

Impact of natural resource wealth on non-resource tax revenue mobilization in Africa: Do institutions and economic diversification matter?

Seydou Coulibaly

▶ **To cite this version:**

Seydou Coulibaly. Impact of natural resource wealth on non-resource tax revenue mobilization in Africa: Do institutions and economic diversification matter?. 2019. halshs-02108128

HAL Id: halshs-02108128
https://shs.hal.science/halshs-02108128

Preprint submitted on 24 Apr 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

CENTRE D'ÉTUDES
ET DE RECHERCHES
SUR LE DEVELOPPEMENT
INTERNATIONAL

SÉRIE ÉTUDES ET DOCUMENTS

Impact of natural resource wealth on non-resource tax revenue mobilization in Africa: Do institutions and economic diversification matter?

Seydou Coulibaly

Études et Documents n° 16
April 2019

To cite this document:

Coulibaly S. (2019) "Impact of natural resource wealth on non-resource tax revenue mobilization in Africa: Do institutions and economic diversification matter*?", Études et Documents*, n° 16, CERDI.

CERDI
PÔLE TERTIAIRE
26 AVENUE LÉON BLUM
F- 63000 CLERMONT FERRAND
TEL. + 33 4 73 17 74 00
FAX + 33 4 73 17 74 28
http://cerdi.uca.fr/

The author

Seydou Coulibaly
PhD Student in Economics, Université Clermont Auvergne, CNRS, IRD, CERDI, F-63000 Clermont-Ferrand, France; African Development Bank, Abidjan, Côte d'Ivoire.

Email addresses: coulsay26@yahoo.fr; s.coulibaly@afdb.org

This work was supported by the LABEX IDGM+ (ANR-10-LABX-14-01) within the program "Investissements d'Avenir" operated by the French National Research Agency (ANR).

Études et Documents are available online at: https://cerdi.uca.fr/etudes-et-documents/

Director of Publication: Grégoire Rota-Graziosi
Editor: Catherine Araujo-Bonjean
Publisher: Mariannick Cornec
ISSN: 2114 - 7957

Disclaimer:

Études et Documents is a working papers series. Working Papers are not refereed, they constitute research in progress. Responsibility for the contents and opinions expressed in the working papers rests solely with the authors. Comments and suggestions are welcome and should be addressed to the authors.

Abstract

This paper estimates the impact of natural resources rents on non-resource tax revenue mobilization. Regressions are carried out using the Panel Smooth Transition Regression model for 29 African countries over the period 1995-2012. The empirical results indicate that while natural resource rents alone have direct negative impact on non-resource tax revenue, the quality of institutions and the level of economic diversification modulate this impact. Natural resource rents enhance non-resource tax revenue collection in more diversified economies and in economies with favorable institutional environment. These findings urge African governments to allocate natural resources revenues towards diversifying the economy and strengthening the quality of institutions for enhancing non-resource tax revenue mobilization.

Keywords

Natural resource rents, Non-resource tax revenue, Institutions, Economic diversification, Africa.

JEL Codes

A13, H20, H30

1. Introduction

With the drop in global official development assistance and foreign direct investments flows in the aftermath of the recent global recession, domestic resource revenue mobilization became imperative for African countries. In this regard, identifying the opportunities and specific conditions for stimulating tax revenue collection is of crucial importance for policymakers in Africa. Natural resources wealth represents a real opportunity for the government to increase its tax revenue collection through the taxation of natural resources exploitation (Crivelli and Gupta, 2014; Eltony, 2002; Ossowski and Gonzales, 2012; Stotsky and WoldeMariam, 1997; Tanzi, 1989; Thomas and Trevino, 2013). While natural resources exploitation may increase resource taxes mobilization, its effect on tax collection from non-resource sectors is however unclear. Indeed, on the one hand, natural resource exploitation and the resource revenue it generates can serve as a catalyst for stimulating the activities of the non-resource sectors and therefore enabling more non-resource tax collection from these sectors. But, on the other hand, the governments that collect a large share of their budget revenue from natural resources exploitation may have incentives to lessen and relax efforts in collecting taxes from non-resource tax bases.

Against this background, an emerging literature on the topic indicates that the effect of natural resource revenue on non-resource tax revenue is non-linear and depends on the quality of institutions (Belinga et al., 2017). The studies from this literature document that natural resource rents increase non-resource tax revenue in countries with good institutions and decrease non-resource tax revenue mobilization in countries with weak institutions. The present paper extends this line in the literature by showing that in addition to the quality of institutions, the effect of natural resource rent on non-resource tax revenue also depends on the level of economic diversification.

In fact, economic diversification favors the broadening of the non-resource tax base by stimulating the activities of tradable sectors suggesting that natural resources may stimulate non-resource tax revenues in countries that are more diversified while they are negatively associated with non-resource tax revenues in less diversified countries. In other words, countries which allocate an important share of their resource revenue to promote the economic diversification may experience better non-resource tax revenue than those which do not act in this direction. Within this context, this study puts forward that in addition to the quality of institutions, the level of economic diversification also matter in the relationship between natural

resource revenue and tax effort. More specifically, this paper estimates the direct impact of natural resource rents on non-resource tax revenue and the conditional effect of natural resources rents on non-resource tax revenue depending on the level of economic diversification and the quality of institutions for African economies. The contribution of our study to the existing literature on the topic is threefold.

First, for analyzing the effect of natural resource wealth on non-resource tax collection, instead of focusing only on hydrocarbons as Belinga et al (2017) and Bornhorst et al. (2009), we consider all the natural resources (hydrocarbons, minerals, fisheries and forests) to take into account the diversity of natural resources endowment in Africa[1].

Second, in contrast to most of previous studies on the subject which have considered as dependent variable total tax revenue (Botlhole et al, 2012), we rather consider non-resource tax revenue to come up with policy-oriented recommendations for facing current tax mobilization challenges in Africa. The rationale behind focusing on non-resource tax revenue instead total tax revenue is mainly is motivated by the strategic substitution role that non-resource tax system could play in mobilizing revenue for African countries in a context of downwards trends in natural resources international prices. Indeed, the recent downwards trend and instabilities in oil and gas prices suggest the redefinition of the strategy of domestic revenue mobilization towards an efficient tax system focused on non-resource taxes. This will help reducing the reliance on natural resources as government's major source of revenue in order to reduce the macroeconomic vulnerabilities of African countries to external shocks related to the volatility of natural resources' global prices[2]. Moreover, given that some natural resource rents are generated from non-renewable resources that will eventually be depleted, an efficient tax system focused on non-resource taxes will be crucial for sustainable domestic revenues mobilization after resource depletion (Fjeldstad et al., 2015). Furthermore, focusing on non-resource tax revenue mobilization is also relevant in a global context of transition toward low carbon economy which might ultimately decrease the importance of hydrocarbons as energy sources and thereby negatively affect resource revenue for hydrocarbons exporting countries.

[1] In fact, around 30% of the global minerals resources are located in Africa and the continent's proven oil reserves represent 8% of the global stock of oil reserves. Africa also hosts 7% of the world's stock of natural gas (ANRC, 2016). Africa's forests and woodlands of Africa are estimated to cover 650 million ha, or 21.8 percent of the continent's land area (FAO, 2003).

[2] Morrissey et al. (2016) provide details discussions on tax revenue performances' vulnerability to external shocks in developing countries.

Finally, to our knowledge this is the first study that on the one hand develops theoretical arguments to show that economic diversification and institutional quality modulate the impact of non-resource tax revenue on non-resource tax revenue and on the other hand, this is the first paper that empirically tests the conditional effect of natural resource rents on non-resource tax revenue depending on the level of economic diversification for African economies.

Furthermore, another contribution of this paper is based on the methodological approach. Indeed, to our knowledge, this is the first study that uses panel smooth transition regression (PSTR) model to estimate the conditional impact of natural resource revenue on tax revenue. In fact, in contrast to previous studies which generally draw upon on linear models with interaction term between natural resource rents and institutions which suggests a linear interaction between resource revenue and institutions in generating non-resource tax revenue to estimate the conditional effect of natural resource on non-resource tax revenue, the present study relies on non-linear model (PSTR) to estimate the conditional effect of natural resources on non-resource tax revenue depending on economic diversification and institutions[3]. The PSTR model has the advantage to take into account heterogeneities in the relationship between natural resources rents and non-resource tax revenue since given the heterogeneities in natural resources endowments and the dependence on natural resource across African countries; one cannot guaranty the homogeneity of the relationship between natural resource revenue and non-resource tax revenue in Africa. Moreover, the economic diversification and improvement in the quality of institutions are not abrupt but rather progressive processes because it takes time to observe significant changes in the level of economic diversification and the quality of institutions for a given country. The PSTR takes into account these considerations since this model assumes smoothness in the conditional effect.

The remainder of the chapter is organized as follows: In section 2, we discuss the mechanisms through which natural resources could affect non-resource tax collection. Section 3 analyses the theoretical impact of resource revenue on non-resource tax revenue depending on institutions and economic diversification. Section 4 reviews the empirical literature on the relationship between natural resources revenue and non-resource tax revenue in developing countries. Then, section 5 motivates and describes in greater details the econometric model, the specification tests and the estimation method utilized to test the impact of natural resources wealth and non-resource tax revenue. Section 6 is dedicated to the presentation of data. Section

[3]However, we run linear regressions with interaction term between natural resource rents and the institutional quality indicator when the relevance of the PSTR model is not accepted by econometrics tests.

7 presents and analyses the estimation results and comes up with policy recommendations that could be drawn from the study, while the section 8 concludes the study.

2. How do natural resources revenues affect non-resource tax revenue mobilization?

Government could use natural resources revenue to finance basic infrastructure for stimulating the whole economic activity, increasing productivity and therefore enhancing tax collection from non-resource sectors. Moreover, a country engaged in natural resources projects could invest in capacity building programs for the relevant tax administrations officials in order to harness a fair value of its natural resources. For instance, the African Natural Resources Center (ECNR) of the African Development Bank and OpenOil are supporting capacity building in financial modeling for the extractive sector in some African countries for strengthening domestic resource mobilization. Financial modeling realizes projections of what should have been paid by companies to the government under the existing tax regime and compares it to what have been really paid to the government for detecting potential discrepancies around natural resources tax revenue collection. In such circumstances, there could therefore be a positive spillover effect from building capacity for improving resource taxes collection to stimulating non-resource tax revenue mobilization performance.

