revenue instability on the instability of public investment which depends on the level of foreign aid. As expected, the coefficient of the additive term of the instability of tax revenue is positive and significant in the two specifications (column 1 and column 2). However, the interaction of this variable with the level of foreign aid per capita exhibits a negative and significant coefficient. This confirms that foreign aid reduces the elasticity of spending shocks to tax revenue shocks. The full offsetting of the impact of tax revenue instability occurs for levels of foreign aid per capita higher than 120 $US per year. We conclude that the mean level of aid per capita (57 US$, in the sample) enables an absorption of 84 percent of the destabilizing effect of the instability of tax revenue on public investment instability, compared to the extreme case of a zero aid situation.

The initial presence of aid inflows in the country

An additional way of explaining the stabilizing effect of foreign aid on public spending might rely in the fact that foreign aid was already financing a large part of public investment in the country thus reducing the propensity of public investment to be instable. We will therefore test whether large inflows of foreign aid in the time period before tax revenue shocks are decreasing the destabilizing effect of current tax revenue instability on public investment[7]. In the model [5], an interactive variable between tax revenue instability and the five year lagged level of foreign aid is introduced.

[7] Instability being measured as the 5 year rolling standard deviation, the level of foreign aid preceding the tax shock is the one in t-5.

Model [5]:

$$\log\left(\sigma_{i,t}^{s}\right)=\alpha+\theta_1\log\left(\sigma_{i,t}^{t}\right)+\theta_2\log\left(\sigma_{i,t}^{t}\right)*\log\left(A_{i,t-5}\right)+\theta_3\log\left(A_{i,t-5}\right)+\mathbf{X}'_{i,t}\,\gamma+u_i+\eta_t+\varepsilon_{i,t}$$

The results are presented in columns 3 and 4 of Table 4. We find that $\theta_1>0$ and $\theta_2<0$, meaning that a higher level of tax revenue instability is translated into public investment volatility but this effect is decreased in the presence of large foreign aid inflows in the 5 years preceding the tax revenue shock. This result is robust to the addition of external debt as control variable in column 4.

The channel of the stabilization of the government tax revenue

In our investigation of the mechanics underlining the contribution of foreign aid on public investment spending stabilization, we ask if a part of the total stabilizing effect of foreign aid might pass through the channel of the stabilization of government tax revenues. Foreign aid can reduce the instability of public tax revenue by enhancing the administrative capacity of the public sector and its efficiency in tax mobilization. Moreover, external development assistance subject to conditionality can enhance the macroeconomic management and institutional quality in receiving countries, which in turn lower the aggregate volatility.

Thus, by lowering the instability of tax revenue in recipient countries aid can contribute to smoothing the level of public spending over the time. However, the contribution of foreign aid into aggregate stability is not always recognized in the literature. Some authors (Rajan and Subramanian, 2009) pointed that aid can lead to a real exchange rate appreciation which is an obvious source of macroeconomic instability in developing countries. It thus results that quantifying the relevance of the channel of aggregate stability due to foreign aid is empirical. We take advantage of the recent literature on foreign aid in developing countries to breakdown the contribution of aid to the stability of public investment into the 'indirect effect' – aid stabilizes the economy and then the government revenues – and the 'direct effect' of aid.

The methodology described in Gomanee et al. (2005) is used to address this issue. The method consists in a two-stage approach. Firstly, we investigate the relationship between aid and the

transmission channel (here, the instability of total tax revenues). The residual term of this first estimation measures the component of the tax revenue instability not explained by foreign aid.

$$\textbf{Model [6]: } \log\left(\sigma_{i,t}^{t}\right) = \alpha + \beta \log\left(A_{i,t}\right) + u_i + \eta_t + \varepsilon_{i,t}$$

The second stage consists in estimating two equations. The first one is designed to measure the direct effect of foreign aid on the instability of public investment by including both the instability of tax revenue and foreign aid. More specifically, we have

$$\textbf{Model [7]: } \log\left(\sigma_{i,t}^{s}\right) = \alpha + \theta_1 \log\left(A_{i,t}\right) + \lambda \log\left(\sigma^{t}{}_{i,t}\right) + \mathbf{X}'_{i,t}\,\gamma + u_i + \eta_t + \varepsilon_{i,t}$$

