Capacity to Mobilize Tax Revenues in Benin: Effect of Tax Fraud

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Abstract: *The idea for the individual not to contribute to the mobilization of funds for the establishment of public goods comes from various attitudes. Among which, we capture that of the behavior of tax evasion. The objective of determining the role of tax evasion in the capacity of mobilization of tax revenues in Benin, leads us to use the extension of the stochastic frontier model (parametric model) of the latest work of (Kumbhakar et al., 2014). Concerning studies on fiscal capacity, mainly those that have focused on the effect of corruption have not taken into account the level of health of the populations in the structural variables. Taking this variable into account, we determine the fiscal capacity of Benin, while evaluating the place of tax evasion in the mobilization of tax revenues. The results of the GCM and the maximum likelihood show that the fiscal mobilization capacity of Benin is 14.25% in 2021 and that tax evasion has a negative and significant effect on tax revenues.*

Keywords: tax fraud, mobilization capacity, tax revenue, GCM

JEL Classification: G21, G28, O33

1. Introduction

Fraudulent behavior develops and increases mainly when the economic operator finds that the majority of the fruits of labor resulting from his economic activities are consumed by the State. Bariliri, (2018) distinguishes several fraudulent practices or behaviors: tax evasion, tax exile, tax offshoring, skillful management of a tax situation, tax evasion (term used in Switzerland). According to Laure Agron , in her thesis on the history of tax vocabulary, the term "fraud" (formerly " fraulde " in 1255) is borrowed from the Latin " fraudis ", which means harm caused to someone, damage resulting from an error or deception, an act carried out with the intention of infringing the rights of others.

Furthermore, Prest, (1979) defines the fiscal capacity of an economy as the maximum amount of taxes it can mobilize, depending on the structure of its economy which forms the potentially taxable tax base and the tax system in force. Consequently, tax evasion behavior undermines the capacity to mobilize tax revenues thus creating a tax gap which represents the difference between the fiscal capacity and the level of tax revenues actually mobilized. This gap makes it possible to assess the size of the tax shortfall, that is to say the quantity of additional tax revenues that can be collected (Lemoine 2014).

The financial statements of United Nations agencies report tax losses due to fraud (Bartsiotas and Achamkulangare 2016). According to (Politiques 2020), African tax administrations are exposed to tax fraud and face a lack of resources to monitor tax expenditures, which are generally not planned in their budget or less declared. Also, according to the World Bank report (World Bank 2018), prepared as part of a study on tax policy in West Africa, it appears that a large part of corporate income tax (CIT) revenue is not declared (see appendix, graph).

In Benin, to combat tax fraud, taxpayers have been provided with an online tax declaration system known as the Integrated Tax and Related Management System (SIGTAS). This system was implemented in 2018 and has its associated shortcomings. It was replaced by the Certified Electronic Billing Machine (MECeF) following its inefficiency (DGI 2023).

Theoretical literature focuses on the determinants of tax evasion rather than establishing a link between tax mobilization capacity and tax evasion. Thus, the work of the pioneer (Allingham and Sandmo 1972) reveal that tax evasion is a problem not considered in theoretical studies, they therefore establish the link between tax evasion and risk taking (Kanbur 1981). Srinivasan, (1973) develops a similar model and agrees with (Allingham and Sandmo 1972). For (Kolm 1973) the model of (Allingham and Sandmo 1972) is full of limitations because the latter do not consider the tax administration.

Several experimental studies focusing on simulation have attempted to confirm the theoretical form of the study of taxpayers' tax evasion behavior. The work of (Friedland et al. 1978) reveal that it is more judicious for the State to apply a strong penalty on tax evasion rather than carry out a frequent audit. Because the decision to opt for an under-declaration of taxable income varies from one taxpayer to another. The experimental works of Friedland (1982), Spicer (1982) also conclude with the same results.

Furthermore, even if theoretical literature does not establish the link between the capacity to mobilize tax revenues and tax evasion, empirical studies determining the capacity to mobilize tax revenues to know the tax gap, question the role of structural variables (including corruption) constituting the tax base of an economy on the capacity to mobilize tax revenues. This is the case of the studies of (Yao et al., 2023; Trinnou, 2021; Doghmi 2020; Boussida, 2020; Brafu-insaidoo and Obeng 2020; Langford and Oldenburg 2016; Fenochietto and Pessino 2013). Indeed, if the level of corruption and the level education are considered as the factors structural disrupting revenue mobilization tax In THE developing countries (Yao et al. 2023), it East so it is possible that the level of health of taxpayers either A postman structure affecting also the mobilization of revenues tax.

In light of the stylized facts and the gap in the literature review, we question the role of tax fraud in the capacity to mobilize tax revenues in Benin. The general research objective is to determine the role of tax fraud in the capacity to mobilize tax revenues in Benin.

To achieve these objectives, we use the stochastic frontier parametric method to estimate the tax administration's revenue shortfall. This study fills the gap in the existing literature not only in terms of the scope of the study (which provides the DGI Benin with an adequate framework to reduce tax fraud) but also takes into account certain characteristics absent in recent literature, that of (Yao et al. 2023; Kobyagda 2021; Doghmi 2020) . Our study also takes the corruption perception index as a proxy for tax evasion in order to assess the effect of tax evasion on the capacity to mobilize tax revenue in Benin. The study contributes to the literature by adding the health level variable to the list of structural variables.

We organize this paper into two sections where the first section would be linked to a brief summary of the theoretical and empirical literature review and the second section would be dedicated to the empirical analysis of the determinants of tax fraud and its effect on the capacity to mobilize tax revenues in Benin.

2. Literature review of the behavior of tax fraud in the face of tax revenue mobilization

This section brings together theoretical and empirical work that develops how tax evasion behavior affects tax revenue mobilization.

2.1 Theoretical framework of tax fraud in the face of tax revenue mobilization

We present the theoretical work on the determinants of tax fraud and at the same time show through this channel how fraud affects tax revenue.

2.1.1 Allingaham 's theory Sandmo 1972

In the economics of crime initiated by Gary Becker in 1960, criminal behavior is that developed by an individual who mixes activities that provide him with profit, while exposing himself in an uncomfortable environment where he can be caught at any time and suffer the consequences of his actions. Thus, the individual finds himself between two phases, the first is the one in which he plays and always succeeds because he enjoys the totality of his efforts even if these are not regulatory in view of the law. The second phase is the one where he gets caught and will have to suffer the consequences of all his perfidies. The individual therefore arbitrates between these two situations which his personal and selfish interest is forced to undergo. The behavior of tax fraud draws its roots from this criminal behavior.

So it was the work of Allingham and Sandmo (1972), who seek to define the taxpayer's choice regarding the share of income he is willing to remit to the state during the declaration of his taxable base. The choice to declare depends on the taxpayer's utility and the possibility of being caught by the tax authorities given that the declaration or not of the taxable base is followed by a tax audit. The taxpayer finds himself in a cost-benefit arbitration where the realization of one or the other is followed by its consequence. To this end, the decision to defraud becomes a lottery because it is subject to enormous consequences of high risk.