In the same vein, some African countries are developing strategies to increase domestic linkages of natural resources sector. For example, Guinea has recently requested the assistance of the ECNR to undertake a study that should put light on efficient strategies for linking mining exploitation to agriculture and energy sectors such that mining sector activities stimulate agriculture and energy sectors. In 2017, Zambia in collaboration with the ECNR has undertaken and validated a study on local content policies aiming at stimulating local activities through mining exploitation. The goal of these strategies is to reinforce the link between natural resources activities to the rest of the economy so that natural resources sector act as an engine for the others sectors in the economy. In such a context, growth in natural resources activities implicitly suggesting an increase in natural resources revenue will boost non-resource sector activities and thus more non-resource tax revenue for the government.

For countries which are experiencing an increase in the level of natural resource revenue, it is possible that the demand for transfers and redistribution from the citizens also increase[4]. Thus,

[4] Burkina Faso is in phase to face this situation. In fact, in 2008 it produced just 5.5 tons of gold from two large-scale projects. Five years after, in 2013, the country has multiplied by 6 its gold production to 33 tones. During

if the raise of the demand for transfers is more proportional than the increase in resource revenue, the government could turn towards the possibility to increase non-resource tax revenue effort in order to satisfy the surplus demand of transfers. From this perspective, natural resources revenues act as a catalyst for non-resource tax revenue mobilization.

However, there is evidence that natural resource wealth can crowd out non-resource tax revenue effort. This seems to be the case for African countries where Ndikumana and Abderrahim (2010) reveal that these countries have been unable to take advantage of their natural resources endowment for raising government revenue collection. Indeed, as stressed by Brun et al, (2015), governments that collect a large share of tax revenue from natural resources have less incentive to increase efforts in mobilizing tax revenues from non-resource tax bases (crowding out effect of resource revenues on non-resource revenue). Furthermore, in order to minimize demand for accountability and demand for public goods and services from the citizens and the taxpayers, governments with large natural resource revenue may lower the tax burden on their taxpayers.

The situation of Dutch disease[5] that may occur in natural abundance countries is detrimental to non-resource tax mobilization as there is a shift of economic activities from non-resource sectors to the natural resource sector. Furthermore, the macroeconomic challenges that follow natural resources exploitation may significantly threaten the growth of the non-resource economy. In fact, an increase in natural resource activities can provoke the appreciation of the real exchange rate, thereby disturbing the competitiveness and the productivity growth of the non-resource sectors (Arezki et al, 2012) and negatively affect tax revenues collected from these sectors. The appreciation of the national currency due to significant revenues from natural resources exports can exacerbate inflation and therefore impedes non-resource tax collection as suggested by the Oliveira-Tanzi effect (negative effect of inflation on tax revenue).

2018, Burkina Faso expects to produce 55 tons of gold, a two-thirds increase on five years ago (2013). But at the same time, the government is facing growing pressure for increasing salaries and transfers. In Côte d'Ivoire, the tax revenues generated by the mining companies totaled FCFA 56, 4 billion in 2017, an increase of 39.8% between the year 2016 and 2017. During the same period, the public sector workers unions have successfully put pressure on the government to pay back unpaid premiums and raise wages in some cases.

[5] Natural resources exports lead to foreign currency inflows in the exporting country which increases the demand for national currency and the price of non tradable goods. This leads to an appreciation of the exchange rate of the national currency with respect to foreign currencies and thereby reducing the country's' price competitiveness of other products on the international market.

3. The conditional effect of resource revenue on non-resource tax revenue depending on institutions and economic diversification.

In this section, we analyze how natural resource revenue can affect non-resource tax revenue depending on the quality of institutions and the level of economic diversification. Governments in countries with good institutions have more capacity and are more likely to use resource rent for investing in establishing an efficient non-resource taxation system that could support and allow government revenue mobilization during bad conjuncture on commodities markets and when the resource will deplete. Furthermore, resource rich countries with good institutions are more capable to apply resource rents towards productive public investments for supporting production and economic activities in the non-resource sectors and thereby more revenue collection from these sectors.

Basically, citizens expect the government to use resource revenue for improving their living standards (building basic infrastructure, schools and hospitals). Thus, when citizens and taxpayers feel that the government is poorly managing natural resources revenue because of weaknesses in institutions, they will be incited to reject taxes. In fact, taxpayers could anticipate that similarly to resource revenue, the taxes they pay to the government will not serve for financing the public needs but rather the ones of the ruling elites and politicians. Clearly, as resource revenues increase, non-resource tax revenue compliance will tend to decrease if institutions are not functioning well. Accordingly, countries with strong institutions may exhibit greater non-resource tax revenue mobilization performance than their peers with relatively weak institutions. Furthermore, in countries with weak checks and balances, the ruling government could easily use natural resource rents for unproductive purposes rather than strengthening the development of non-resource sectors. This will result in less non-resource tax revenue collection.

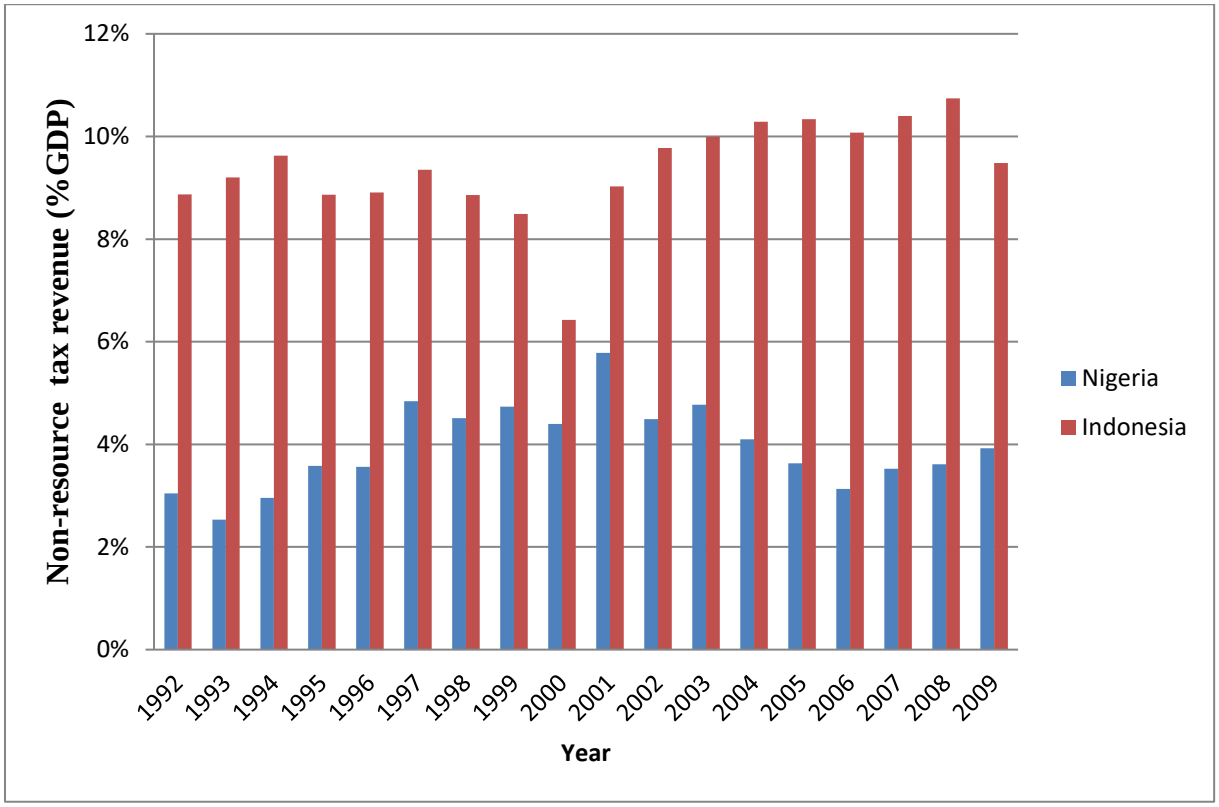
Economic diversification refers to the actions undertaken for the structural transformation of the economy by investing in education, health, basic infrastructure and all other productive investments and therefore reduces the higher dependence of the country to one sector, especially the extractives sector. Typically, economic diversification suggests diversification of exports and output away from greater dependence on commodities and change towards broadly based exports and output (Gylfason, 2017), the economic diversification favors the broadening of the non-resource tax base by stimulating the activities of tradable sectors. Accordingly, countries

which use natural resource revenues to support economic diversification are likely to collect more non-resource tax revenues.

We illustrate this point by comparing the experiences of Nigeria and Indonesia in diversifying their economies in a context of oil exploitation. A study undertaken by the AfDB in collaboration with Bill and Melinda Gates foundation in 2015 reported that Nigeria and Indonesia have experienced oil booms at almost the same period (in the year 1970s). While Indonesia managed to diversify its economy by using oil revenue to accelerate investments in basic infrastructure (schools, roads, and irrigation) and to subsidize fertilizers for boosting agricultural productivity and jobs creation, Nigeria has been affected by the Dutch disease (AfDB and Bill and Melinda Gates, 2015). This has putted down the competitiveness of the agriculture sector and its contribution to the national income. The loss of competitiveness of the agriculture sector has increased the dependency of the government revenue to oil and gas exploitation[6] and slowed down the country's economic diversification (Anyaehie and Areji, 2015). We examine the non-resource tax performance in proportion of GDP for Nigeria and Indonesia over the years where data are jointly available for the two countries. Figure 1 below shows that Indonesia collected much more non-resource tax revenue in proportion of GDP than Nigeria over the period 1992-2009. Nonetheless, the satisfactory point for Nigeria is that it has experienced an increase in non-resource tax revenue from 1993 to 2001. This trend could be traced to efforts made by the Nigerian government for diversifying the economy over this period. However, from the year 2001 to 2009, there is an overall downward trend in Nigeria's non-resource tax revenue. The non-resource tax revenue decreases probably because the government might have relaxed its efforts in collecting non-resource tax revenue following the increasing oil prices after the year 2000. This trend could also be attributed to potential inefficiencies and challenges encountered by government policies in diversifying the economy. These challenges including poor policies, weaknesses in economic institutions and governance and corruption contributed to lead the diversification index for the country to fall from 0.4 to 0.3 from the period 1991-2000 to the period 2001-2009 (Anyaehie and Areji, 2015).

[6] In Nigeria, petroleum revenue accounts for around 80% of government revenue (Anyaehie and Areji, 2015).