The second one replaces the effective value of tax revenue instability by its residual component estimated in the model [6]. It results that the coefficient associated with foreign aid in this specification measures the 'total effect' of aid on public spending instability. This leads to

$$\textbf{Model [8]: } \log\left(\sigma_{i,t}^{s}\right) = \alpha + \theta_2 \log\left(A_{i,t}\right) + \lambda \hat{\sigma}^{t}{}_{i,t} + \mathbf{X}'_{i,t}\,\gamma + u_i + \eta_t + \varepsilon_{i,t}$$

Finally, the indirect effect (expressed in percentage of the total effect) of foreign aid which passes through the channel of the stabilization of the government revenues is given by: $100 \times \dfrac{(\theta_2 - \theta_1)}{\theta_2}$.

The results of the estimations are presented in Table 5. In column 1, we see that the value of β is about - 0.20. This suggests a strong and significant negative correlation between the instability of tax revenue and foreign aid.

- Table 5 –

In column 2, the direct effect of foreign aid (obtained by controlling for observed instability of tax) is close to - 0.20. Finally, in column 3 the instability of tax revenue is replaced by the residual term of tax instability derived from the specification of column 1. We notice that the 'total effect' of foreign

aid is then -0.26. It thus comes that the indirect contribution of foreign through the macroeconomic stability channel is around 17% of the total potential stabilizing effect of aid. The main conclusion that comes after this result is that the 'indirect channel' tackled here is quite low and then foreign aid acts like a spending smoother primarily through the insurance channel discussed in the two previous sub-sections and not necessarily through the stabilization of the government tax revenues.

B. How can tax composition affect revenue instability?

This section is devoted to the 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 (2009) which includes disaggregated tax data on: international trade taxes, indirect taxes (VAT, sales taxes and excises) and income taxes (individuals' and corporate income taxes) are expressed in percent of GDP.

We focus primarily on the stabilizing effect of the domestic taxation-based systems vis-a-vis the dependency on trade tax revenues. The hypothesis tested is that a high dependency on trade taxes rather than on domestic taxes (indirect or direct) leads to more revenue instability because trade taxes are more vulnerable to external shocks (Bleaney et al. 1995). In contrast, the dependency on domestic indirect taxes for example, should be associated with low instability of tax revenue because the corresponding tax base, mainly the private consumption, is more stable and relatively less affected by the business cycle.[8]

Looking at the stabilizing effect of the reliance on domestic taxes is also a value added to the recent literature which has analyzed the effectiveness of the domestic tax instruments in the recovery of tax revenues looses after the trade liberalization in many developing countries (Baunsgaard and Keen, 2010). Our paper therefore adds to this literature another relevant motive to enhance the efficiency of the domestic tax instruments by looking not at the effect on the level of the tax revenues collected, but at the stability of this level.

[8] Even though about 55 percent on average (Ebrill et al., 2001) of the value-added tax is collected at the border on imports, the remaining 45 percent rely on domestic consumption and are therefore likely to be more stable.

In order to quantify the differential effects on tax instability of the different categories of taxes, several specifications can be retained. Indeed, the first way to quantify the differential effect of the dependency on trade tax revenues rather than domestic tax revenues is to explain the instability of the total tax revenue ratio by the share of trade tax revenues in the total tax revenues. This is described by the model [9]:

$$\textbf{Model [9]: } \log(\sigma_{i,t}) = \alpha + \mathbf{X}'_{i,t}\,\delta + \theta_1 ttx_{i,t} + u_i + \eta_t + \varepsilon_{i,t}$$

where *ttx* represents the logarithm of the ratio of the trade tax revenues over the total tax revenues in each country, $\sigma_{i,t}$ is the instability of total taxes. **X** is the matrix of control variables.