According to Jacquemet and Malézieux (2020), the model of Allingham and Sandmo, (1972) have made it possible to establish the link between the decision of tax evasion and the different instruments of tax policy. These are: the tax rate which defines the benefit linked to tax evasion if the taxpayer does not get caught (this rate also defines the cost of fraud in the event that the taxpayer is subject to penalties proportional to the taxes paid); the frequency of the tax audit which is likely to increase the probability that the taxpayer will be faced with an audit; and finally, the effectiveness of the audit which is characteristic of the conviction of the subject.

2.1.2 Criticism of Allingaham 's theory Sandmo 1972

The behavioral model of tax fraud has been the subject of a great analysis and criticism by several researchers with the intention of improving this model. Thus, we have the work of Kolm (1973) where the author develops the behavioral model of tax fraud by integrating the Ministry of Finance, tax collectors, and the cost of detecting fraud. Allingham and Sandmo (1972), suggested in their model that the penalty rate be applied to undeclared income so it will have a contradictory effect, income effect and substitution effect. On the other hand, in the reflection initiated by Yitzhaki (1974) no contradictory effect, income effect and substitution effect, exists in the condition where the penalty rate is applied to the amount defrauded.

Pencavel (1979), finds the implications of the behavioral model of tax evasion restricted. Sandmo (1981) returns alone, to integrate tax evasion into the analysis of the optimal taxation of income. Also, Landsberger and Meilijson (1982) define a penalty model which summarizes the measures allowing to mitigate the costly externalities created by the economic agents who develop the behavior of tax optimization. Koskela (1983), Allingham and Sandmo (1972), they do not establish any link between the tax rate and tax evasion in their model.

Watson (1985) by examining the effect of changes in various parameters on fraud and labor market equilibrium, models the case where potential tax fraud varies. Cowell, (1985) suggests a study of the behavioral model of tax fraud that takes into account the different forms of the tax fraud problem. Reinganum and Wilde (1985) based on the assumption that the probability of tax audit is known, redefines the tax fraud model.

2.2. Factors likely to reduce tax evasion

Several factors may contribute to the reduction of tax evasion, including the penalty rate Allingham and Sandmo (1972), the frequency of tax audit, audit strategies, improvement of services within the tax administration (Gulyás and Tóth 2015), tax fairness, probability of detection (Obid 2004), monetary tax incentives (Falkinger and Walther 1991).

2.2.1. Penalty and tax fraud: What effect on tax revenue?

According to Falkinger and Walther (1991) reducing penalties can increase tax revenues. In a dynamic system, the penalty reduces tax evasion and externalities (Landsberger and Meilijson 1982). This contributes to improving tax revenues. (Friedland 1982) shows that increasing the penalty rate reduces tax evasion behavior. On the other hand, if the delay in income declaration is subject to tax penalties, this can increase the risk of tax evasion (Oladipupo and Obazee 2016), weakening the mobilization of tax revenues.

Allingham and Sandmo (1972) demonstrate that taxpayers can declare a reasonable income if the probability of tax detection increases. Chau and Leung (2009) share the same ideas as the previous ones by arguing that the reduction of tax evasion when associated with an increase in penalties increases tax revenues. In the same vein, Feld and Frey (2007) present the tax penalty as reducing the practices of tax evasion. Hasseldine et al. (2007); Spicer (1982) also confirmed that the severity of criminal sanctions is significantly associated with tax evasion, thus increasing tax revenues.

However, unlike studies that find that tax penalties deter the act of tax evasion, other authors find that in some countries the penalty does not reduce tax evasion. The study of Fjeldstad and Semboja (2001) reveals a positive impact of tax penalties on tax evasion in Tanzania. Oladipupo and Obazee (2016) discovered that the tax penalty had an insignificant negative impact on tax evasion among SMEs in Nigeria. This is also the same observation in America as Ali and his colleagues (2001) demonstrate that tax penalties do not impact the act of tax evasion of American taxpayers. Jabbar (2018) concludes that an abundant literature has shown the detrimental effect of tax penalties on tax evasion unlike the minority who find a positive link.

2.2.2. Tax rates and tax evasion: What effect on tax revenues?

According to the theory of optimal taxation (Mansor and Gurama 2016) , the tax rate is an essential element in the mobilization of tax revenue. Thus Devos (2007) states that the tax rate is a key variable in the tax structure that affects the perception of the fairness of the tax system. For Fjeldstad and Semboja (2001) compulsory tax leads taxpayers to resist tax evasion.

Furthermore, the theory of deterrence shows that an increase in the tax rate reduces tax evasion Allingham and Sandmo (1972). In both developed and developing countries, high tax rates generate an increase in tax evasion (Dlamini, 2017; Martinez-Vazquez and Rider 2005; Malkawi and Haloush 2006; Guldana, 2013) . Crane and Nourzad (1990) argue that high tax rate encourages taxpayers with large turnover to adopt the act of tax evasion, which reduces tax revenue.

Taxpayers are sensitive to an increase in the tax rate because it leads to under-reporting behavior (Mpofu 2022). Rahhal (2017) studied changes in tax rates and their effects on tax evasion in Palestine, and found that the effect of the tax rate was significant.

2.2.3. Probability and tax evasion: What effect on tax revenue?

Detection probability is the set of strategies adopted by tax authorities to detect fraud behavior developed by taxpayers (Alkhatib et al. 2017; Chau and Leung 2009) . Thus, Allingham and Sandmo (1972) claim that the high probability of detection encourages taxpayers to declare the majority of taxable income. If taxpayers are risk averse, an increase in the frequency of controls would decrease tax evasion (Almunia and Lopez-Rodriguez 2018; Abdixhiku 2013), allowing an increase in tax revenue. This negative relationship between the probability of detection and tax fraud has been confirmed by works (Ayers, et al. 2015; Slemrod et al. 2001; Almunia and Lopez-Rodriguez 2018; Bott et al. 2017).

For Wang (1990), when the probability of detection is high, firms reduce the choice to tax evasion. (Friedland 1982) shows that the probability of detection reduces tax evasion. Musayev and Gazanfarli (2020) support the same idea as the previous ones, inferring that the high probability of detection reduces tax evasion. Allingham and Sandmo (1972) suggested increasing the probability of detection to encourage taxpayers to file their tax returns in full. However, studies (Alm and McKee 2006; Ariel 2012) revealed an insignificant effect of the probability of detection and audits on tax fraud, respectively.

2.2.4. Other factors likely to reduce tax evasion

The severity of tax sanctions expresses the severity of fines and imprisonment associated with the detection of tax fraud (Efebera et al. 2004). Monetary tax incentives are sources of reduction in tax fraud. (Falkinger and Walther 1991). For Fjeldstad and Semboja (2001) Taxpayer harassment by tax collectors leads taxpayers to resist tax evasion. Uyar et al. (2021) propose the digitalization of government services to reduce tax evasion, mainly in economies with higher ICT adoption rates. For Gulyás, and Tóth (2015), Improving tax controls, improving government services, adaptive audit strategies would effectively reduce tax evasion. Lekpek (2022) suggests that non-economic economic, legal, institutional, demographic, cultural, and behavioral factors significantly affect tax evasion.