Figure 1: Nigeria and Indonesia Non-resource tax revenue performances



Source: Author's construction using ICTD/UNU-WIDER GRD (2017).

Within this background, we speculate that natural resources stimulate non-resource tax revenues in countries that are more diversified while they are negatively associated with non-resource tax revenues in less diversified countries. Similarly, we expect natural resources boost non-resource tax revenue in countries with good institutions while they are negatively associated with non-resource tax performance in countries with institutional weaknesses.

4. Literature review

The impact of natural resources revenues on tax revenue mobilization tends to be ambiguous in the tax effort literature (Botlhole et al. 2012; Gupta, 2007). For 46 sub-Saharan Africa (SSA) Stotsky and WoldeMariam (1997) find a negative impact of mining to GDP on tax revenues countries over the period 1990-1995. Drummond et al. (2012) confirm the result of Stotsky and WoldeMariam (1997). They find negative association between mining and tax revenues for 28 SSA countries over the period 1990-2010. In the same region, Thomas and Trevino (2013) find that resource revenues have negative impact on non-resource revenue. Based on a sample of 30 oil-producing countries over the period 1992-2005, Bornhorst et al. (2009) find that revenue from hydrocarbon exploitation negatively affects non-resource government revenue. Using

panel data for 35 resource-rich countries including 16 African countries over the period 1992-2009, Crivelli and Gupta (2014) find that resource revenues negatively influence non-resource revenue. Ossowski and Gonzales (2012) confirm the eviction effect of resource revenue on non-resource revenue for 15 Latin American countries over the period 1994-2010. Using data for 31 resources depending developing countries, Brun and Diakité (2016) run ordinary least squares regressions and find that while natural resource rents positively affect total tax revenues; they are negatively associated with non-resource tax revenues.

The studies that found negative impact of natural resource revenue on tax revenues explained this result by the fact that the situation of Dutch disease caused by a greater dependence of the economy to the mining and petroleum sector to the detriment of other sectors does not contribute to broaden the non-resource tax base (Brun et al, 2015). In addition, resource-rich countries have strong incentives to relax efforts in mobilizing revenues from non-resource tax bases leading to a lower tax collection effort. Furthermore, for minimizing demand for accountability regarding the management of resource revenue and demand for transfers from the population, governments which collect large natural resource revenue may lower the non-resource tax burden on its taxpayers (McGuirk, 2013; Ross, 2001)

Since natural resources are after all an important source of revenues for the government they may substantially contribute to increase tax revenue. For SSA, Tanzi (1989) finds that the mineral exports in proportion of GDP have a positive impact on tax revenue. Again in SSA, Ghura (1998) also finds a positive impact of mining shares in % of GDP on tax ratio. Keen and Mansour (2010) find that in SSA, over the period 1980-2005, resource-rich countries have performed well than non-resource rich countries in terms of revenue mobilization.

More recently, for 22 oil producing countries around the world, Knebelmann (2017) finds that during the 2000s oil price boom, oil revenue did not crowd out non-oil taxes except for two countries (Equatorial Guinea and Timor-Leste),where there are signs of an eviction effect between oil revenue and non-oil sector.

However, few studies have attempted to find out the factor behind the heterogeneous effect of natural resource revenues on non-resource tax collection. Why do some resource rich countries collect more non-resource tax revenue than others? Botlhole et al. (2012) bring preliminary insights on that particular point. For 45 Sub-Saharan African countries over the period 1990-2007, these authors find that the impact of natural resources rents on non-resource tax revenue is driven by the quality of institutions. More precisely, they find that natural resource rents increase tax revenue in countries with good institutions and decrease tax revenue mobilization

in countries with weak institutions. Botlhole et al. (2012) document that countries with good institutions are more likely to set strong apparatus for tax revenue collection through further investment in education, health and public infrastructures. While in countries with bad institutions, natural resources generate rent-seeking behaviors from policy makers and raise the probability of the country to suffer from resource curve situation which is detrimental to tax revenue mobilization.

Belinga et al (2017) extend this line of empirical research. Using 30 resource rich countries over the period 1992-2012, they find that hydrocarbon revenues are likely to have an eviction effect on non-resource revenues. Nonetheless, in line with the findings of Botlhole et al. (2012), these authors underline that the crowding out effect of natural resource revenue on non-resource revenue could be mitigated or reversed with an improvement in the quality of institutions.

5. Econometric methodology

This section develops the empirical model used to estimate the impact of natural resource wealth on non-resource tax revenue and presents in greater details the specification tests as well as the control variables.

5.1 Empirical specification

Because of heterogeneity in natural resources endowment between African countries, the impact of natural resource wealth may not be homogeneous across countries. Moreover, the efficiency in improving the quality of institutions, diversifying the economy away from natural resource sectors and managing natural resources may change gradually over time within each country. Accordingly, the impact of natural resource rents on non-resource tax collection depending on the level of economic diversification and the quality of institutions may change over time within each economy. The Panel Smooth Transition Regression (hereafter PSTR) model developed by Gonzales et al (2005) and Fok et al (2005) is well suited to account for heterogeneity and time variability in the relationship between natural resources revenue and non-resource tax revenues depending on institutions. With the PSTR model, the impact of natural resource revenue on non-resource tax revenues takes different values across countries depending on the state of economic diversification and institutions (regimes). The PSTR assumes that the transition from one regime to another regime is smooth. This is particularly interesting in a context of African countries where most of the time, transition or changes in institutional quality take time. Clearly, economic diversification in Africa appears as a progressive process rather than brutal. In fact, Ghana which is sometimes cited as a good student

in terms of governance and institutional quality in Africa has taken time to stabilize, stop the series of coup d'états and improve the quality of institutions. On the other hand, Cote d'Ivoire which was relatively stable since its independence in 1960 has seen her stability and institutions deteriorate over time after the death of the first president from the independence in 1993 with the eruption of a rebellion in 2002 and a post electoral conflict in 2011. To summarize, changes in the quality of institutions and the level of economic diversification takes time, they are not systematic.

The PSTR model allows countries to change gradually over time between the group of "bad institutions" (more diversified) countries and "good institutions" (less diversified) countries depending on the level of institutional quality (economic diversification). The PSTR model is therefore viewed as a regime-switching model allowing for few extreme regimes. It is a generalization of the Panel Threshold Regression (PTR hereafter) of Hansen (1999) in which coefficients of some explanatory variables take different values depending on the value of another variable called the transition variable. The PTR model assumes a sharp shift from a regime to another while the PSTR model allows the coefficients to change smoothly.

Taking d_{it}, an economic diversification index as the transition variable, the PSTR model is given as follows:

$$\boldsymbol{NRT_{it} = \mu_i + \beta_0 NRR_{it} + \beta_1 NRR_{it}\, g(d_{it}, \gamma, c) + \alpha X_{it} + \varepsilon_{it}} \quad \textbf{(1)}$$

where NRT_{it} is non-resource tax revenues and $NRR_{it}$is natural resource rents in country i at time t, for i = 1,..., N, and t = 1,. . . ,T.

The non-resource tax revenue (excluding social contribution) encompasses all the taxes collected from non-resource sectors using tax instruments available in the economy. Data on non-resource tax revenue in proportion of GDP are collected from the International Center for Taxation and Development (ICTD) Government revenue data base (Prichard et al, 2014).

Natural resource rent represents the revenue from the export of natural resource (oil, natural gas, coal, mineral and forest) netted from costs generated during its production process. Total natural resources rents are the sum of oil rents, natural gas rents, coal rents, mineral rents, and forest rents as indicated in the statistical notes from the World Development Indicators database of the World Bank.

In equation (1), μ_i represents an individual fixed effect and ε_{it} the usual independent and identically distributed error term. X_{it} represents the vector of traditional determinants of tax revenue. $g(d_{it}, \gamma, c)$ is the transition function. It is a continuous function of the transition variable d_{it}, and bounded between 0 and 1, defining the two extreme regimes. When d_{it} equals 0, the impact of natural resources rents (NRR) on non-resource tax revenues (NRT) is β_0 and when it equals 1, the impact of NRR on NRT is $\beta_0 + \beta_1$.

Following Granger and Teräsvirta (1993) and González et al. (2005) the transition function is specified as the following logistic function: $g(d_{it}, \gamma, c) = \left[1 + \exp(-\gamma \prod_{j=1}^{m}(d_{it} - c_j))\right]^{-1}$ (2) with γ the slope of the transition function (smoothness parameter) and c = (c_1; c_2,…; c_m) an m-dimensional vector of threshold /location parameters. For m = 1 (the case we will focus on here in this study) there is one threshold of economic diversification/institutional quality around which the impact of NRR on NRT is non-linear. This non-linear impact is represented by a continuum of parameters between the two extreme regimes early mentioned ($g(d_{it}, \gamma, c)$ =0 and $g(d_{it}, \gamma, c)$ =1). The first extreme regime which is associated with low values of the transition variable d_{it} corresponds to the case where the transition function is null ($g(d_{it}, \gamma, c)$ =0) while the second extreme regime corresponds to the case where the transition function takes the value 1. This latter regime is associated with high values of the transition variable d_{it}. Between these extreme regimes, the marginal effect of NRR on NRT is given as follows:

$\frac{\partial NRT_{it}}{\partial NRR_{it}} = \beta_0 + \beta_1 g(d_{it}, \gamma, c)$ (3).

The relation (3) suggests that the effect of NRR on NRT is country and time specific as the transition variable d_{it} varies over countries and time. It is worth noting that when the smoothness parameter γ tends toward zero ($\gamma \to 0$), the PSTR model reduces to a simple linear panel fixed effects model. As γ tends to infinity ($\gamma \to \infty$) the PSTR model reduces to a threshold model with two regimes[7]

5.2 Control variables

Following the literature on tax effort, we include GDP per capita, trade openness, inflation, and agricultural value added as control variables (Crivelli and Gupta, 2014; Eltony, 2002; Ossowski

[7] It reduces to Hansen's (1999) two-regime panel threshold regression for m=1.

and Gonzales, 2012; Stotsky and WoldeMariam, 1997; Tanzi, 1989; Thomas and Trevino, 2013).

Agriculture value added

Agriculture value added as proportion of GDP is used as a proxy of the sectoral composition of the economy. In Africa, the Agriculture sector in developing sector is dominated by a large number of small farmers who produce for self-consumption or sell their output in informal markets[8] or exchange theirs output for other goods[9]. In addition, most farmers in African countries do not keep modern accountings for the management of their farms. All these aforementioned factors contribute to the complexity of the agricultural sector's taxation in Africa (Fox and Gurley, 2005**;** Stotsky and WoldeMariam, 1997; Gupta, 2007**).** We therefore expected negative impact of agriculture value added on non-resource tax revenues in our estimations.