To confront the effect of the dependency on trade tax revenue with that of the domestic tax dependency, the same model is estimated by replacing *ttx* by the logarithm of domestic tax revenue divided by the total tax revenues (*dtx*)

$$\textbf{Model [10]: } \log(\sigma_{i,t}) = \alpha + \mathbf{X}'_{i,t}\,\delta + \theta_2 dtx_{i,t} + u_i + \eta_t + \varepsilon_{i,t}$$

While the previous approach seems interesting to give a first look at the respective effects of the dependency on trade and domestic tax revenues, it does not allow estimating in the same equation, the effects of the dependency on trade tax vis-à-vis the domestic tax. In fact, because of the high and negative colinearity between these two variables (the sum of the two leads to 100%), introducing additively the two variables in the equation may induce a bias.

We tackle this potential issue by replacing both the trade tax and the domestic tax dependency by a new variable *R* which is the ratio of the domestic tax revenues divided by the trade tax revenues to approximate the structure of the taxation system in each country. Therefore, an increase in this ratio should be associated to less instability of the government tax revenues according to our hypothesis that the reliance on a domestic taxation system is more stabilizing. The specification derived from this is presented in model [11]:

$$\textbf{Model [11]: } \log(\sigma_{i,t}) = \alpha + \mathbf{X}'_{i,t}\,\delta + \theta_3 \log(R_{i,t}) + u_i + \eta_t + \varepsilon_{i,t}$$

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 we have GDP per capita, country size (population), trade openness, and the level of natural resources rent. The other determinants are shocks variables: the GDP per capita growth instability, the terms of trade instability and the inflation volatility.

We expect that the instability of the tax base (GDP per capita instability) and both the inflation and terms of trade volatility should be positively correlated with the instability of total tax revenues. The level of economic development (GDP per capita) should be negatively associated with the instability of taxes because it proxies for the degree of risk management and diversification of productions activities, which can lower the extent of volatility. The country size might also reduce the instability of tax revenue because small countries are more prone to covariant shocks than larger countries.

The contribution of trade openness to tax instability is less striking. On the one hand, trade openness might proxy for an openness policy behind which there exists a willingness to provide a better management of the economic affairs, good institutions and policies for competitiveness. On the other hand, trade openness might proxy for the "natural openness" which increases the vulnerability of a small open economy to external shocks. Altogether, the sign of the coefficient associated to the trade openness variable (exports plus imports divided by the GDP) is ambiguous. Finally, we expect a positive association between the levels of natural resources rent and tax revenue instability because the natural resources prices are known to be highly volatile.

Regarding the shocks, we expect that each type of shocks will increase the instability of government tax revenues. All the data on control variables are 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 heteroskedastic and first-order autoregressive error structure in the residuals.

Results: The effect of the tax composition on the instability of revenues

Table 6 shows the estimation of the coefficients associated with the tax structure variables. The most important result which emerges in the three first columns is that the high dependency on trade

taxes is a significant and positive determinant of the instability of government revenue in SSA and this appears to be robust to the alternative specifications used. On contrary, the dependency on domestic taxes has a stabilizing effect which can be observed in columns 2 and 3.

- Table 6 -

Domestic taxes are composed of both direct taxes, on personal and companies' income, and indirect taxes, such as value added taxes or excises, so we investigate in the last three columns of Table 6 whether the stabilizing effect of a higher reliance on domestic taxes is due to direct taxes or to domestic indirect taxes.