Considering the various developments of the tax evasion behavior model and the criticisms made by the literature, we note that no author has so far addressed the tax evasion behavior model in the case of a progressive tax rate, nor in the case where the taxpayer legally uses the laws in force of the tax legislation to relocate his businesses to neighboring countries where the tax regulations seem profitable to him. Hence the need to study a theoretical framework of tax evasion behavior that takes into account the progressive rates in the taxpayer's national country on the one hand, and also on the other hand, to study a theoretical framework that takes into account the economic characteristics of the host country, in the case of online commerce.

2.3. Empirical review of the capacity to mobilize tax revenues: Effect of tax fraud

This section is organized into two sections. The first concerns the review of the determinants of tax evasion and the second brings together empirical work carried out on the tax gap.

2.3.1 Determinants of tax fraud

Empirical and theoretical studies generally establish the link between tax rate, tax audit frequency, the probability of being detected by the perpetrator, age, nationality, culture and tax evasion.

Mansor and Gurama (2016) use survey data from 303 randomly selected personal taxpayers from the public and private sectors in Gombe to characterize the determinants of tax evasion. The results of the analysis show that the tax system, income level, and education level have a significant positive relationship with tax evasion. On the other hand, the tax rate and corruption (CR) have a positive but insignificant relationship with tax evasion. Clotfelter (1983) conducted an analysis using data from the TCMP (Taxpayer Compliance Measurement Program) from 1969. These results allowed him to conclude that the level of disposable income and the marginal tax rate have a significant and negative effect on tax reporting. This confirms the work of (Wahlund 1992) explaining that high tax rates intensify the individual's aversion to tax.

According to Witte and Woodbury (1983) found that tax audits reduce the development of tax fraud because they arouse the subject's notion of honesty, which is consistent with the theory. The author therefore suggests that tax audits should be taken seriously with great importance. The results of these authors confirm the work of (Yitzhaki, 1974) The difficulty experienced by these authors is to establish a link between the probability of being subjected to a criminal sanction following the detection of fraud and the choice to defraud.

Dubin and Wilde (1988) conducted a study in the United States on federal tax and citizens' income. In this study, the author demonstrated that an increase in the resources of the tax administration led to a strengthening of tax audits of all categories of taxpayers. Westat, (1980) studied two fraud behaviors according to the dichotomy of belonging to alternative categories: "blue-collar" or "white-collar".

2.3.2 Capacity and Tax Gap: Effect of Tax Evasion

The tax gap is the difference between actual tax revenues collected and the tax frontier at a given date. Here are some empirical studies on the tax frontier.

Among the structural variables representing the tax base, (Langford and Oldenburg 2016), find that corruption has a negative and significant effect on tax revenues while (Fenochietto and Pessino 2013) has a non-significant positive effect.Yao and al. (2023) assess in sub-Saharan Africa, the potential and the tax effort, over the period 2000-2021, treating specifically the case of the WAEMU countries. It is inspired by the methodological approach of the model of (Kumbhakar and Hardaker 2012). The results show that the WAEMU countries such as Benin, Burkina Faso, Cote d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo have respectively a tax gap as a percentage of GDP of 5.5; 4.8; 4.1; 3.5; 3.6; 3.5; 4.9; 5.2.

Still in the UEMOA space (Kobyagda 2021) estimates the tax potential using the stochastic frontier model of (Kumbhakar et al. 2012) over the period 1987-2017. The results of its estimates indicate that the tax burden is low because countries still have tax potential to be exploited. The author takes as structural variables for his estimation model, variables such as: GDP per capita, the degree of trade openness, agricultural value added, industrial value added and the degree of monetization.

The study of (Trinnou 2021) notes that EU countries are failing to achieve their full potential in terms of tax effort. The estimated tax effort at EU level averaged 78.1% over the period 2003-2019. This effort results from the combination of tax efforts linked to tax policy decisions (87.3%) and tax efforts reflecting the degree of performance of the tax administration (89.5%). Tax effort varies by country, with levels ranging from 64.3% in Côte d'Ivoire to 89.6% in Mali. These results have important implications for economic policy in the region.

In a study specific to ECOWAS, (Korsu 2021) used the Battese and Coelli (1992) model to estimate the tax effort of countries in this region over the period 2001-2015. The results showed that trade openness and financial development have a positive effect on tax revenues, while the level of urbanization tends to limit tax mobilization in this area. The average tax effort was estimated at 90% of the potential level in ECOWAS countries. These results are generally consistent with previous studies on low-income countries.

Using the ARDL approach to estimate and evaluate the tax potential based on structural variables such as: the value added of agriculture in GDP, the variant of the money supply reported to GDP, the ratio between the sum of import and export per

GDP, real GDP per capita and the urbanization rate, (Boussida 2020) uses data covering the periods 1984 to 2017 in Tunisia. The estimation results reveal a very low, or even negative, tax gap for each year from 1984 to 2017.

Using the latest generation of the stochastic frontier model, a study of 76 developing countries over the period 1980-2017 reveals that Morocco is not fully exploiting its tax capacity, with a tax gap of 6.7 percentage points of GDP. This gap is 4.1 for low-income countries, 6.1 for lower-middle-income countries and 8.3 for upper-middle-income countries (Lemoine 2014). A study estimating and analyzing tax potential and tax effort in Ghana, covering the period 1985-2014, showed that Ghana admits a significant tax gap that it will have to exploit (Brafu-insaidoo and Obeng 2020).

Starting from a stochastic efficiency frontier model, (Diangne, 2016) determines the margin of increase in tax revenues as a percentage of GDP and finds a gap of 2.8 points with a tax potential of 22.4% of GDP. The work of (Fenochietto and Pessino 2013) studied a larger sample of 113 countries over the period 1991-2012. Langford and Oldenburg (2016) estimated the tax effort of 85 non-resource-rich countries over a period of 27 years using the model of (Battese and Coelli, 1995). As for the work of (Fenochietto and Pessino 2013), Their results show a positive evolution of the tax effort, with higher levels in high-income and upper-middle-income countries compared to low-income and lower-middle-income economies.

Geourjon 's study (2020) found that sub-Saharan African countries are failing to achieve their full potential in terms of tax performance. As previous findings suggest, the level of development measured by per capita income, financial development, and trade openness play an important role in improving tax revenue mobilization. In contrast, natural resource rents and the agricultural sector have a negative impact on non-resource taxes.

In summary, recent work has attempted to cover the WAEMU sample and developing countries in general but does not take into consideration the level of taxpayers' health. Given that the level of corruption and the level of education are important factors for tax revenue mobilization in developing countries (Yao and al., 2023), the level of taxpayers' health would also be important because a taxpayer who does not have an average level of health will not be able to pay his taxes, which would have hampered the mobilization of tax revenue. In addition, previous analyses have not always been carried out for individual taxes, namely the goods and services tax and the export tax. This study therefore complements the existing literature by estimating the gap for each type of specific tax and implements the Benin case based on a sample from sub-Saharan Africa.