GDP per capita

GDP per capita measures the level of development. High level of development tends to be correlated with a higher capacity to pay and collect taxes. Moreover, high level of development goes together with high demand for public goods and services (Wagner's law). The impact of GDP per capita is therefore expected to be positive.

Trade openness

Trade openness expressed as the sum of exports and imports as a percentage of GDP is expected to increase non-resource tax mobilization as trade openness stimulates trade volume and therefore trade taxes. However, in Africa, trade liberalization policies have been implementing by cuts in tariffs. These measures have resulted in losses in tax revenues for some countries (Baunsgaard and Keen[10] , 2010) while others have compensated losses in tariffs by domestic taxes (Bird and Gendron, 2007; Cnossen, 2015) rending thereby difficult the prediction of the impact of trade openness on non-resource tax revenue.

[8] Agriculture is often used as a proxy of the informal sector (see Mahdavi, 2008)
[9] It is typically subsistence agriculture (Drummond et al, 2012).
[10] These authors reveal that low income countries have recovered at most 30 cents per dollar lost in tariffs reduction.

Inflation

Inflation is proxied by the percentage change in average consumer prices. Its effect on non-resource tax-to-GDP ratio, the so called "Oliveira-Tanzi effect" is assumed to be negative because of lags in tax collection. Indeed, with high inflation rate, the real value of taxes is likely to decrease between the date of implementation and the effective date when tax is collected. However, because of climb in sales in nominal terms due to inflation, the turnover of firms might exceed the threshold of value added tax (VAT) liability making these firms now liable to VAT and then lead to increase VAT revenue if there is no explicit VAT threshold adjustment (ATAF[11], 2017). This latter consideration complicates the prediction of the effect of inflation on non-resource tax revenue.

5.3 Specification tests and Estimation method

Before estimating equation (1), we need to perform some specifications tests. The first batch of tests is the linearity test. It tests the homogeneity of the coefficient for the relationship between natural resource rents and non-resource tax revenue conditional to the transition variable. In other words, the linearity test indicates whether the PSTR model is preferable than a linear model to estimate the impact of natural resource rents on non resources tax revenues. The rejection of the null hypothesis (H0: Linear fixed effects panel) against the alternative (H1: PSTR with *m* regimes) suggests that the PSTR model is suited to estimate equation (1).

The homogeneity test in the PSTR model is performing by testing: H0: $\gamma = 0$

or H0: $\beta 1 = 0$ against the alternative H1: $\gamma \neq 0$ or $\beta 1 \neq 0$. However, these tests are nonstandard since the PSTR model contains unidentified nuisance parameters under the null hypothesis (Hansen, 1996, Gonzales et al, 2005). This identification problem is solved by replacing the transition function g(d_{it}; γ; c) by its first-order Taylor expansion around $\gamma = 0$ and to test with an equivalent hypothesis based on the following auxiliary regression:

$$NRT_{it} = \mu_i + \beta_0^* NRR_{it} + \beta_1^* NRR_{it} d_{it} + \alpha^* X_{it} + \cdots + \beta_m^* NRR_{it} q_{it}^m \varepsilon_{it} + \varepsilon_{it}^* \quad (4)$$

where β_0^*, β_1^* and β_m^* are multiple of γ and ε_{it}^* is the usual error term plus the remainder of the Taylor development $\varepsilon_{it}^* = \varepsilon_{it} + R(\text{d_it}; \gamma; c)$. Accordingly, testing linearity against the PSTR model becomes testing H0: $\beta_0^* = \beta_1^* = \beta_m^* = 0$ in the auxiliary equation which is linear.

[11] African Tax Administration Forum (ATAF)

Following Colletaz and Hurlin (2006), the test decision relies on the LM, F-version LM, and pseudo-LR tests and their statistics are given as follows:

LM = TN (SSR0−SSR1)/SSR0 ((follows Chi2 (mk))

LMF = [(SSR0−SSR1) /mK] / [SSR0/ (TN−N−m(K + 1))] ~ F(mk; TN –N-m(k+ 1))

LR = −2 [log(SSR1)− log(SSR0)]. LR follows Chi2 with mk degree of freedom, LR~Chi2 (mk).

where SSR0 is the panel sum of squared residuals under H0 (linear panel model with individual effects), SSR1 the panel sum of squared residuals under H1 (PSTR model with two regimes), and K the number of explanatory variables.

After the linearity/homogeneity test, the second specification test is the number of regimes test. This test seeks to determine the appropriate number of transition functions (m), implicitly the number of regimes (r+1) in the PSTR model.

The null hypothesis of the test of number of regimes is H0: the PSTR model has one transition function (m = 1) while the alternative hypothesis is H1: the PSTR model has at least two transition functions (m = 2). The decision of the test is based on the statistics of *LMw* and *LMf*. If the coefficients are statistically significant at the 5%, the null hypothesis is rejected suggesting that there are at least two transition functions for the PSTR model. In this case, a two-regime PSTR model is then estimated. If the two regime model is also rejected, a three regime model is estimated. The testing procedure continues like that until the non-rejection of the null hypothesis of no remaining heterogeneity.

The non-rejection of H0 suggests that the model has one transition function, two regimes. The estimation method of the PSTR consists of eliminating the individual fixed effects μ_i by removing country specific means and then applying non-linear least squares to the transformed model (Gonzalez et al, 2005).

6. Data

Regressions are carried out using a sample of 29 African countries[12] over the period 1995-2012. We extract natural resource rents data from the World Development Indicator (WDI), the World

[12] The list of countries is given in appendix.

Bank database. Natural resource rents is the revenue from the export of natural resources (oil, natural gas, coal, mineral and forest) netted from their production costs.

We measure institutional quality by the government stability index[13] from international Country Risk Guide (ICRG). The higher the index, the better institutions. Government stability is crucial for converting natural resources revenue towards non-resource sectors development. In fact, when the members of the ruling government feel that the uncertainties are increasing about the future of their stay in power, they may be motivated to adopt rent seeking behaviors before the possible end of their regime. Practically, they will ignore the implementation of broaden based policies that promote the development of non-resource sectors activities while grabbing resource revenue to finance their supporters and buying opponents for organizing resistance. They could also lessen the tax burden on groups of taxpayers for getting their support in order to resist and stay in power.

The dependent variable, non-resource tax revenue is directly extracted from the Government Revenue Database (GRD) of the International Centre for Tax and Development (Prichard et al, 2014). Non-resource tax revenue encompasses all the taxes collected from tax base other than natural resources. The control variables including trade openness, inflation, agriculture value added and GDP per capita are taken from the World Development Indicators database, the World Bank.

We measure economic diversification by the share of manufactures exports in the total exports of merchandise. This indicator provides an interesting picture about the structure of exports and could therefore reflect an acceptable measure of economic diversification. Data on manufactures exports in percent of merchandise exports are extracted from WDI, the World Bank database. As indicated in the statistical notes of the WDI database, manufactures include chemicals, basic manufactures, machinery and transport equipment, and miscellaneous manufactured goods, and exclude non-ferrous metals. The three linearity tests validate the preference for the PSTR model with manufactures as transition variable comparatively to the linear model

Given that large countries with relatively vast internal market may not export much to the rest of the world, exports diversification index may show partial picture of the state of

[13] The government stability index from ICRG indicates the ability of the government to stay in office and to implement its program. Government unity, legislative strength and popular support are the three components used to construct the government stability indicator (see ICRG methodology).

diversification. However, since African countries tend to be more outward oriented because of the relatively small size of their internal markets, we think that an exports based diversification index is suitable and acceptable as an economic diversification index for African economies (Alsharif et al, 2017). Descriptive statistics on all these variables are provided in table 1 below. For our sample, on average the non-resource tax revenue is 15.5% of GDP while natural resource rents account for 12% of GDP (table 1). On average, manufactures exports account for 30% of total merchandise exports for the countries under investigation in this study (table 1).

Table 1: Descriptive statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Non resource tax revenue	506	15.512	8.652	3.205	62.828
Natural resource rents	505	12.120	15.073	.0037	77.054
Government stability	432	8.911	1.643	4	11.083
GDP per capita	522	2535.6	2742.25	168.931	12633.8
Trade openness	522	77.473	39.846	17.434	261.529
Inflation	522	8.001	10.988	-18.222	132.823
Agriculture value added	518	21.113	13.214	1.953	51.848
Export diversification index	400	3.982	1.090	1.784	6.063
Manufactures exports (% merchandise exports)	458	29.857	26.272	0.0242	94.875

Source: Author's calculations from ICTD-GRD (Prichard et al, 2014); WDI, ICRG and IMF (2017).

7. Impact of natural resource rents on non-resource tax revenue: specification tests and Estimation results

This section first presents results from specification tests and those obtained from the estimation of the impact of natural resources rents on non-resource tax revenue depending on institutions and diversification. Then, results from various robustness analyses are presented and finally, the section comes up with policy implications which could be drawn from the study.

7.1 Linearity and unit root tests

The linearity tests results are reported in table 2 below. The three linearity tests reject the null hypothesis of linearity of the relationship between natural resource rents and non-resource tax revenue conditional to the level of economic diversification suggesting that the impact of

natural resources rents on non-resource tax revenue depends on the country's economic diversification. The PSTR model is therefore appropriate for our case.

Table 2: Linearity tests

Threshold variables	Wald LM test	Fisher test	Pseudo LRT test
IMF Export Diversification index	3.116* (0.07)	2.866* (0.09)	3.130* (0.07)
L.(IMF Export Diversification index)	4.343** (0.03)	3.985** (0.04)	4.372** (0.03)
Government stability	1.342	1.235	1.344
Polity2	47.665*** (0.000)	9.843*** (0.000)	50.27*** (0.000)
Manufactures exports (% merchandise exports)	16.692*** (0.005)	3.197*** (0.008)	17.029*** (0.004)

Note: P-values are in parenthesis.

Before carrying out regressions, we run panel unit root test to see whether the variables under consideration are stationary as the time dimension of our panel is relatively long. We apply Maddala and Wu (1999) (Fisher type test) to take into account the heterogeneity of our panel data (in terms of natural resources rents, non-resource tax collection and economic diversification) and the fact that the panel data is unbalanced. Results from Fisher test reported in Table 3 below indicates that for all the variables the null hypothesis of non-stationarity is rejected.