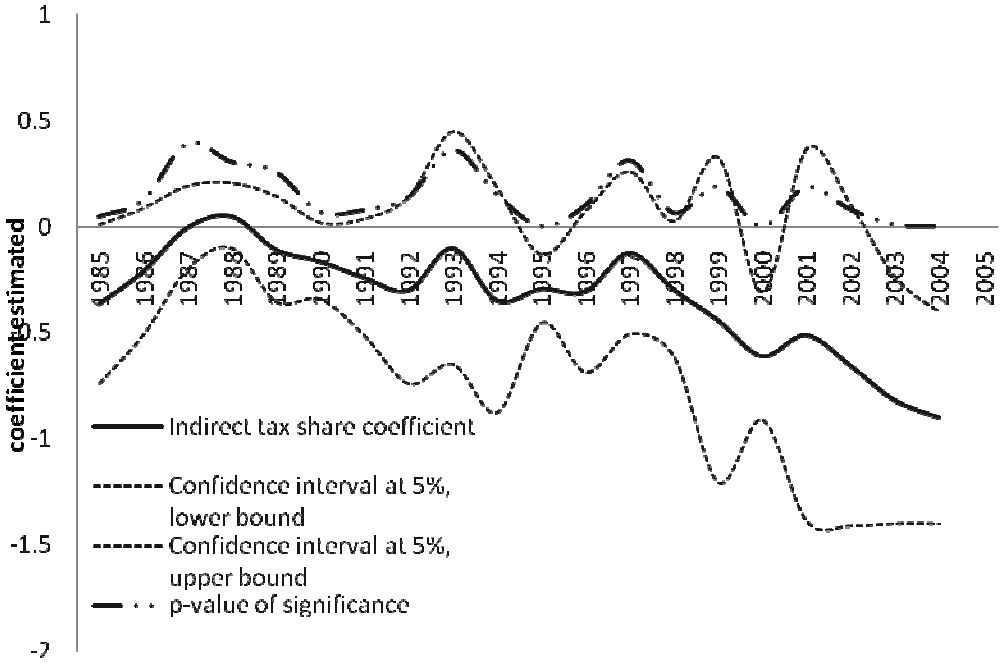
We breakdown the domestic tax revenues into the indirect tax and the direct tax revenue ratios and confront their respective impacts of the instability of the government tax revenue in Africa. However, since our test consists in comparing the respective effects of direct tax revenue ratio relative to the contribution of the reliance on trade tax revenues in column 4 and domestic indirect tax ratio compared to trade tax dependency in column 5 there might be a colinearity problem. Indeed, as mentioned by Bleaney et al. (1995), the two tax variables in column 4 are necessarily negatively correlated with the domestic indirect tax ratio (the sum of the three leads to 100) and an arithmetical transformation is needed to reduce the colinearity problem. To deal with that, we follow Bleaney et al. (1995) by computing the dependency 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. We use these same measures for direct taxes dependency and domestic indirect taxes dependency in the last column of Table 6, but include simultaneously the two variables in the same equation both as a robustness check and to allow for a better interpretation of the effects.

In column 4, the coefficient associated with the dependency on direct taxes is non significant whereas a higher dependency on indirect taxes (columns 5 and 6) is significantly associated with decreased tax instability.

Because the domestic indirect taxes have undergone several reforms in developing countries over the period 1980-2005, the impact of domestic indirect taxes on the instability of tax revenue might not be constant over the period. Put differently, it is possible that the effect of domestic indirect taxes varies over time and thus becomes more significant in the recent period, a period characterized by peaks in the VAT adoption in Sub-Saharan Africa and by several reforms taken to improve the 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 lead to more stable tax revenue in Sub-Saharan African countries.

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

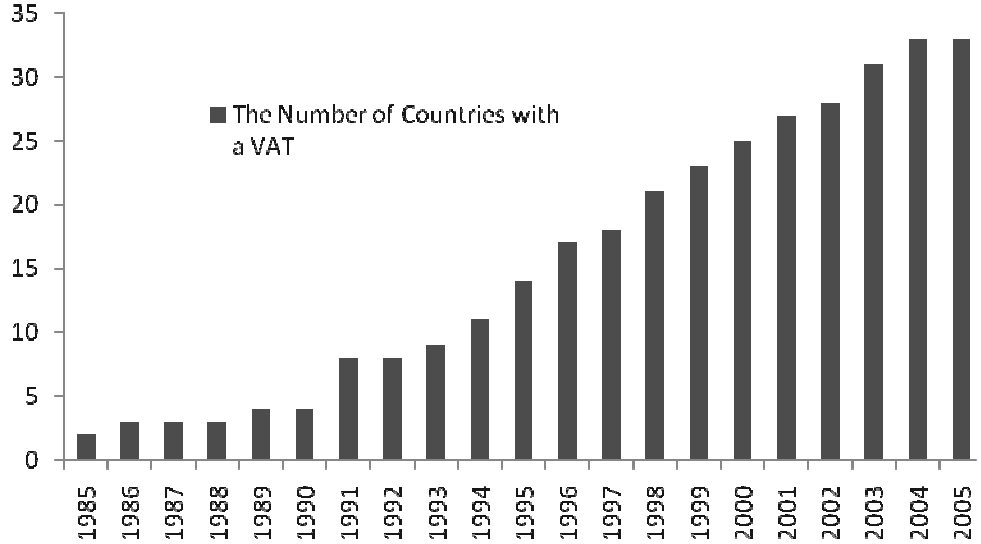
Figure 2. Coefficient of the indirect tax share variable



Source: Authors' calculations

The reinforced negative effect of indirect taxes dependency on government revenues instability in the recent period coincides in fact with the period of more VAT adopters in Sub-Saharan Africa (Figure 3).