3. Empirical analysis of tax fraud in tax revenue mobilization in Benin

In this section, to verify our two research objectives, the first is to estimate the fiscal capacity of tax revenue mobilization in Benin and the second is to determine the place of tax evasion in the capacity of tax revenue mobilization in Benin.

3.1. Methodological framework

This section presents the research methodology and the interpretation of the results obtained from the estimations.

3.1.1. Method for estimating the capacity to mobilize tax revenues and the effect of tax fraud

We estimate the loss of revenue for the tax administration, due to the behavior of fraud and tax evasion developed by formal taxpayers in terms of direct tax revenue. In order to determine the tax gap of direct tax revenue, we use the model of (Pitt, & Lee, 1981) formulated the original FS model applied to panel data, in the dynamics of tax revenue collection by country. We therefore rely on this formula to quantify the maximum direct tax revenue Tax_{it}^{M} that the Beninese economy can withdraw from formal production units at a time t given its economic characteristics. These are represented by a set of input vectors Z_{it}functions of production f expressing the spread technology :

$$Tax_{it}^{M} = f(Z_{it}, \beta) \quad (1)$$

β gathers a vector of coefficients related to Z_{it}. Technical inefficiency δ_{it}, the source of poor tax revenue collection, generates a deviation in the quantity of tax revenue from the tax border. Thus, we have:

$$Tax_{it} = f(Z_{it}, \beta).\delta_{it} \le f(Z_{it}, \beta) = Tax_{it}^{M}$$

$\delta_{it} \in]0,1]$ and captures the technical inefficiency that causes the difference between the revenue actually collected and the tax frontier. In the case where $\delta_{it} = 1$, the observed tax revenue is maximum, thus we conclude that the country has reached its technical efficiency. On the other hand, if $\delta_{it} < 1$, the tax revenue collected is lower than the maximum threshold, thus δ_{it}captures the tax loss.

Since Tax_{it}^{M} it eventually undergoes random shocks θ_{it}, which cannot be controlled by countries and thus affect the mobilization of tax revenues. In addition, Tax_{it}^{M} it also undergoes errors in the specification of the frontier model and those in the measurement of inputs. We can SO rewrite the model as following:

$$Tax_{it} = f(Z_{it}, \beta).\theta_{it}\delta_{it} \qquad (3)$$

Assume the function f is log-linear with:

$X_{it} = log\{Z_{it}\}, v_{it} = \log(\theta_{it}) , u_{it} =$
$-\log(\delta_{it})$
and apply the logarithm to equation (3):

$$\log(Tax_{it}) = \alpha + \beta'.X_{it} + v_{it} - u_{it}$$
$$\underbrace{\log(Tax_{it})}_{Tax\ revenue} + \underbrace{\alpha + \beta'.X_{it} + v_{it}}_{tax\ border} - \underbrace{u_{it}}_{Tax\ loss} \qquad (4)$$

The error terms $v_{it}\ et\ u_{it}$have no dependency on each other and are also independent of vector X_{it}. Estimating this model requires that the distributions of $v_{it}\ et\ u_{it}$be specified. Thus, according to (Aigner, Lovell, and Schmidt 1977) , v_{it}follows a normal distribution, i.e., $v_{it} \sim N(0, \sigma_v^2)$and u_{it}follows a half-normal distribution, i.e., $u_{it} \sim N^+(0, \sigma_v^2)$.

Thus, in accordance with the structural factors of an economy i at time t, the tax revenue it is able to collect less the tax loss linked to technical inefficiency in collection, is equal to the actual revenue collected.

The work on stochastic frontier models has been extended since its origins to the latest work of (Kumbhakar et al., 2014). These latter treat the technical efficiency model especially with random effects. This allows them to consider the unobserved heterogeneous effect between countries on tax revenues ; and to disaggregate technical efficiency u_{it}into two compartments, a long-term topical component fixed in time and the second which evolves over time. Thus (Kumbhakar et al., 2014) writes his model as follows:

$$\underbrace{\frac{T_{it}}{Y_{it}}}_{Tax\ revenue} = \underbrace{\alpha + \beta'.X_{it} + \mu_i + v_{it}}_{Tax\ border} - \underbrace{\eta_i - u_{it}}_{Taxe\ loss}$$

with, $\frac{T_{it}}{Y_{it}}$ the share of tax revenue (T_{it})in GDP (Y_{it}), captured for a country i at time t and and translated into logarithm $(\mathrm{i} = 1, \dots, \mathrm{N\ et\ t} = 1. \dots, \mathrm{T})$; $\alpha\ une\ constance$; X_{it}, a vector grouping the structural variables which define the tax base available to the country is taken in logarithm. $\mu_i\ capte\ les\ effets\ individuels\ aléatoire\ par\ pays$; v_{it}captures random shocks, η_i captures fixed technical efficiency over time and finally u_{it}which captures variable technical efficiency over time.

Estimating this model requires a three-step procedure, rewriting model (5) as follows:

$$\frac{T_{it}}{Y_{it}} = \alpha^* + \beta'.X_{it} + \alpha_i + \epsilon_{it} \quad (6)$$

Whose specification is:

$$\frac{DirectTax_{it}}{PIB_{it}} = \alpha^* + \beta_1 Fraud_{it} + \beta_2 Ph_{it} + \beta_3 Ag_{it} + \beta_4 ind_{it} + \beta_5 Im_{it} + \beta_1 Ex_{it} + \beta_1 Niv\_B\_etre_{it} + \beta_1 Hl_{it} + \alpha_i + \varepsilon_{it} \quad (7)$$

$$\alpha^* = \alpha - E(\eta_i) - E(u_{it}) \quad (8)$$

$$\epsilon_{it} = v_{it} - u_{it} + E(u_{it}) \quad (9)$$

$$\alpha_i = \mu_i - \eta_i + E(\eta_i) \quad (10)$$

First step: Estimation of linear regression in panel data.

This estimation is made on equation (6) in order to predict the values $\hat{\beta}, \hat{\alpha}\ et \hat{\epsilon}$ of the generalized least squares (GLS) estimator.

Second step: Estimation of the variation over time $(u_{it})$of technical efficiency

Here we estimate u_{it}which represents the time-varying technical efficiency using equation (9). This estimation is made possible by applying the maximum likelihood estimation method on the residuals initially predicted at the first estimation step. Here, it is assumed that $v_{it}$is dispersed by the normal distribution with mean 0 and variance

$\sigma^2$is $\sigma_v^2, i.e, v_{it} \sim N(0, \sigma_v^2)$. Moreover, it is also assumed that $u_{it}$is pierced by the half-normal distribution with mean 0 and variance $\sigma^2$is $\sigma_u^2, i.e, u_{it} \sim N(0^+, \sigma_u^2)$.