Table 3: Fisher type unit root test

Variables	**Maddala and Wu ADF-Fisher , inverse chi2**
Non resource tax revenue	133.498 (0.000)
Natural resource rents	151.121 (0.000)
GDP per capita	79.407 (0.032)
Trade openness	122.319 (0.000)
Inflation	242.760 (0.000)
Agriculture value added	172.062 (0.000)
Government stability	177.601 (0.000)

Note: P-values are in parenthesis.

7.2 PSTR estimation of the impact of resource rents on non-resource tax revenue depending on diversification

This subsection analyses and discusses the main results obtained from the estimation of the empirical model.

7.2.1 Main results

Table 4 displays the results obtained from the estimation of the PSTR model. The direct impact of natural resources rent on non-resource tax revenue (measured by βo) is negative and statistically significant at 5% (table 4). This result is in line with those found in previous work indicating that natural resources revenue undermine the governments' effort to properly tax non-resource sector (Brun et al, 2015, Crivelli and Gupta, 2014). While the direct effect of natural resources rents on non-resource tax revenue is negative, the effect of its interaction with economic diversification (nonlinear effect) is positive. In other words, this result reveals that natural resource rents contribute to non-resource tax revenue mobilization in more diversified economies while they slow down non-resource tax collection only in less diversified economies.

The location parameter for this regression C=32.990 is higher than the average manufacturing exports (the threshold variable) equals to is 29.857, suggesting that countries with

manufacturing exports level below the threshold value 29.857 need additional efforts towards improving economic diversification to reverse the crowding out effect of natural resource rents on non-resource tax revenue collection.

We plotted in figure 2 the elasticity of non-resource tax revenue with respect to resource rents, depending on the values of manufacturing exports. From the lower to higher regimes, the elasticity of resource rents with respect to non-resource tax revenues smoothly increases as manufacturing exports (the threshold variable) increase. Accordingly, any improvement in diversifying the economy (higher manufacturing exports) will result in a gradual increase in the non-resource tax revenue effect of resource rents (from -0.063 to 0.754).

Figure 2: Elasticities of non-resource tax revenue with respect to resource rents conditional on manufacturing exports.

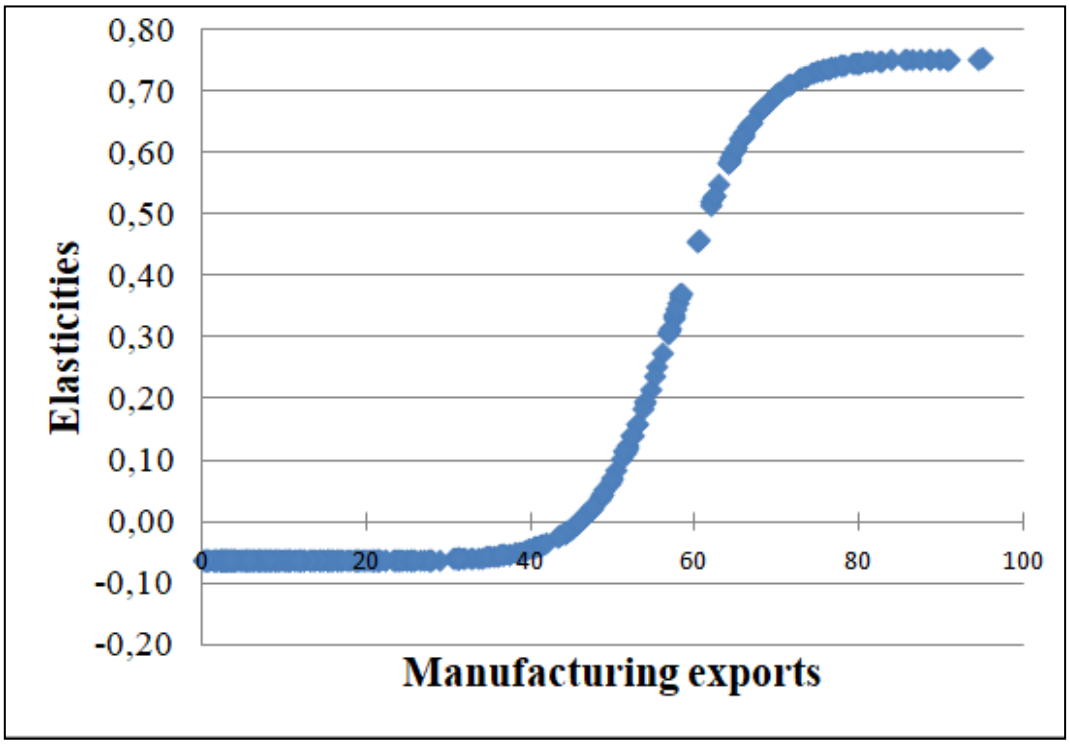


Table 4: Impact of Natural resources rents on Non-resource tax revenue depending on economic diversification

Dependent variable :Non-resource tax revenue (% GDP)	
Transition variable	**Manufactures exports (% merchandise exports)**
Natural resource rents (βo)	-0.201*** (0.013)
Natural resource rents (β1)	0.331 *** (0.0682)
GDP per capita	0.0002** (0.000)
Trade openness	0.017** (0.005)
Inflation	-0.048*** (0.012)
Agriculture value added	-0.204*** (0.025)
Gamma (γ)	0.160
C	57.528
AIC criterion	1.291
BIC criterion	1.380
Observations	345

Notes: Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

7.2.2 Further analysis: overview on country-specific cases.

For few number of countries, the economic diversification indicator over the period 1995-2012 have been generally above or below the threshold value identified in the estimation. More precisely, countries such as Botswana, Lesotho, Morocco, Mauritius, Swaziland, Tunisia and South Africa have always had the maximum impact of resource rents on non-resource tax revenue (higher regime) as their manufactures exports in percentage of total merchandise exports were most of time above the threshold. This result suggests that these countries have been efficient in using resource rents towards stimulating non-resource tax revenue mobilisation through diversification. In other words, these countries did not experience any

crowding out effect of resource rents on non-resource tax collection because of their relatively advanced level of economic diversification.

The presence of Botswana among the group of countries where resource rents do not crowd out non-resource tax revenue collection is not surprising. In fact, Botswana has received praise and has gained a worldwide reputation for its management of extractive resources wealth. The success of Botswana, among other factors is related to the fact that the country has placed a attention to the development of non-mining sector.

Indeed, from the beginning of mining exploitation in the country (1970s), the authorities have always kept in mind that the role of extractives in the economy will eventually decline. Accordingly, the government used revenue from extractives resources as a platform to boost the diversification of the economy. In fact, the policy in Botswana aimed at utilising revenues collected from minerals to finance investments in other sectors in order to create a strong basis for revenue generation that can eventually replace mineral revenue. Accordingly, almost the entire mineral wealth was used to finance investments in education, healthcare and physical capital. For instance, during the period 1983-1984 to 2014-2015, the total mineral revenues amounted to BWP406bn (US$39bn, €33bn) at 2012 prices, and these revenues were almost entirely invested in physical and human capital (ANRC, 2016b). This policy has spurred the development of the private sector and has reduced the importance of the mining sector in the economy. In fact, from 2004 to 2014, the non-mining private sector grew by 128 percent, while the mining sector collapsed by 13 percent (ANRC, 2016b). The ANRC (2016b) argues that these developments (faster growth of the non-mining sector compared to the mining sector) provide an indication that economic diversification policies in Botswana have to some extent succeeded. The tendency towards diversifying the economy away from mining sector has fostered the development of non-mining sectors and has therefore sustained greater tax revenue collection from these sectors. As early mentioned, in addition to Botswana, we also find positive impact of resource rents on non-resource tax revenue collection for some countries like Swaziland, Morocco and Tunisia. In spite of the potential institutional deficiencies in these countries, resource rents favour the mobilisation of non-resource tax revenue because of the relatively more advanced state of economic diversification in these countries compared with their peers. This result suggests that beyond institutions, economic diversification could reverse the crowding-out effect of resource revenue on non-resource tax collection.

In contrast, for countries like Algeria, Cameroon, Nigeria, Sudan, Republic of Congo, Gabon Mali, Burkina Faso, Malawi, Côte d'Ivoire, Ghana and Tanzania, resource rents have experienced a crowding out effect of resource rents on non-resource tax revenue mobilisation because of weak economic diversification level, such that higher resource rents, not only relax government efforts in collecting taxes from non-resource sectors, but also in some extent, shrink the development of these sectors.

Nonetheless, for some countries like Togo, there is change in the impact of resource rents on non-resource tax revenue. For this country, the impact of resource rents on non-resource tax revenue shifted from negative values (low regime: -0.063) to positive value (high regime: 0.61). Togo achieved in 2003 the critical threshold of manufactures exports in percent of total merchandise exports for which the crowding out effect of resource rent on non-resource tax revenue is reversed. In fact, over the last two decades, in Togo, efforts have been made to diversify the economy away from phosphate and cotton in order to develop the industrial sector and to attract foreign direct investments, especially with the creation of a free trade zone for exports processing and the construction of roads infrastructures. The country has also strengthened and has modernized the equipment and the capacities of the port of Lomé in order to revitalize the country's transit function in the West African Economic and monetary Union (WAEMU) region, mainly for the landlocked countries (Mali, Burkina and Niger). As a result, based on the IMF Theil diversification index, in its 2017 report on international trade, the Central Bank of West African Countries remarked that Togo is one the WAEMU countries which has recorded the highest performance in improving the economic diversification over the period 2006-2017.

Adversely for countries such as Senegal, the degradation of the business environment since the year 2000s which has slowed down economic diversification has ultimately (ceteris paribus) negatively affected the elasticity of non-resource tax revenue to resource rents (transition from high non-resource tax revenue regime to low regime). Indeed, as explained in Jude and Levieuge (2016), Senegal has implemented a package of policy reforms aiming at improving the country's business climate. These reforms contribute to the emergence and the development of indigenous enterprises. However, during the 2000s, frequent government change with its corollary of concentration of executive power, and sometimes high state interference in the economy. This has reduced the activities of foreign investors in the country and finally slowed down the diversification of the economy and thereby negatively affect non-resource tax collection. This result could serve as a lesson for Senegal which is expected to start oil

production in 2021. The country may consider paying attention to factors that sustain economic diversification such that the country does not suffer from the crowding out effect of oil exploitation on non-resource tax collection.