Figure 3. The Number of African Countries with a VAT



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

Beyond the stabilizing effect of a higher dependency on domestic indirect taxes, other variables are also significant determinants of tax instability on which governments should focus. In Table 6, we can notice that large countries experiment less instability of their total tax revenue. In large countries, the government takes advantage of the spatial dispersion (geographical dispersion) of the taxpayers, what leads to a more stable revenue collected since citizens in large countries do not experiment the same shocks at the same time. This result seems close to the conclusion of Furceri and Ribeiro (2009) who found that large countries exhibit a low instability of the government consumption ratio.

Regarding the shocks variables, inflation volatility and the instability of the aggregate tax base (GDP per capita instability) are significantly and positively associated with the instability of tax revenues. These results highlight the importance of the macroeconomic stability and the disinflation policies as among the main policy agenda to reduce the instability of government tax revenue in Africa. Moreover, the level of natural resources rents also appears positively correlated with the instability of government revenues in Africa (columns 1 and 4). This can be explained by the

instability in the oil price which is transmitted into government revenues what reinforces the macroeconomic uncertainty and the difficulties for these countries in the conduct of fiscal and developmental policies.

5. CONCLUSION AND POLICY RECOMMENDATIONS

Tax revenues 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 revenues instability in a panel of 39 Sub-Saharan African countries over the period 1980-2005 and derived solutions in order to mitigate it. Tax revenue instability in Sub-Saharan Africa is not only high but also highly detrimental since we found that it leads to increased public spending volatility. Moreover, we found robust evidence that high instability of the public investment has a negative impact on the level of public investment.

Given these negative consequences of tax revenues instability, we studied how governments could cope with and/or manage the instability of tax revenues. Firstly, we found that foreign aid acts as a buffer mechanism to counter the detrimental impact of the instability of tax revenues on the public capital spending. Secondly, we analysed what factors could reduce the instability of tax revenue per se. We found that tax composition matters. A lower reliance on trade taxes and a higher dependency on domestic indirect taxes lead significantly to low levels of instability of tax revenues. Therefore, the departure from trade taxes toward indirect domestic taxes, which is currently occurring in developing countries, is beneficial for limiting tax revenues instability. Foreign aid can also help Sub-Saharan African countries to achieve more rapidly and efficiently these tariff-tax reforms.

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

	Public Investment instability		Governement Consumption instability	
	(1)	(2)	(3)	(4)
Tax revenue instability	0.226***	0.215***	0.154***	0.156***
	(0.0597)	(0.0611)	(0.0402)	(0.0402)
GDP per capita	-0.281	-0.208	-0.0828	-0.185
	(0.174)	(0.219)	(0.0944)	(0.128)
Foreign aid per capita		-0.216**		-0.0700
		(0.0945)		(0.0681)
External debt		0.152		-0.0953
		(0.127)		(0.0858)
Constant	4.228***	3.564**	2.667***	3.672***
	(0.864)	(1.479)	(0.486)	(1.046)
Observations	834	801	833	802
Number of countries	39	38	39	38

Note: Robust standard errors in parentheses. All the variables are expressed in their natural logarithmic terms. 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.