Furthermore, we apply the estimation method of (Jondrow, Knox, and Schmidt 1982) allowing to define the conditional dispersion $u_i$knowing $\hat{\epsilon}$ to derive the estimator $\hat{\eta}_{it}$. Thus the time-varying technical efficiency ETV_{it}can be written as follows :

$$\mathrm{ETV}_{it} = \exp(-\hat{u}_{it}) \qquad (11)$$

Step 3: Estimation of technical efficiency over time (η_i)

This third and final step concerns the estimator of $\eta_i$which represents the constant technical efficiency over time using equation (9). This estimation is applied to the maximum likelihood estimation method on the residuals $\widehat{\alpha}$ initially predicted at the first estimation step. Here, it is assumed that $\mu_i$is dispersed by the normal distribution with mean 0 and variance $\sigma^2$is $\sigma_\mu^2, i.e, \mu_i \sim N(0, \sigma_\mu^2)$. In addition, it is also assumed that $\eta_i$is pierced by the half-normal distribution with mean 0 and variance $\sigma^2$is $\sigma_\eta^2, i.e, \eta_i \sim N(0^+, \sigma_u^2)$.

Furthermore, we apply the estimation method of (Jondrow et al. 1982) allowing to define the conditional dispersion η_i knowing $\widehat{\alpha}$ to derive the estimator $\widehat{\eta_\iota}$. Thus, the time-varying technical efficiency ETP_{it}can be written as follows:

$$\mathrm{ETV}_{it} = \exp(-\hat{\eta}_{it}) \qquad (12)$$

This is how we determine the overall technical efficiency of a country i as follows:

$$\mathrm{ETG}_{it} = \mathrm{ETV}_{it} + \mathrm{ETP}_i \qquad (13)$$

2.1.2 Description of variables and data sources

The dependent variable $\frac{T_{it}}{Y_{it}}$is defined as the ratio of direct tax revenue to GDP, expressed in logarithm, excluding natural resources and social security contributions. This allows us to consider the social security system and natural resources available to each country. Tax revenue data are taken from the UNU-WIDER Government Revenue Data database, version 2023. This database provides the detailed composition of different individual taxes over a period of 1980-2022 and covers 188 countries. It is initiated from data compiled from International Monetary Fund (IMF) reports.

The independent structural variables represented by the vector $X_{it}$are expressed in logarithm and constitute the availability of taxable wealth in a country, thus the potential of the tax base. They are represented by the value added of the service sector, trade, agriculture, industry, manufacturing, transport and trade openness disaggregated into imports and exports. These data are taken from the WGI World Development Indicators (WDI) database. Our sample consists of unbalanced panel data on 28 African countries and covers a period from 2006 to 2022, from which we deduce and interpret the results for the case of Benin. The expected variables and signs are presented in the appendix.

3.2. Discussion and interpretation of results

This section presents the results of preliminary tests, estimations and interprets them.

3.2.1 Descriptive statistics

Descriptive statistics are essential before any estimation in a research project because they allow the information conveyed by the data to be structured

and represented. We present descriptive statistics for the case of Benin.

Table 1: Descriptive statistics

Variables	Obs	Mean	Std. dev.	Min	Max
PCP	17	0.5778211	0.0323457	0.5208465	0.6457338
LTa	17	13.42081	0.3234326	12.85364	14.09367
LTd	17	11.83922	0.2106838	11.43428	12.11231
LTi	17	13.09383	0.2176894	12.57674	13.28771
LTipc	17	11.74098	0.2002849	11.3449	12.17716
LTgs	17	12.64564	0.2061127	12.11925	12.81828
LTiT	17	12.13193	0.4078455	11.54933	12.97108
LAg	17	21.87729	0.2676332	21.35097	22.34202
LIm	17	21.94932	0.3433706	21.14695	22.35158
LEx	17	21.75488	0.3414507	20.96245	22.17355
Linen	17	2.836032	0.0895561	2.683891	3.051971
LLl	17	1.37892	0.1638452	1.161108	1.761271
PC	17	0.7647699	0.1192823	0.5318837	.8559555
LSe	17	22.4268	0.3051897	21.73851	22.82255
LNpt	17	3.969004	0.0194173	3.951244	3.988984
LUr	17	3.807793	0.0561688	3.714767	3.87981

Source: Result of descriptive statistics

On average, the Beninese administration collects 13.421 of total tax revenue (LTa) with a minimum of 12.8536. In addition, the maximum tax revenue it collects is 14.094. As for direct revenue (LTd), the Beninese administration mobilizes on average 11.839 with a minimum of 12.853 and a maximum of 14.093. In addition, on average, the Beninese administration collects 13.093 of indirect tax revenue (LTi) with a minimum of 12.57. Also, the maximum indirect tax revenue it collects is 13.287. At the same time, on average, the Beninese administration mobilizes 13.0938 of the tax on goods and services (LTgs) with a minimum of 12.119. In addition, the maximum tax on goods and services it collects is 12.818.

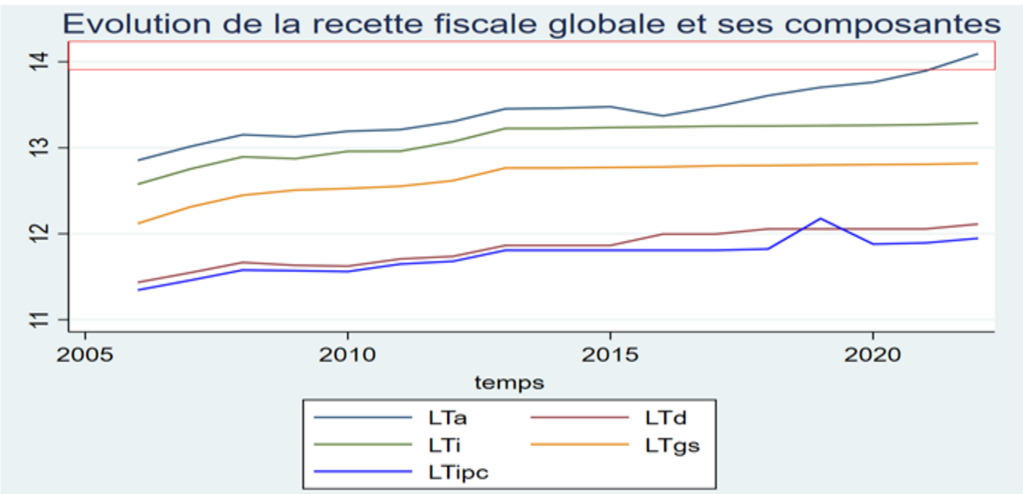


Figure 1: Evolution of overall tax revenue and its components
Source: Made by the author, UNIWIDER 2023 data

In Benin, indirect tax revenues (LTi) are more mobilized than direct revenues (LTd). This result is explained by a low rate of companies registered by the general tax directorate and the behavior of fraud, evasion, non-payment of taxes within the time limit developed by formal companies. This also justifies the low mobilization of personal income tax (Tipc) according to the graph which is the least collected. After the descriptive statistics, we carry out the preliminary tests necessary for an analysis of the panel data. Remember that we use panel data in order to have a robust result of the fiscal capacity of Benin.

3.2.2. Preliminary unit root test in panel data

To avoid the problems of structural breaks and low capacity of small sample tests, panel data are generally used. For this purpose, the unit root test is used and relevant to ensure whether the data being tested are non-stationary series or stationary series. The literature proposes several generations of the unit root test, among which, in this study, we use the first-generation test of Levin and Lin and Chu. This test is based on the assumption of inter-individual independence and is adapted to our sample, which includes sub-Saharan African countries that do not all have the same characteristics.