Finally, we find that the elasticity of non-resource tax revenue to resource rents has been volatile for a certain number of countries where the economic diversification indicators fluctuate. Namibia and Madagascar are among these countries.

Although Namibia has achieved significant development outcome (the country's GDP per capita was USD 5 227,18 in 2017, WDI) thanks to mining exploitation, the country's level of economic diversification is still relatively low mainly because of weak backward and forward linkages between mining sector and non-mining sectors. Nonetheless, over the past two decades efforts have been made towards the diversification of the economy. The manufacturing sector's contribution to GDP increased from 5.3 percent in 1990 to 11.3 percent in 2012, mainly due to the quick development of fish and meat processing and some mineral beneficiation. As a result, over the periods 2000-2002 and 2004-2006, the country even exhibits positive elasticity of non-resource tax revenue with respect to resource rents. However, from 2010 to 2012 the country's elasticity of non-resource tax revenue to resource rents was negative while it was positive for the year 2009.

Basically, one of the real challenges with Namibian economic diversification is the fact that the manufacturing sector is concentrated on mineral processing activities, such that the manufacturing exports and therefore economic diversification is vulnerable to fluctuations of mineral prices. Consequently, the country could not enjoy better non-resource tax collection both in periods of mining booms (because of relaxing effort in collecting taxes from other non-mining sectors) and mining busts (because of weak tax potential from non-mining sectors due to a potential slowdown in the mineral processing manufacturing activities). The country therefore could consider scaling up its diversification level by strengthening the productivity of the agro-industry

7.3 Estimation results of non-resource tax revenue elasticity to resource rents depending on institutions

We now turn to the estimation of the effect of natural resources rents on non-resource tax revenue depending on the quality of institutions. Government stability is used as measure of institutional quality and therefore as the transition variable in the PSTR model. However, the

three linearity tests carried out using government stability as the transition variable fail to reject the linearity hypothesis (table 2 in appendix) suggesting that the PSTR model is not suitable to test for the non-linear effect of natural resource rents on non-resource tax revenue depending on government stability[14]. Accordingly, as Botlhole et al (2012), we estimate a simple panel data model by including the interaction term between natural resource rents and government stability as an explanatory variable to test for the non-linear effect of natural resources rents on non-resource tax revenue depending on the institutions. The estimation results from the fixed effects panel data model are reported in table 5. In column (1) of table 5, we both introduce natural resource rents and government stability as explanatory variables, but we do not include their interaction term as control variable. Column (2) reports results obtained from panel fixed effects estimator with Driscoll Kray (DK-FE) autocorrelation and heteroskedasticity standard errors correction. The results show that natural resource rents negatively affect non-resource tax revenue while government stability fosters non-resource tax collection. In column (2) of table 5, we introduce the interaction term of natural resource rents and government stability. The interaction term is positive and statistically significant at the 5% level suggesting that as the quality of institutions improves, natural resources revenue becomes an important engine of non-resource tax revenue. Natural resource rents still negatively affect non-resource tax revenue and government stability is always positively associated with better non-resource tax mobilization. In summary, our estimation results show that natural resource rents slow down non-resource tax revenue in countries with weak institutions while they stimulate non-resource tax ratio in countries with better institutions.

[14] Similar results were found when we use an alternative indicator of institutional quality, namely political rights, civil liberties and bureaucracy quality.

Table 5: Non-linear effect of natural resource rents on non-resource tax revenue: fixed effects model with interaction term.

Non-resource tax revenue	**(1)** **FE-DK**	**(2)** **FE-DK**
Natural resource rents (Rents)	-0.044**	-0.046*
	(0.019)	(0.025)
Government Stability	0.161***	0.157**
	(0.047)	(0.059)
Rents*Government Stability		0.0002**
		(0.002)
GDP per capita	0.002***	0.002***
	(0.000)	(0.000)
Trade openness	0.039***	0.039***
	(0.011)	(0.011)
Inflation	-0.01	-0.01
	(0.00845)	(0.00827)
Agriculture value added	-0.033***	-0.033***
	(0.010)	(0.008)
Constant	7.091***	7.116***
	(1.454)	(1.395)
Observations	398	398
Number of countries	24	24

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

7.4 Robustness analysis

In this subsection, we analyze whether the main results obtained from the estimation of the baseline equation (equation 1) remain unchanged under some circumstances.

7.4.1 Alternative indicators of economic diversification and the quality of institutions.

Alternative indicator of institutions

We test whether our results resist to a change in the indicator of institutional quality. Since institutions are likely to work better in democratic regimes than autocratic ones, we use as institutional variable the indicator Polity from polity IV database (Marshall et al, 2014). In addition to the fact that it covers many countries over long period, Acemoglu et al (2003) argue that this indicator "*is conceptually attractive since it measures institutional and other constraints that are placed on presidents and dictators (or monarchies*)" (p.52). The indicator polity ranges from -10 (autocratic) to +10 (democratic) regimes. The linearity tests validate the PSTR model with polity as the transition variable (table 2). The PSTR estimation results using polity as threshold variable are reported in table 6. The main findings of the chapter remain

qualitatively unchanged. Natural resources rents are negatively associated to non-resource tax revenue. However, with better institutions, natural resources rents foster non-resource tax collection in Sub-Saharan Africa (table 6, column 2) suggesting that the baseline results of this study are robust to the use of alternative indicator of institutions.

The threshold variable C=6.116 while the average polity index for the countries under consideration is equal to 1.4 suggesting that African countries should significant increase effort to improve institutions such that natural resource rents contribute to enhance non-resource tax revenue. Indeed, countries such as Botswana, Namibia, South Africa and Mauritius well known for their relative political stability and for their relatively well functioning institutions have always had the maximum elasticity of non-resource tax revenue with respect to resource rents depending on the quality of institutions.

More interestingly, countries such as Ghana, Kenya and Lesotho shift from negative elasticity of non-resource tax revenue with respect to resource rents conditional on the institutions to positive elasticities. The critical threshold of the indicator of institutions quality (polity2) has been achieved in Ghana in 2001. For Ghana, it was the period of government instability with the series of coups d'etats from 1966 (ten years after its independence) to 2000 which has led to a negative effect of resource rents on non-resource tax revenue. In fact, since 2000, efforts made by Ghana in moving away from political instability and establishing democratic institutions have contributed, all things being equal, to reverse the crowding out effect of resource revenue on non-resource tax revenue mobilization. Indeed, in 2000, under the provision of the fourth republic, Jerry Rawlings, the ruling president was prohibited by term limits provision for running for a third presidential mandate. The opposition party's candidate, John Kufour won the presidential elections that year. This orderly transition between parties was an important signal of the political stability of Ghana. The president John Kufour focused his actions in developing Ghana's economy and enhancing the country's' international reputation. As a result, he was reelected in 2004. However, in 2008, after two mandates, Kufour cannot run for a third presidential mandate. Thus, in 2008, John Atta Mills, Rawlings' former Vice-President who had lost to Kufour in the 2000 elections, won the election and therefore replaced Kufour. In 2012, the president John Atta Mills passed away in office and his Vice-President, John Dramani Mahama, temporarily replaced him. After this peaceful and smooth transition of power to Dramani Mahama, in 2012, subsequent presidential elections were organised in the same year as provided by the constitution. John Dramani Mahama won that election. In 2016, Nana Akufo Addo defeated Mahama in a single round during general

elections. This was the first time that a ruling president failed to win a second presidential term in Ghana. Despite that, the transition of power from Dramani Mahama to Akufo Addo was on overall peaceful.

Alternative indicator of diversification

While manufactures exports in percent of merchandise exports measures the structure of exports across products categories, this measure however does not capture the number of exported products, which, yet reflects the diversity of exported products. The economic diversification indicator (export diversification index) developed by the International Monetary Fund[15] (IMF) takes into account this consideration. Indeed, this index considers both extensive export diversification (reflecting change in the number of export products) and intensive export diversification (reflecting change in the shares of export volumes across export products such that a country is considered less diversified when only a few sectors are driving export revenue, even if the country is exporting many different goods). Higher values of the index indicate lower exports diversification. For robustness check, we alternatively use the IMF export diversification index as the economic diversification indicator. To facilitate the interpretation of results, we inverse the diversification index in our regressions so that higher values of this index reflects higher economic diversification of in the country's under investigation.

[15] Data on this index are available at https://www.imf.org/external/np/res/dfidimf/diversification.htm

Table 6: PSTR estimation of the conditional impact of natural resources rents on non-resource tax revenue depending on economic diversification: Alternatives measures of diversifications and institutions

Dependent variable: Non-resource tax revenue	(1)	(2)
Transition variable :	**IMF export diversification index**	**Polity2**
Natural resource rents (βo)	-0.063 (0.021)	-0.074 (0.016)
Natural resource rents (β1)	0.818*** (0.182)	0.254** (0.129)
GDP per capita	0.001*** (0.000)	0.002*** (0.000)
Trade openness	0.046 (0.034)	0.054*** (0.018)
Inflation	-0.073 (0.163)	-0.098 (0.062)
Agriculture value added	-0.220 (0.107)	--0.145 (0.038)
Gamma (γ)	0.209	1.627
C	0.2	6.363
AIC criterion	1.489	1.597
BIC criterion	1.587	1.695
Observations	270	270

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

7.4.2 Alternative measure of natural resource wealth

So far, natural resource rents have been used as an indicator of natural resource wealth. The variable natural resource rents extracted from the WDI, the World Bank database has the advantage to cover a wide range of African countries over long periods thereby allowing reducing the risk of sample selection bias. Moreover, it could mitigate the endogeneity problem

resulting from reverse causality between non-resource tax revenue and natural resources wealth. In fact, it is unlikely that non-resource tax revenue at the current period in a given country will affect resource rents because the latter largely depend on the country's endowment in natural resources and world commodity prices which are exogenous to African countries. Despite these qualities, uncertainties around production costs for natural resources extraction could cast doubt on the accuracy and relevance of natural resource rents data. Since, the confidence about production costs could be challenged; one should take with caution the measures of natural resources wealth which include production costs in their calculations. In addition, the World Bank's natural resources data refer to rents captured both by the private and the public sector (Klomp and de Haan, 2016). Even if in most countries African, governments attempt to capture the largest share of rents, given the purpose of this study, it should be desirable to isolate rents received by public sector. We take onboard all these considerations above by replacing natural resource rents by resource taxes in the baseline specification. Resource taxes are tax revenues collected from natural resources sector (resource taxes). Data on resource taxes are directly taken from the ICTD-GRD database (Prichard et al, 2014). PSTR Regressions are therefore carried using as interest variable resources taxes instead of resource rents. Estimation results are reported in table 7. We find that resources taxes exert negative impact though not statistically significant on non-resource tax revenue. However, the impact of resource taxes on non-resources taxes depending on the level of economic diversification and the quality of institutions are positive and statistically significant at 5% level (table 7). These results suggest that the main results of this paper qualitatively remain to the use of alternative measure of resource wealth. The conditional impact of resource wealth on non-resource tax revenue (depending on institutions and diversification) is positive while the direct impact of resource wealth on non-resource tax revenue is negative.