Table 3: How the instability of tax revenue lowers the level of public spending, 1980-2005

	Public Investment Ratio		
	OLS-FE	IV-FE	System-GMM-IV
	(1)	(2)	(3)
Public investment ratio (t-1)			0.767***
			(0.068)
Public investment instability	-0.0575**	-0.792***	-0.112**
	(0.0285)	(0.217)	(0.0443)
GDP per capita	0.243**	0.127	0.118
	(0.111)	(0.164)	(0.0973)
Urbanization rate	-0.609***	-0.872**	-0.248*
	(0.209)	(0.374)	(0.150)
Inflation	-0.0739	0.286	0.158
	(0.132)	(0.228)	(0.137)
Foreign aid per capita	0.203***	0.0788	0.220
	(0.065)	(0.101)	(0.220)
External debt	0.411***	0.411***	0.0957
	(0.087)	(0.112)	(0.114)
Constant	0.283		-1.018
	(1.100)		(1.115)
Observations	687	687	685
Number of countries	36	36	36
Number of instruments	..	..	34
AR(1) p-value	..	..	0.000
AR(2) p-value	..	..	0.869
Hansen OID p-value	..	..	0.963

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 log terms. In column (2), the instability of public investment is instrumented by the instability of total taxes revenue. In column (3), the two-step estimator with the Windmeijer (2005) correction for finite sample bias has been used. In the GMM-System estimation, the level of inflation, the rate of urbanization and year dummies are considered as exogenous, the lagged dependent variable is treated as predetermined and the public investment instability and the level of foreign aid, the level of external debt and the level of GDP are considered as endogenous and instrumented with one lag. We include as external instrument the logarithm instability of tax revenue. AR(2) refers to the probability of the test of 2nd order autocorrelation of Arellano and Bond (1991) of the residuals in first differences. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: The stabilizing effect of foreign aid in Sub-Saharan Africa, 1980-2005

	Public Investment Instability			
	(1)	(2)	(3)	(4)
Foreign aid per capita	0.430*	0.449*		
	(0.256)	(0.265)		
Tax revenue instability * Foreign aid	-0.243**	-0.270***		
	(0.0945)	(0.0975)		
Tax revenue instability	1.175***	1.281***	0.993***	1.095***
	(0.390)	(0.400)	(0.364)	(0.380)
Foreign aid per capita (t-5)			0.462*	0.431
			(0.258)	(0.271)
Tax revenue instability * Foreign aid (t-5)			-0.200**	-0.227**
			(0.0880)	(0.0922)
GDP per capita	-0.327*	-0.195	-0.239	-0.0369
	(0.174)	(0.218)	(0.177)	(0.207)
External debt		0.169		0.227**
		(0.125)		(0.114)
Constant	2.755	0.785	2.253	0.313
	(0)	(1.789)	(1.488)	(1.854)
Observations	825	801	787	767
Number of countries	39	38	39	38
Joint significance of instability variables, *p-value*	0.0001	0.0001	0.0004	0.0006
Threshold of foreign aid per capita $US [a]	**126 $**	**116 $**		

Note: Robust standard errors in parentheses. Countries and year fixed-effects are included. The OLS estimator with Newey-West standard-errors is applied to the data.

[a] refers to the level of foreign aid which fully offsets the impact of the instability of tax revenue on the instability of public developmental expenditures. It has been obtained after taking the first derivative of public spending with respect to the instability of tax revenue.

*** p<0.01, ** p<0.05, * p<0.1.

Table 5: Public Investment Instability and aid: the channel of tax base stabilization

VARIABLES	Tax Revenue Instability	Public Investment Instability	
	(1)	(2)	(3)
Tax Revenue Instability		0.215***	
		(0.0611)	
Residual Term Instability Tax			0.215***
			(0.0611)
Foreign Aid per capita	-0.196***	-0.216**	-0.258***
	(0.0686)	(0.0945)	(0.0950)
GDP per capita		-0.208	-0.208
		(0.219)	(0.219)
External Debt		0.152	0.152
		(0.127)	(0.127)
Constant	3.531***	3.564**	4.243***
	(0.301)	(1.479)	(1.477)
Observations	866	801	801
Number of countries	40	38	38

Note: Robust standard errors in parentheses. Countries and year fixed-effects are included.
The OLS estimator with Newey-West standard-errors is applied to the data.
*** p<0.01, ** p<0.05, * p<0.1.