Table 2: Unit root test

	Root test unitary				
Variables	Statistics	P-value	Variables	Statistics	P-value
Your	-7.84***	0.0000	LLi	-8.888***	0.0001
Td	-8.1915***	0.0000	LUr	-9.7437***	0.0000
Tipc	-7.7504***	0.0000	Linen	-7.8050***	0.0005
Tin	-7.7890***	0.0000	LFa	-9.6196***	0.0000
Tgs	-9.2360***	0.0000	LCo	-8.6196***	0.0000
Tit	-6.1550***	0.0001	THE	-8.9904***	0.0001
LPh	-93235***	0.0000	PC	-7.9798***	0.0000
LAg	-7.9704***	0.0000	PCP	-8.5488***	0.0000
Lim	-9.5937***	0.0000	PCN	-4.2240***	0.0000
LEx	-8.4021***	0.0000	LHl	-8.7220***	0.0000
NpT	-7.4312**	0.0113	LDm	-8.5460***	0.0113

LLC test result : Note: *** significant at the 1% level; ** significant at the 5% level

The results of the Levin and Lin and Chu test show that all variables have a p-value lower than the 1% threshold. Therefore, we cannot reject the hypothesis H1 of Panel stationary against the hypothesis Ho of Panel containing a unit root.

3.2.3. Interpretation and choice of the specific model

Following the unit root tests under the hypothesis of interdependence of individuals (first generation test) carried out on the variables of our study; it appears that all the variables of equation (6) are stationary in level, this is therefore the source of the specification tests.

Table 3: Summary of regressions on specific models and choice of empirical model

	Hypotheses	*Probability*	*Decision*
Fisher test	*H0: Absence of effect H1: Presence of fixed effect*	*Prob > F = 0.0000 Prob > F = 0.0000*	*Fixed effect pres,*
Breusch -Pagan Test	*H0: Absence of effect H1: Presence of random effect*	*Prob > F = 0.0000 P, > chi2 = 0.0000*	*Pres, of random eff,*
Hausman test	*H0: Pres,of random effect H1: Pres,of fixed effect*	*P,>chi2=0.0397 P> at the 1% threshold*	*Random effect model*

author's result

3.2.4. Variance covariance matrix

The variance covariance matrix is square and carries the variances and covariances of several variables, It allows to quantify the relationship existence between the variables taken two by two and to know the meaning of correlation.

Table 4: Variance covariance matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LTa	1.000														
LPh	-0.181	1.000													
LAg	0.411	-0.072	1.000												
LIm	0.2433	0.524	0.6362	1.000											
LEx	0.2520	0.599	0.5748	0.9625	1.000										
LFa	-0.066	0.196	-0.196	0.0659	0.1218	1.000									
LIn	-0.023	0.4725	-0.200	0.3365	0.4310	0.516	1.000								
LLl	-0.016	0.2915	0.2278	0.3979	0.4007	0.057	0.138	1.000							
Hl	0.275	0.1251	0.5414	0.3375	0.3077	-0.365	-0.169	0.1384	1.000						
LDm	0.0476	0.0578	-0.070	-0.066	-0.109	-0.150	-0.106	-0.105	0.1958	1.000					
Pc	0.0990	0.1189	0.0718	0.1932	0.2245	0.1537	0.1012	-0.055	-0.241	-0.091	1.0000				
LNpt	0.0074	-0.296	-0.075	-0.376	-0.326	0.0518	0.0749	-0.207	-0.057	0.0265	-0.068	1.0000			
LUr	0.0281	0.5380	-0.041	0.3022	0.4160	-0.062	0.2673	0.1912	0.146	-0.097	0.1736	-0.018	1.000		
LSe	0.2595	0.5051	0.7203	0.9363	0.9160	0.0539	0.2028	0.3365	0.4562	-0.066	0.1725	-0.387	0.275	1.000	
LCo	-0.154	0.296	-0.489	0.1336	0.1610	0.2243	0.5151	0.1399	-0.396	0.0296	0.1088	-0.043	0.267	-0.156	1.0000

Multicollinearity test result

The results of the correction test between the variables taken two by two, show that the variables suffer from a multicollinearity bias, Because according to (Kennedy, 2008), the results of the correlation test providing significance coefficients that are greater than 0,80 or less than - 0,8 revealed multicollinearity. To solve different problems, the first step of the model (Kumbhakar et al. 2014) is estimated by Generalized Least Squares.

Table 5: Estimation result of the first stage

Dep.Variables	Tax revenue : effect of fraud						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Fraud	-1.15213	-1.114689*	-1.109863	-1.077213	-1.114689*	-1.109863	-1.11114*
	(-1.52)	(-1.74)	(-1.74)	(-1.52)	(-1.74)	(-1.74)	(-1.72)
LPh	0.57018***	0.57767***	0.583567***	0.582611***	0.517179***	0.509238***	0.509098***
	(2.62)	(2.64)	(2.66)	(2.65)	(2.53)	(2.59)	(2.13)
LAg	0.89878***	0.897984***	0.897412***	0.893483***	0.6832388***	0.6715908***	0.672529***
	(5.75)	(5.72)	(5.70)	(5.66)	(4.63)	(4.53)	(4.27)
LIm	-.247478	-.255055	-0.265783	-.284032	-0.1847903	-0.1970334	-0.1961095
	(-1.30)	(-1.32)	(-1.37)	(-1.46)	(-1.05)	(-1.13)	(-1.06)
LEx	-.2460***	-.2469***	-0.2415***	-0.20138***	-0.11352***	-0.1273***	-0.1272***
	(-1.32)	(-1.32)	(-1.29)	(-1.07)	(-0.66)	(0.74)	(-074)
Lind	0.1213762	0.127588	0.1300731	0.1339606	-0.0181163	-0.0191057	-0.0193419
	(0.59)	(0.61)	(0.63)	(0.65)	(0.10)	(-0.10)	(-0.10)
LLl	0.138133	0.1465233	0.1817072	0.281302	0.402205	0.383606	0.3830048
	(0.45)	(0.47)	(0.58)	(0.88)	(1.39)	(1.33)	(1.33)
Hl	.155957***	0.1559615***	0.160816***	0.1615289***	0.2263505***	0.2091374***	0.209185***
	(7.81)	(7.81)	(7.73)	(7.78)	(11.37)	(9.47)	(8.96)
LFa		-.040970	-.0359	-0.0078093	-0.0841064	-0.0773271	-0.076742
		(-0.26)	(-0.18)	(-0.04)	(-0.47)	(-0.43)	(-0.43)
PC			0.43200	0.3433585	0.6697131	0.6089879	0.6093117
			(0.82)	(0.65)	(1.40)	(1.27)	(1.27)
LDm			0.0505432	0.0573995	.1243314	0.1004445	0.1005889
			(0.40)	(0.46)	(1.09)	(0.88)	(0.88)
LNpt					1.882919***	1.914014*	1.912881
					(9.90)	(10.08)	(10.01)
LUr						0.9123464*	0.910461*
						(1.83)	(1.81)
LSe							-0.00203***
							(-0.01)
_cons	-8.7218***	-8.50665**	-9.07964***	-8.95540***	-18.13823***	-19.65954***	-19.6470***
	(-3.54)	(-3.25)	(-3.33)	(-3.28)	(-6.76)	(-6.99)	(-6.23)
Country	28	28	28	28	28	28	28
Number of course	476	476	476	476	476	476	476

Result of our estimates, * significance at 10%, ** significance at 5%, *** significance at 1%

According to the results of the first estimation, GDP per capita, agricultural value added, industrial value added, and healthcare level are statistically significant and positively affect fiscal capacity. Contrary to our results, the results of (Doghmi 2018) showed that agricultural value added negatively affects fiscal capacity. An increase of one percentage point in GDP per capita, agricultural value added, industrial value added, and healthcare level will increase fiscal capacity by 0.57; 0.12; 0.89; and 0.15 percentage points, respectively.

On the other hand, corruption, here approximated by tax evasion, negatively affects fiscal capacity. This relationship is weakly significant in the context of our study, Similarly, exports and imports negatively affect fiscal potential, but they are not statistically significant. This result contradicts the theory. The level of population well-being and the level of demographics have a positive but not statistically significant effect.

We test the robustness of our estimates with the method of adding variables, from the initial model (1) to model (7), the sign the significance of the variables remained rigid, which attests to the robustness of our estimates. As a result of the robustness tested in model (5), it appears that the positive aspect corruption has a positive and significant effect on the fiscal capacity, In model (7), the added value of the service sector positively and significantly affects the fiscal potential.

We present the results of the second and third stage estimations allowing us to determine the tax gaps of the different taxes which justifies the objective of our study.

Table 6: Result of the second stage estimations

variables dependents	Random ε_{it} shocks						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
usigma							
constant	4.0266***	3.9593***	3.9817***	3.98153***	4.02077***	4.5629***	4.499***
	(1.9006)	(1.8533)	(1.8791)	(1.8789)	(1.6654)	(1.9642)	(1.8674)
vsigmas							
constant	0.3647***	0.36345***	0.35952***	0.35952***	0.31467***	0.3045***	0.3030 **
	(0.0244)	(0.0243)	(0.0240)	(0.0240)	(0.0210)	(0.02039)	(0.0202)
Log likelihood	-509.394	-508.642	-506.268	-506.268	-476.577	-470.712	-469.970
σ_u	1.598	1.590	1.587	1.706	2.414	1.798	1.817
σ_v	1.362	2.224	2.225	2.218	2.395	2.426	2.425
$\lambda = {}^{\sigma_u}/_{\sigma_u}$	0.73	0.715	0.7131	0.7694	1.008	0.7409	0.7493
Country	28	28	28	28	28	28	28
Number observation	476	476	476	476	476	476	476

Estimation results; *** significance at the 1% threshold
Standard errors are in parentheses

Table 7: Result of the third stage estimates

variables dependents	Effects individuals α_i						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
usigma							
constant	7.34615***	7.36487***	7.2840***	7.1323***	8.8830***	11.0599***	11.0439***
	(3.3357)	(3.3433)	(3.2734)	(3.1599)	(4.2325)	(6.3267)	(6.3130)
vsigmas							
constant	0.51139***	0.51122 ***	0.51048***	0.5085***	0.40958***	0.4052**	0.4052***
	(0.03897)	(.034180)	(.03413)	(.03399)	(.0274)	(.0271)	(.0271)
Log likelihood	-585.9874	-585.9576	-585.659	-584.752	-538.115	-535.684	-535.6835
σ_η	0.1812	2.239	2.238	2.2283	2.2284	2.4809	2.4787
σ_μ	2.287	2.292	2.290	2.2783	2.2783	2.5223	2.54927
$\lambda = {}^{\sigma_\eta}/_{\sigma_\mu}$	0.7923	0.9768	0.9770	0.978	0.978	0.984	0.972
Country	28	28	28	28	28	28	28
Number observation	476	476	476	476	476	476	476

Estimation results; *** significance at the 1% threshold
Standard errors are in parentheses

The estimates of the first and second stages allowed us to determine the capacity for mobilizing tax revenues in Benin. This capacity is called the tax potential

3.2.5. Tax revenue and tax potential

Table 8: Tax revenue and tax potential

Year	Recipe	Potential
2006	12.853639	13.10085
2007	13.014815	13.29635
2008	13.151438	13.61359
2009	13.127316	13.57845
2010	13.192357	13.44159
2011	13.211406	13.60387
2012	13.304525	13.70195
2013	13.453105	13.79253
2014	13.460548	13.89530
2015	13.477377	13.61910
2016	13.370941	13.72203
2017	13.476956	13.80743
2018	13.606517	13.95545
2019	13.702678	13.87317
2020	13.761899	14.05258
2021	13.894599	14.25528
2022	14.093673	14.10574

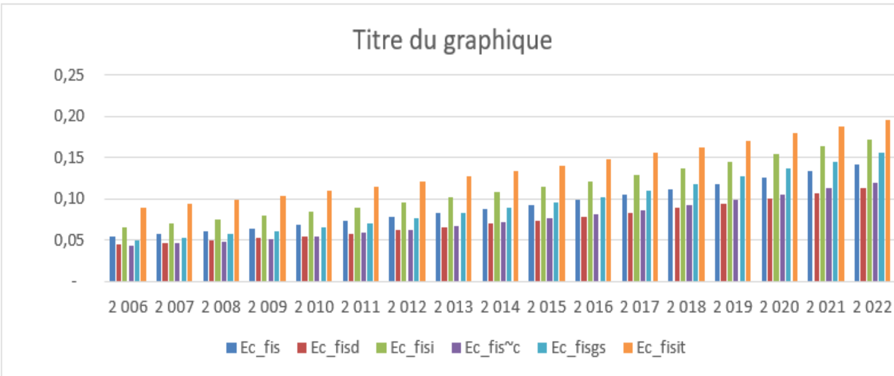
Result of the estimates

Benin's tax potential in 2022 is 14.09% (tax revenue to GDP ratio) while the tax potential for the year 2021 is 14.25% (tax revenue to GDP ratio). Our results are not identical to the results of the work of the (IMF 2022) . Taking into account the health index variable and the perception of corruption and also the use of the model of (Kumbhakar et al,, 2014) , made it possible to estimate the best potential. Thus while the work of the (IMF 2022) finds a tax potential of 13.6% (tax revenue to GDP ratio), our estimates show that Benin could have mobilized a tax revenue to GDP ratio of 14.25% in 2021.

Our research hypothesis, which states that Benin's tax potential is higher than the current tax revenue-to-GDP ratio, is validated. To this end, we can represent the tax gaps generated by this difference.

3.2.6 Presentation and interpretation of tax differences

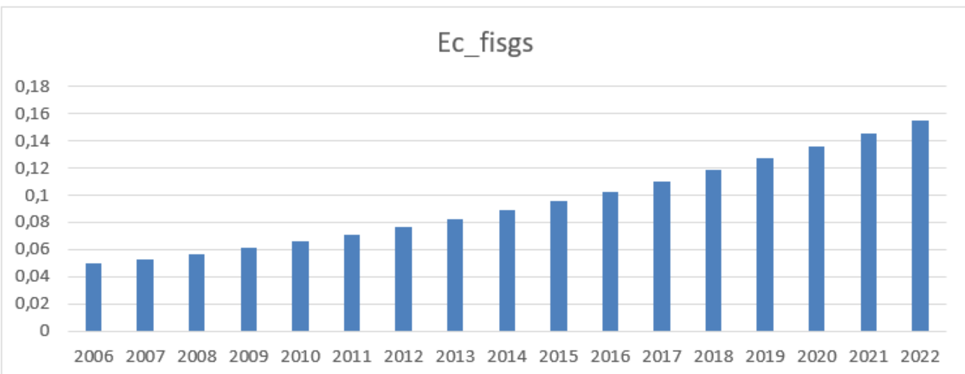
Fig. 2 : Graphical representation of tax gaps



Result of our estimates

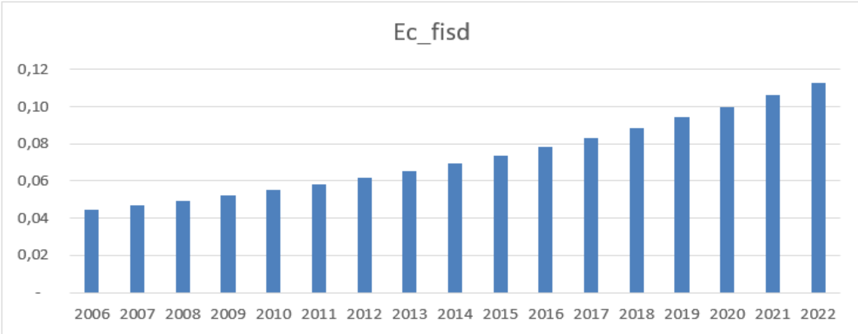
The results show that Benin's tax gaps in 2022 are 1.4%, 1.1%, 1.7%, 1.2%, 1.6%, 1.2%, respectively for overall revenue (Ec_fis), direct revenue (EC_fisd), indirect revenue (Ec_fisi), goods and service tax (Ec_fisgs), personal income tax (Ec_fisit). These tax gaps are linked to corruption, tax evasion and fraud, and tax incivility developed by formal businesses. The tax gaps for individual taxes vary from year to year, as shown in the following graphs.

Fig.3: Evolution of tax gaps in the Goods and Services tax



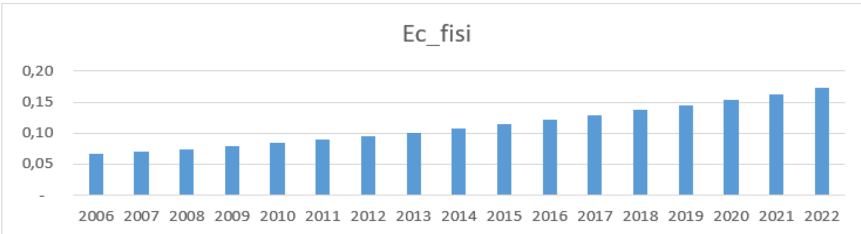
Source : Result of our estimates

Fig.4: Evolution of tax gaps in direct tax revenue



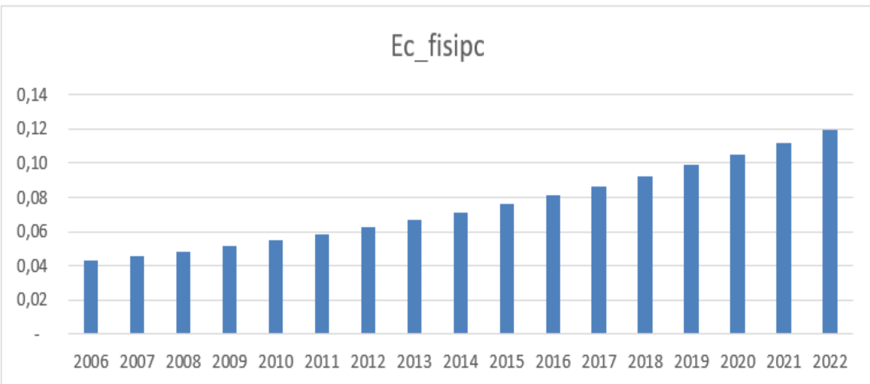
Source : Result of our estimates

Fig. 5: Evolution of tax gaps in indirect tax revenue



Source : Result of our estimates

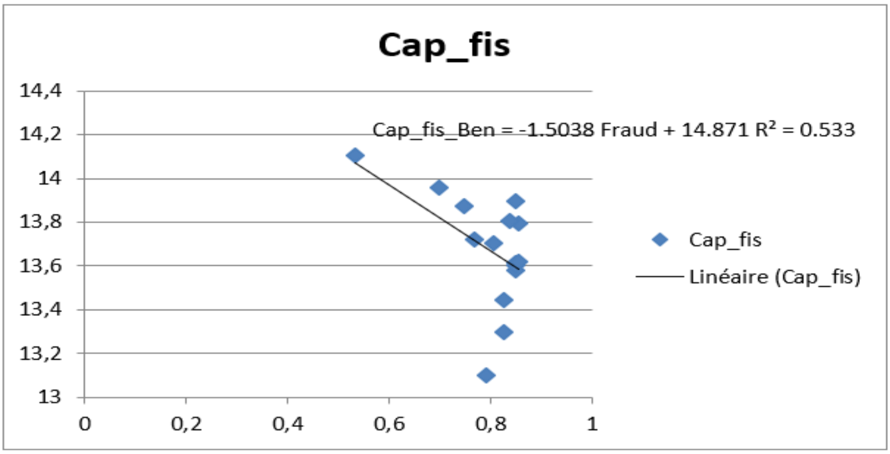
Fig. 6: Evolution of tax gaps in personal income tax



Source : Result of our estimates

The graphs show a growing tax gap for the individual taxes assessed in this study, Benin's tax administration must work to reverse the trend in tax gaps to the point where they are essentially zero in the coming decades. Aafter estimating tax potential, we represent the negative relationship between tax capacity and tax evasion in Benin with the following graph.

Fig. 7: Direction of correlation between tax evasion and tax capacity



Result of our estimates

4. Conclusion

The idea for the individual not to contribute to the mobilization of funds for the establishment of public goods comes from various attitudes. Among which, we capture that of the behavior of tax evasion. The objective of determining the role of tax evasion in the capacity of mobilizing tax revenue in Benin, leads us to use the extension of the stochastic frontier model (parametric model) of the latest work of (Kumbhakar et al., 2014). Concerning studies on fiscal capacity, mainly those that have focused on the effect of corruption have not taken into account the level of health of the populations in the structural variables. Taking this variable into account, we determine the fiscal capacity of Benin, while evaluating the place of tax evasion in the mobilization of tax revenues. The results of the GCM and the maximum likelihood show that the fiscal mobilization capacity of Benin is 14.25% in 2021 and that tax evasion has a negative and significant effect on tax revenues.

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