Table 7: Conditional impact of resources taxes on non-resource tax revenue depending on economic diversification and institutions.

Dependent variable: Non-resource tax revenue	**Transition variable: IMF Diversification index**	**Transition variable: Government stability**
Resource taxes (βo)	- 1.403 (0.198)	- 0.519 (0.062)
Resource taxes (β1)	1.589*** (0.412)	0.11** (0.051)
GDP per capita	0.0004 (0.000)	0.001*** (0.0003)
Trade openness	0.068*** (0.014)	0.054*** (0.014)
Inflation	-0.010 (0.016)	-0.008 (0.015)
Agriculture value added	-0.196 (0.032)	-0.021 (0.021)
Gamma (γ)	0.967	588.11
C	0.227	7.124
AIC criterion	0.371	0.604
BIC criterion	0.469	0.702
Observations	270	270
Wald test, pvalue	0.000	0.06
LRT, pvalue	0.000	0.056
Fisher Test, pvalue	0.000	0.079

Notes: standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

7.4.3 Discussing and mitigating the potential endogeneity issue of the explanatory variables.

Our estimations may suffer from a potential endogeneity bias that needs to be addressed. Endogeneity can arise from reverse causality between natural resource rents and non-resource taxes. On the one hand, natural resources can weaken government efforts to mobilize non-resource tax revenues. On the other hand, a government could rely on natural resources exploitation because of the narrowness of the non-resource tax base or because non-resource tax revenues are no longer enough to cover its financing needs. In fact, recent developments on oil, gas and mining projects in Africa corroborate the desire of African governments to increase domestic revenue mobilization. More precisely, over the recent years, African countries, especially East African countries have invested more in natural resources projects to increase

domestic revenue collection. As outcome, in our knowledge, all of the African countries have undertaken oil exploration activities except Swaziland. In 2015 and 2016, nine of the worldwide top 20 discoveries were made in Africa (PWC, 2016). There are mostly gas and account for 57% of the reserves discovered. Up to date almost all the African countries are involved in at least one oil project. Clearly, the tendency towards exploiting natural resources across all the countries in the African continent provides indications that the difficulty and inability to collect more non- resource taxes and the narrowness of non- resource tax bases may stimulate natural resources exploitation and therefore affect natural resource rents. This consideration suggests that the variable natural resource rents is potentially endogenous in the baseline equation (1).

The instrumental variable (IV) technique is usually used to address the endogeneity issue in the estimation of econometric models. However, IV methods have not yet been developed in a PSTR context. Thus, instead of current values, we include one-year lag values of natural resource rents, GDP per capita, Trade openness, Inflation and Agriculture value added to mitigate the reverse causality problems. This approach[16] is acceptable in our case since resources collected from natural resources previously influences the government current behavior regarding non-resource tax revenues mobilization whereas current level of non-resource tax revenue cannot affect natural resources rents that have already been collected. We also lagged the transition variable to mitigate the issue of reverse causality since if economic diversification is a vehicle for increasing non-resource tax mobilization; countries with high tax revenue are more likely to diversify their economies. As indicated in table 8, even using one-year lagged value of diversification as the transition variable, the three linearity tests suggest that the PSTR model is still suitable to estimate the effect of natural resource rents on non-resource tax revenue depending on the level of economic diversification. Estimation results are displayed in table 8 Results are qualitatively the same as those reported in table suggesting that the main findings of this study are robust to potential endogeneity of control variables. The direct effect of natural resources rents on non-resource tax revenue is negative. The non-linear effect of non-resource tax revenue depending economic diversification, measured by $\beta 1$ is positive.

[16] Jude and Levieuge (2016) adopt the same approach to address the endogeneity problem in their PSTR estimation of the conditional effect of foreign direct investments on economic growth depending on the quality of institutions.

Table 8: Natural resource rents and non-resource tax revenue: mitigating the potential endogeneity issue of explanatory variables.

Dependent variable: Non-resource tax revenue	
Transition variable :	**L.Diversification (manufactures export in % merchandise exports)**
Natural resource rents (βo)	-0.262*** (0.030)
Natural resource rents (β1)	0.359*** (0.102)
GDP per capita	0.0003** (0.0001)
Trade openness	0.023*** (0.005)
Inflation	-0.042*** (0.012)
Agriculture value added	-0.143*** (0.021)
Gamma (γ)	0.063*** (0.017)
C	24.513*** (5.510)
AIC criterion	1.276
BIC criterion	1.369
Observations	323

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

7.4.4 Control for path dependence in non-resource tax revenue.

Previous studies on tax effort have revealed persistence in tax revenue performance suggesting that tax revenue-collected at the current date depends on the tax revenue collected at previous periods (Agbeyegbe et al., 2006; Gnangnon and Brun, 2017; Gupta, 2007; Baunsgaard and Keen, 2010; Leuthold, 1991). Indeed, government finances current tax revenue collection with tax revenue previously collected. To take onboard this consideration, we follow the approach

adopted in the literature by including one-year lagged value of non-resource tax revenue among the explanatory variables, leading to specify a dynamic model. Since the PSTR model is static by nature (see Gonzales et al, 2005), we estimate a dynamic panel fixed effect model to control for inertia in non-resource tax revenue. The specification of the dynamic model allows correcting for the serial correlation of the error term (Gupta, 2007) and it helps preventing from econometrics problem related with omitted variable bias (Bond, 2002). The estimation of dynamic model with fixed effects estimator would lead to inconsistent estimates because of the dynamic panel bias (known as Nickell bias) caused by the correlation between the lagged dependent variable and the error term.

Nonetheless, the dynamic panel data bias tends to zero as the time length of the panel data tends to infinity (Nickell, 1981). More practically, Hurlin and Venet (2001) consider that for a time dimension of 31 the dynamic panel bias could be neglected. But our panel dimension which is equal to 18 (T=18) is not sufficiently high in the sense of Hurlin and Venet (2001) to consider that the Nickell (1981) bias is negligible with fixed effect estimator. Following the literature on the estimation of dynamic panel data model, we therefore rely on system GMM estimator to estimate the dynamic specification of equation 1 in order to obtain consistent and efficient estimates. More interestingly, in addition to the correction of the panel data bias, the system GMM estimator corrects for potential endogeneity bias of the other explanatory variables. This feature of system GMM makes this estimator suitable and relevant in our case as some of the structural determinants of non-resources tax revenue we included in our specification may be endogenous like the GDP per capita. In fact, GDP per capita affect non-resource tax revenue through an increase in the taxable income. However, countries with higher non-resource tax revenue are more likely to finance broad-based economic growth policies for improving the GDP per capita.

There are two categories of GMM estimator: the first-difference GMM estimator (Arellano and Bond, 1991), and the GMM system estimator (Blundell and Bond, 1998). The first-difference GMM estimator eliminates individual unobserved fixed-effects by first difference and uses previous level values of the lagged differenced variables as instrumental variables (see Blundell and Bond, 1998). The system GMM estimator combines the equation in differences with the equation in levels and uses lagged first differences as instrumental variables for the levels equation and lagged levels are used as instrumental variables for the first-difference variables. The system GMM estimator performs better than the first GMM difference estimator in the presence of high persistence in the variables under consideration (Blundell and Bond, 1998)

and when cross-sectional variability dominates time variability. The validity of the instrumental variables in system GMM regressions is checked through the Hansen test of over-identifying restrictions and the Arellano and Bond's autocorrelation tests. Arellano-Bond (AB) tests of autocorrelation determine whether there is first-order serial correlation in the error term [AR (1)] and no second-order autocorrelation in the residuals [AR (2)]. In addition, with the system GMM estimator, we must ensure that the total number of instruments does not exceed the number of countries to avoid the problem of "instrument proliferation" in the estimations (Roodman, 2009). We collapse the set of instrumental variables to avoid the instrument proliferation problem in the estimations. Similarly to growth regressions, we split the time span of the panel data in three-year non-overlapping intervals to obtain six-year panel data (1995/1997; 1998/2000; 2001/2003; 2004/2006; 2007/2009; 2010/2012). This transformation eliminates cyclical fluctuations thus, enabling to focus on long term relationships. It also enables reducing the length of the time dimension (T) of the panel as GMM estimator is more efficient for panel data with small T and large individual dimension (N). The estimation results from the system GMM (two-step) are displayed in table 9. These results are qualitatively the same with those found with the PSTR estimation. We find that government stability, the institutional variable used here has positive effect non-resource tax revenue, suggesting that improving institutions would enhance non-resource tax revenue mobilization in Africa. Once again, the results indicate that natural resources rents have negative effect on non-resource tax revenue (table 9). However, the interaction term between natural resource rents and government stability (Rents*Government stability) is positively related to non-resource tax ratio (table 9) suggesting that with better institutions, natural resource rents positively contribute to non-resource tax revenue mobilization in Africa. From a policy implication perspective, these results provide an additional motivation to policy makers for improving the quality of institutions and diversifying the economy for better non-resource tax revenue mobilization. In other words, our findings suggest that African countries may experience more non-resource tax revenue if they use revenue from natural resources to support the economic diversification and to improve the quality of institutions.

Table 9: Non-linear effect of Natural resource rents on resource tax revenue: accounting for inertia in non-resource tax revenue.

Non-resource tax revenue	
	Sys GMM
L.Non-resource tax revenue	0.700***
	(0.078)
Natural resource rents (Rents)	-0.374***
	(0.140)
Government Stability	-0.454***
	(0.150)
Rents*Government Stability	0.029**
	(0.014)
GDP per capita	0.0004***
	(0.000)
Trade openness	0.023***
	(0.008)
Inflation	0.035
	(0.024)
Agriculture value added	-0.01
	(0.033)
Constant	7.753***
	(2.487)
Observations	112
Number of countries	24
ar1, pvalue	0.036
Hansen,pvalue	0.228
Number of instruments	18
ar2, pvalue	0.153

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

8. Conclusion

This paper analyses the effect of natural resources rents on non-resource tax revenue conditional on the level of economic diversification and the quality of institutions for 29 African countries over the period 1995-2012. The main methodology used is the panel smooth transition regression technique to account for heterogeneities and non-linearity in natural resources and non-resource tax relationship and the gradualism of the process towards diversification and better institutions in African countries. The results show that economic diversification and institutional quality modulate the effect of natural resources on non-resource tax revenue. The direct effect of natural resources rents on non-resource tax revenue is negative. However, natural resources rents tend to positively affect non-resource tax revenue for higher levels of economic diversification and better institutions. In terms of policy recommendations, our research findings suggest that African government invest more in economic diversification and

improve the quality of institutions so that natural resources revenue strengthens non-resource tax revenue mobilization performance in African countries.

Appendix

List of countries

Algeria, Botswana, Burkina faso, Cameroon, Comoros, Republic of Congo, Côte d'Ivoire, Egypt, Gabon, Ghana, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritius, Morocco, Mozambique, Namibia, Nigeria, Senegal, Seychelles, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda.

References

AfDB and Bill and Melinda Gates (2015). Delivering on the promise Leveraging natural resources to accelerate human development in Africa**.**

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

Alsharif, N; Bhattacharyya, S. and Intartaglia, M (2017). Economic diversification in resource rich countries: History, state of knowledge and research agenda. *Resources Policy*, 52, 154- 164

Anyaehie, M. C., & Areji, A. C. (2015). Economic Diversification for Sustainable Development in Nigeria. Open Journal of Political Science, 5, 87-94. http://dx.doi.org/10.4236/ojps.2015.52010

ANRC (2016). African Natural Resources Center: Catalyzing Growth and Development Through Effective Natural Resources Management. African Development Bank, https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/anrc/AfDB_ANRC_BROCHURE_en.pdf.

ANRC (2016). Botswana's Mineral Revenues, Expenditure and Savings Policy: A Case Study. African Natural Resources Center African Development Bank, Abidjan, 2016

Arellano, M., and Bond, S. (1991). Some Tests of specification for Panel Data: MonteCarlo Evidence and an Application to Employment Equations. *The review of Economic Studies*, vol.58, pp.277-297.

Arezki, R., Gylfason, T., Sy, A. (eds.) (2012). *Beyond the Curse : Policies to Harness the Power of Natural Resources*, Washington, DC: International Monetary Fund.

ATAF (2017). African Tax Outlook 2017. Second Edition.

Baunsgaard, T. and Keen, M. (2010). Tax revenue and (or?) trade liberalization", *Journal of Public Economics*, 94, pp.563-577.

BCEAO (2017). RAPPORT SUR LE COMMERCE EXTERIEUR DE L'UEMOA EN 2017. Direction Générale de l'Economie et de la Monnaie, Direction des Statistiques, Service de la Balance des Paiements. Dakar, Août 2018.

Belinga,V.; Melou, M.K. and Nganou, J-P. (2017). Does Oil Revenue Crowd Out Other Tax Revenues? Policy Lessons for Uganda. Policy Research Working Paper 8048, World Bank Group.

Bird R., Gendron, P-P. (2007). The VAT in Developing and Transitional Countries. Cambridge: Cambridge University Press.

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

Bornhorst, F.; Gupta, S. and Thornton, J. (2009). Natural resource endowments and the domestic revenue effort. *European Journal of Political Economy*, 25, pp.439–446.

Botlhole, T; Asafu-Adjaye, J. and Carmignani, F. (2012). Natural Resource Abundance, Institutions and Tax Revenue Mobilisation in Sub-Sahara Africa. *South African Journal of Economics*, Vol. 80:2, pp.135-156.

Brun, J.F; Chambas, G. and Mansour, M. (2014). Tax Effort of Developing Countries: An Alternative Measure. FERDI.

Brun J.-F., Diakité M. (2016). Tax Potential and Tax Effort: An Empirical Estimation for Non-resource Tax Revenue and VAT's Revenue. *Études et Documents*, n° 10, CERDI. http://cerdi.org/production/show/id/1814/type_production_id/1

Colletaz G., Hurlin C. (2006). Threshold Effects of the Public Capital Productivity: An International Panel Smooth Transition Approach. Document de Recherche du Laboratoire d'Economie d'Orléans, 2006-1.

Cnossen, S. (2015). Mobilizing VAT Revenues in African Countries. *International Tax and Public Finance*, 22: 1077–108.

Crivelli, E. and Gupta, S. (2014). Resource Blessing, Revenue Curse? Domestic Revenue Effort in Resource-Rich Countries. *European Journal of Political Economy*, 35, pp. 88-101.

Drummond, P.; Daal, W; Srivastava, N; Oliveira, L. E. (2012). Mobilizing Revenue in Sub-Saharan Africa: Empirical Norms and Key Determinants. *IMF Working Paper*, WP/12/108.

Eltony, M. N. (2002). Determinants of Tax Efforts in Arab Countries. Arab Planning Institute Working Paper 207.

FAO (2003). Forestry Outlook Study for Africa. Regional Report - Opportunities and challenges towards 2020. FAO Forestry Paper 141. Rome. Italy.

Fjeldstad, O-H.; Jahari, C.; Mmari, D. and Sjursen, I. H. (2015), "Non-resource taxation in a resource rich setting: A broader tax base will enhance tax compliance in Tanzania. Chr. Michelsen Institute/ REPOA.

Fok, D., van Dijk, D. and Franses, P. (2005). A multi-level panel STAR model for US manufacturing sectors. *Journal of Applied Econometrics*, 20(6), 811-827.

Fox, W. F. and Gurley, T. (2005). An Exploration of Tax Patterns Around the World. Tax *Notes International*, 28: 793–805.

Ghura M. D. (1998). *Tax Revenue in Sub-Saharan Africa—Effects of Economic Policies and Corruption (EPub)*. Washington, D.C.: International Monetary Fund, pp. 98–135.

Gnangnon, S.K.; Brun, J-F. (2017). Impact of export upgrading on tax revenue in developing and high-income countries. *Oxford Development Studies*, DOI:10.1080/13600818.2017.1313398.

González A., Teräsvirta T., van Dijk D. (2005). Panel Smooth Transition Regression Models. SSE/EFI Working Paper Series in Economics and Finance, 604.

Granger C. W., Teräsvirta T. (1993). *Modelling Non-Linear Economic Relationships*. Oxford: Oxford University Press.

Gupta, S., A. (2007). Determinants of Tax Revenue Efforts in Developing Countries. *IMF Working Papers*, WP/07/184.

Gylfason, T. (2017). From Double Diversification to Efficiency and Growth. *Comparative Economic Studies*, Volume 59, Issue 2, pp 149–168.

Hansen B. E. (1999). Threshold Effects in Non-dynamic Panels: Estimation, Testing, and Inference. *Journal of Econometrics*, 93: 345–368.

Hansen, B. E. (1996). Inference when a nuisance parameter is not identified under the null Hypothesis. *Econometrica*, 64, 413–430.

Hinrichs, H.H. (1965). Determinants of Government Revenue Share among Less Developed Countries. *Economic Journal*, vol. 75, pp.546–556.

Hurlin, C., and Venet, B. (2001). Granger causality tests in panel data models with fixed coefficients. Paris: Miméo, University Paris IX.

ICTD/UNU-WIDER. (2017). Government Revenue Dataset. https://www.wider.unu.edu/project/government-revenue-dataset

Jude, C. and Levieuge, G. (2016). Growth Effect of Foreign Direct Investment in Developing Economies : The Role of Institutional Quality. *The World Economy*. doi: 10.1111/twec.12402.

Klomp, J., and de Haan, J. (2016). Election cycles in natural resource rents: Empirical evidence. *Journal of Development Economics*, 121, 79–93.

Knebelmann, J. (2017). Natural resources' impact on government revenues. WIDER Working Paper 2017/10. UNU-WIDER.

Maddala, G.S. and Wu, S. (1999). A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test. *Oxford Bulletin of Economics and Statistics*, special issue, pp. 631-652.

Marshall, M.G; Gurr, T. R. and Jaggers, K. (2014). Polity IV Project: Data user's Manual; Political regimes Characteristics and Transitions, 1800-2012. Vienna, Center for Systemic Peace.

McGuirk, E. (2013). The illusory leader : natural resources, taxation and accountability. *Public Choice*, 154, 285–313.

Morrissey, O.; Von Haldenwang, C.; Von Schiller, A.; Ivanyna, M.; and Bordon, I. (2016). Tax Revenue Performance and Vulnerability in Developing Countries. *Journal of Development Studies*.

Ndikumana, L. and Abderrahim, K. (2010). Revenue Mobilization in African Countries: Does Natural Resource Endowment Matter?. *African Development Review*, Vol. 22, No.3, 2010, 351–365.

Nickell, S. (1981), Biases in dynamic models with fixed effects. *Econometrica*, Vol. 49, pp.1417-1426.

Ossowski, R., and Gonzales, A. (2012). Manna from Heaven: the Impact of Non-Renewable Resource Revenues on Other Revenues of Resource Exporters in Latin America and the Caribbean. *IDB Working Paper*, No. 337, New York.

Prichard, W. ; Cobham, A. and Goodall, A. (2014) The ICTD Government Revenue Dataset. *ICTD Working Paper*, No. 19, Brighton, UK.

PWC. (2016). The Choice to Change: Report on current developments in the oil & gas industry in Africa. *Africa Oil & Gas Review*, .2016.

Roodman, D. (2009). Practitioners' Corner A Note on the Theme of Too Many Instruments. *Oxford Bulletin of Economics and Statistics*, 71, pp. 135-158.

Ross, M. L. (2001). Does oil hinder democracy? *World Politics*, 53(3), 325–361.

Stotsky, J. G. and WoldeMariam, A. (1997). Tax Effort in Sub-Saharan Africa. *IMF Working Paper*, No. 97/107, Washington, DC.

Tanzi, V. (1989). The impact of macroeconomic policies on the level of taxation and fiscal balance in developing countries. IMF Staff Papers No. 36, 633-656.

Thomas, A. and Trevino, J.P. (2013). Resource Dependence and Fiscal Effort in Sub-Saharan Africa. *IMF Working Paper*, No. 13/198, Washington, DC.