Table 6 : Effect of the tax composition on the instability of tax revenues

	Dependent variable : Total tax revenue instability					
	(1)	(2)	(3)	(4)	(5)	(6)
Tax composition variables						
Trade taxes dependency	0.237***			0.227***	0.248***	0.256***
	(0.0808)			(0.0865)	(0.0807)	(0.0871)
Domestic taxes dependency		-0.437***				
		(0.153)				
Ratio Domestic/Trade taxes			-0.275***			
			(0.0733)			
Direct taxes dependency				0.0541		-0.0401
				(0.117)		(0.128)
DomesticIndirect taxes dependency					-0.0777*	-0.0818*
					(0.0464)	(0.0467)
Structural factors						
GDP per capita	0.0109	-0.247	-0.0571	0.0125	-0.0179	-0.0208
	(0.216)	(0.179)	(0.195)	(0.216)	(0.195)	(0.196)
Population	-2.511***	-2.674***	-2.688***	-2.514***	-2.644***	-2.650***
	(0.636)	(0.636)	(0.639)	(0.637)	(0.645)	(0.647)
Trade openness	-0.234*	-0.237*	-0.229*	-0.238*	-0.232*	-0.229
	(0.139)	(0.132)	(0.134)	(0.140)	(0.138)	(0.139)
Natural resources rents	1.402**	0.202	0.882	1.452**	1.136	1.085
	(0.680)	(0.669)	(0.635)	(0.687)	(0.693)	(0.701)
Shocks variables						
GDP per capita instability	0.218***	0.196***	0.211***	0.219***	0.216***	0.216***
	(0.0471)	(0.0486)	(0.0476)	(0.0465)	(0.0465)	(0.0462)
Inflation volatility	0.0730*	0.0759**	0.0673*	0.0737*	0.0788**	0.0788**
	(0.0384)	(0.0371)	(0.0366)	(0.0383)	(0.0382)	(0.0382)
Terms of trade volatility	0.0660	0.0451	0.0577	0.0678	0.0602	0.0584
	(0.0417)	(0.0393)	(0.0397)	(0.0416)	(0.0411)	(0.0407)
Constant	39.96***	46.54	45.72***	39.84	42.84***	43.08***
	(9.916)	(0)	(10.17)	(0)	(9.984)	(10.08)
Observations	576	576	571	576	570	570
Countries	33	33	33	33	33	33

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 log terms. *** p<0.01, ** p<0.05, * p<0.1.

APPENDICES

Appendix 1 – Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Tax Revenues					
Total tax revenue instability (log)	875	2.535	.7538	.3500	5.667
Trade tax revenue instability (log)	875	3.044	.7951	.7890	6.456
Indirect tax revenue instability (log)	869	3.027	.8923	.6396	5.725
Income tax revenue instability (log)	875	2.806	.7229	.5536	5.507
Corporate tax revenue instability (log)	800	3.321	.7902	1.074	6.244
Individual tax revenue instability (log)	806	2.909	.7832	.2425	6.365
Trade Tax dependency (log)	1027	3.266	.7309	-1.555	4.504
Domestic Tax dependency (log)	1028	3.868	.5270	.5993	4.5559
Ratio Domestic/Trade taxes	1022	5.197	.938	1.949	10.701
Direct Tax dependency (log)	1033	3.504	.5947	.5247	4.5262
Indirect Domestic Tax Dependency (log)	1024	3.490	.9863	-3.157	4.463
Public Spending					
Public investment instability (log)	856	3.2187	.9237	-3.7879	6.0627
Government consumption instability (log)	837	2.371	.770	.1914	4.304
Public investment ratio (log)	966	1.8750	.7380	-2.2671	4.5502
Control Variables					
GDP per capita instability (log)	846	1.0907	.8242	-1.5944	3.4338
Terms of trade instability (log)	698	2.1875	.8917	-1.8921	4.2694
Inflation (log)	864	4.7288	.1770	4.4111	6.2761
Inflation Volatility (log)	744	1.7087	.9939	-1.021	5.073
Natural Resources Rent (log(1+x))	953	.04804	.0945	0	.8652
Population (log)	1040	15.2708	1.6125	11.0729	18.7668
Openness (log)	991	4.1226	.5323	1.8438	5.6176
GDP per capita (log)	997	6.1333	1.0440	4.5226	8.9994
External debt (%GNI) (log)	943	4.2751	.73169	1.5905	6.2185
Foreign aid per capita (log)	1023	4.0468	.6686	.1038	6.5077

Appendix 2 – List of countries (39 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, Namibia, Niger, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone, South Africa, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe.