Potential of Tax Resources in WAEMU Member States: estimating the VAT Gap and its determinants

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Abstract This paper focused on the estimates of the VAT gap in WAEMU Member States using the "top-down approach" and conducted econometric analysis to assist in the understanding of the nature and causes of the VAT gap, and to identify country-specific characteristics that appear related to different levels of the VAT gap. The VAT gap is the difference between the theoretical VAT liability and VAT actually collected. It is often expressed in relative terms as a ratio of a theoretical VAT liability. Panel Corrected Standard Errors, robust OLS regression and instrumental variable methods have been used to identify the factors which explain the different levels of VAT gap. Two variables were found to have the strongest relationship with the level of the VAT gap. The VAT gap share increases with the final consumption (% of GDP) of households and non-profit organizations. Second, if the VAT burden, characterized by the ratio theoretical VAT liability to GDP is included as a candidate explanatory variable, then we find a significantly positive connection with the VAT gap. But, we have identified the risk that this estimated correlation could be biased by the measurement errors in the estimation of the theoretical liability. After taking into account this risk through instrumental variable regression, we conclude on a negative and significant relationship with the VAT gap. However, it is up to policymakers to account for not only the VAT rates but also the structure of the tax base with a view to a more efficient VAT system.

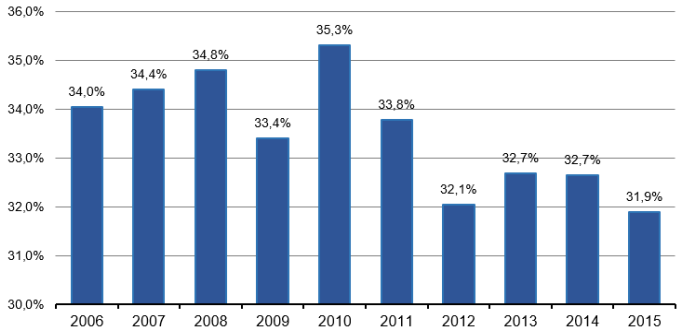
Keywords: VAT Gap, VAT evasion, Theoretical VAT liability, VAT Compliance

1 Introduction

Value Added Tax (VAT) plays a substantial role in mobilizing tax resources. For example, in WAEMU Member States, excluding Guinea Bissau, the share of VAT in total tax revenues amounted to an average of 35.6% and approximately 6% of GDP in 2015. According to the International Monetary Fund (IMF), VAT has established itself as a robust source of revenue, appearing as a relatively efficient instrument. It

usually accounts for about a quarter of tax revenue and it turns out that VAT has long been adopted in high-income countries. Others such as Keen and Lockwood (2010) have affirmed that, all other things being equal, countries that introduce VAT generally raise more revenue. Figure1 shows that in WAEMU countries, VAT accounts for more than a one-third of tax revenues.

Fig. 1: Share of VAT in Total Tax Revenue in WAEMU



Source: CBWAS and BDSM-UEMOA, own representation of data

Theoretically, the performance of a VAT system is linked to the effectiveness of tax administration enforcement and control measures by the tax administration, and the ability of the authorities to define an optimal tax policy. Otherwise, the VAT gap rises further. The reasons can be varied. First, failures in tax policy may lead, in particular to the bankruptcy of certain economic operators, to tax evasion and incomplete declarations. Similarly, when a tax administration does not have the necessary capacities, particularly, material, human, financial and in terms of organization and anticipation, we often witness negligence in the collection of taxes, mistakes made in determining the tax base, tax evasion and inappropriate tax deductions. These factors create a shortfall in VAT revenues, that the VAT gap measures.

The VAT gap is the overall difference between the expected VAT revenue and the amount actually collected (European Commission, 2017). It's a key indicator that allows measures to be taken to improving tax revenues and combating tax evasion as well as non-compliance VAT. It provides guidance to better target tax policy measures, including the determination or adjustment of the tax base and the VAT threshold, in order to reconsider certain principles, such as the application of a single rate (Geourjon et al., 2016). It also makes it possible to identify the faults related to the tax administration, in particular the evaluation and collection of VAT. In addition, the VAT gap is of great importance in the assessment of the informal economy and citizens' fiscal responsibility (Canıkalp et al., 2016).

Currently, the big challenge for governments in developing countries, particularly those in WAEMU, is to find ways to durably reduce the public debt ratio, against a backdrop of growing needs for financing the economy, especially in terms of invest-

ment in economic infrastructure and social basic services. Thus, beyond the financial strategies oriented towards the public-private partnership and the rationalization of the government expenditure, a greater mobilization of public resources becomes unavoidable. In fact, the government is moving towards increasing tax revenues. This one can not be done, with economic efficiency, without a serious analysis of the shortfall of VAT, since VAT is the primary source of tax revenue for all of these countries. In this respect, quantifying and analyzing the VAT gap could potentially contribute to reducing it through the reduction of tax evasion and tax fraud as well as unpaid VAT credits due to insolvency and costs related to corporate tax discipline or VAT compliance.

The purpose of this article is to demonstrate that WAEMU Member States have sufficient leeway to mobilize domestic tax resources and provide some pointers on which they can rely to improve the efficiency of their tax revenues in the future. Specifically, the aim is to estimate the VAT gap of six (06) WAEMU Member States over the period 2006 to 2015 and then to identify the common determinant to theses countries with respect to various factors related to the economic, social and tax system.

In the first part of this paper, we review the different methods for estimating the VAT gap and previous econometric studies that determine the factors influencing the VAT gap or the VAT performance measured by other indicators than the VAT gap. In the second part, explanatory variables selected are presented in a table with the relevant sources of data. We also presented the estimates of the VAT gap, and the econometric approach adopted in this article. In the third section, we present and analyze the results of each regression, and compare then with previous literature. And the last section concludes.

2 Review of Literature

Three main approaches are used to estimate the VAT gap in the literature. One of them is grounded in econometric techniques, such as stochastic frontier analysis and time series analysis. However, the results are quite sensitive to the choice of determinants and assumptions used in the model. In addition, the results may be difficult to interpret from the point of view of VAT compliance. The use of this approach is therefore not recommended for the studies, whose main objective is to estimate the VAT gap, although it may still be useful for more general studies on the effectiveness of the VAT system.

The other two methods are identified in Reckon (2009) and are based on macroeconomic or individual companies data. The first one is so-called *bottom-up* approach basing on basic statistical techniques, such as random sampling of taxpayers for the control or analysis of the behaviors and risks of non-compliance with VAT obligations. This approach offers valuable information on the specific behaviors of taxpayers. As such, it can be used to test and interpret estimates of the top-down approach. Nonetheless, this method is not generally used by researchers because they can not

obtain relevant information. The second one is so-called *top-down* approach based macroeconomic data from the national accounts to assess the amount of the theoretical VAT liability for the whole economy and compare it to the actual VAT receipts collected by the tax authorities. The theoretical VAT liability include the VAT applied to the final consumption of households and non-profit organizations, which is the most important part thereof, as well as the VAT applied to intermediate consumption and gross fixed capital formation of firms and institutions that do not have a full right to deduct VAT. However, even if the top-down approach is supposed to provide reasonable results at the macroeconomic level, it does not explain the behavior of non-compliance VAT by companies.

A large series of studies have investigated the determinants of VAT revenue losses. Some of them focused on other indicators than the VAT gap. This is the case, for example, of Christie and Holzner (2006) that wondering about the causes of tax evasion, did not refer to similar studies mentioning that, in general, there is no econometric modeling of tax evasion. Smith and Keen (2007) confirmed this point of view. They have equated the lack of empirical work on the determinants of the VAT gap with the difficulty of measuring VAT noncompliance.

Recently many studies have attempted to fill this gap. But, the majority of these studies have focused on European countries, and quite often on EU Member States. For instance, Barbone et al. (2012) have focused on the relationship between VAT administration costs and VAT evasion and have found a significant correlation between the tax gap and the administrative costs of VAT compliance in the EU Member States. Likewise, Agha and Haughton (1996) constructs and analyses the VAT compliance rates in a sample of 17 OECD countries, using Ordinary Least Squares "further OLS" cross-country regression. The results suggest that a high VAT rate and the number of VAT rates reduce the level of VAT compliance. In addition, VAT compliance is even greater in small countries in terms of population and in countries where VAT has been introduced for a long time. Christie and Holzner (2006) examined data from a panel of 29 European countries over the period 2000-2003, using a fixed effects regression. The conclusions of their paper are as follows: a high weighted average VAT rate has a negative impact on VAT compliance, greater legal and judicial efficiency is favorable to VAT compliance, the countries where citizens want more power for local authorities (used as a proxy for tax morale) have a low rate of VAT compliance, and countries where travel revenues account for a large share of GDP are more respectful of VAT compliance. In addition, the authors found no statistically significant relationship between the rate of VAT compliance and other determinants such as corruption index, income inequality, confidence in the health care system, level of poverty, GDP per capita and the complexity of the VAT system.

The study of Reckon (2009) is also widely referenced in the literature. Reckon (2009) quantifies and performs an econometric analysis of the VAT gap in 25 EU Member States, in order to identify the intrinsic characteristics of each country that determine the different levels of VAT gap. Econometric estimates have identified the level of corruption in countries as having the most significant link with the VAT gap, and have shown that a low level of corruption tends to reduce the VAT gap share.

Similarly, the VAT burden measured by the theoretical VAT liability divided GDP is positively correlated with the VAT gap. On the other hand, an increase in the standard rate of VAT, which also expresses the VAT burden, reduces the VAT gap. They also found that countries with large populations have high VAT gap share. Next, the authors suspected a bias in the estimated relationships due to the possibility of measurement errors in the estimation of the theoretical VAT liability. The authors use the instrumental variables method to account for this bias, using the standard VAT rate and the share of final government consumption in GDP as instruments of the VAT burden. But no significant link was found between the VAT gap share and the VAT burden.

In addition, a series of studies has also been published by the Center for Social and Economic Research (CASE) for quantifying and analysing the VAT Gap in the EU Member States. Among them we can cite the one of Barbone et al. (2013) using data from CASE previous calculation of the VAT gap for 27 EU countries over the period 2000 to 2011. This report proceeds with a fixed effects regression and analyzes the influence of the business cycle and the VAT rate. A number of control variables were also used. There are, for example, the Corruption Perception Index (further "CPI"), that could influence the tax morale and tax enforcement, and GDP per capita which expresses the differences in the level of development between countries, which could impact the VAT compliance. Lather, Poniatowski et al. (2018) performing the CASE VAT gap analysis using data from its own VAT gap estimates for 28 EU Member States over the period 2012 to 2016. They authors found a significant and non-linear relationship between the VAT gap and the level of population, meaning that the marginal impact is positive i.e. in favour of a higher VAT gap with a minimum level of population, but the impact remains null on the interval between the minimum and maximum levels of population, and becomes negative beyond the maximum level.

Furthermore, Zídková et al. (2014) conducted an econometric analysis of potential factors influencing the VAT gap in 24 EU Member States. This study was carried out over two selected years, in particular 2002 and 2006. The results identified, in the surveyed countries examined, two factors common for both studied years, which affected the VAT gap that are the final consumption of households and non-profit organizations that grows with VAT gap, and the share of VAT in GDP that negatively impacts the VAT gap. Other exogenous variables were also highlighted to explain the level of the VAT gap including the share of intra-community trade, the number of VAT rates, GDP per capita, the final consumption of restaurant and hotels services which are all negatively correlated to the VAT gap in contrast to the share of the shadow economy which has a positive impact. In Zídková and Pavel (2016) including 25 EU Member States over the period 2000-2011, the results reveal that the VAT gap grows when the standard VAT rate and the difference between the standard and reduced VAT rate increase, and that the share of household consumption in GDP increases with the VAT gap while the share of VAT receipts in GDP is associated with a deteriorating effect.

Some other studies have focused on developing emerging countries. The results depend on the explanatory factors used to explain the VAT revenue losses. Kas-

nauskienė and Krimisieraitė (2015) conclude that when the marginal propensity to save i.e. the share of disposable income devoted to saving increases, it is to the detriment of consumption, and this accentuates the VAT gap in the short-run. In the long run, the relationship between the two components is not significant, as business take into account changes in the preferences of households savings in the short-term, but in the long run they adapt and seek alternatives than avoiding tax obligations. Authors also used other explanatory variables such as inflation, cash and cash equivalents i.e. money, and gross fixe capital formation. Inflation is defined as the continuous and widespread rise in price levels. That being so, it is therefore not without significant effects either on the VAT compliance or the VAT gap. First of all, in the short term, inflation causes an increase in the demand for goods and services in anticipation of a rise in prices by consumers. This increase in demand, however, leads to an increase in VAT receipts and therefore reduces the VAT gap. But in the longer run, inflation reduces the purchasing power of assets held by households. Therefore, to keep the same level of cash, households are forced to reduce their consumption to save more. As a result, VAT receipts fall and the VAT gap widens further (Kasnauskienė and Krimisieraitė, 2015). On the other hand, producers and consumers alike, in trying to escape the negative effects of inflation, may be pushing for alternatives such as illegal trade in goods and/or services for relatively low prices.

According to Tedds and Giles (2002), the development of the public sector associated with increased government spending or economic regulation is often one of the incentives to engage in informal or illegal activities. From there, the variable "final consumption expenditure of general government" is used as a determinant of the VAT gap. Similarly, the perception of public sector performance or the perception of how government revenue is spent is also likely to explain compliance with tax obligations or not. Godin et al. (2015) have shown that the quality of government (which reflects the degree of independence of the tax administration from political pressures as well as the quality of policy formulation and implementation) has impact on the efficiency of the tax system. We take into account this potential impact through a government effectiveness variable "Government Effectivness" (Poniatowski et al., 2018). It can be noted that when a country's economy is growing, companies must provide sufficient supply of goods and services to meet demand, sustain growth and compete in the market. This increase in supply requires increased investment, that can increase income and reduce incentives for noncompliance of VAT (Kasnauskienė and Krimisieraitė, 2015). In fact, we will try to measure this impact through the variable "Gross Fixed Capital Formation" expressed as a percentage of GDP.

The literature also reveals that some studies have instead explored possible explanatory factors for some other measures of VAT revenue productivity. Aizenman and Jinjarak (2005) quantified and analyzed the C-efficiency ratio, defined as the ratio of VAT revenues to overall consumption (i.e. final consumption of households, non-profit organizations serving households, and the government) divided by the standard rate of VAT. This ratio depends both on VAT compliance and the "purity"of the VAT system. However, in the non-existence of VAT evasion, a widespread application of the standard VAT rate without recourse to exemptions that compromise

the VAT neutrality would lead to a "perfect" C-ratio equal to 100%. The authors showed that the C-ratio decreases with the share of the agricultural sector in GDP. On the other hand, other variables such as the degree of openness of the economy, the stability of the political system including"the durability of political regime and the regulation of political participation," and GDP per capita have been found to have positive relationship with the C-ratio.

Another indicator has been used in Ebrill et al. (2001) that is so-named the VAT Revenue Ratio (VRR), defined as VAT revenues divided by the potential tax base, and multiplied by the standard VAT rate. The difference with the C-efficiency ratio calculated by Aizenman and Jinjarak (2005) is that the potential tax base is the final consumption (as in the C-efficiency ratio) net of VAT revenues, because the consumption amounts registered in the national accounts are declared on the basis of prices including VAT. The results showed that the VAT revenues ratio increases as the share in international trade increases. They also show that the higher the difference between the VAT rates applied in the country, the more the VRR increases. A positive relationship has also been identified between the VRR and the time for which VAT has been introduced in the country.

In view of the literature, there are no previous studies focusing on an econometric analysis of the potential determinants of the VAT gap in the West African Economic and Monetary Union (WAEMU) Member States. This article aims to fill this gap by highlighting the factors identified in the review and discuss their impact on the VAT gap in case of WAEMU Member States.

3 Methods and data

3.1 Theoretical Background

Model for estimating the theoretical VAT liability

The total amount of the theoretical VAT liability is the sum of the VAT amount paid by the final consumers and paid by producers. Final consumers pay VAT on purchases of taxable goods and services, while producers pay VAT on inputs when producing non-taxable or exempt goods and services, (see Box 1, Pg. 8). The value-added model for theoretical VAT liability can therefore be written as follows:

$$TVL = \sum_{b=1}^{n} (TVLc_b + TVLp_b) \tag{1}$$

where b denotes a particular industry, and n is the total number of industries. TVL is the total amount of theoretical VAT liability. $TVLc_b$ represents the amount of theoretical VAT liability paid by final consumers c on purchases of taxable goods and services of the industry b. $TVLp_b$ is the amount of theoretical VAT liability paid by producers in industry b on inputs when they produce exempt goods and services.

The amount of theoretical VAT liability paid by final consumers c on purchases of taxable goods and services of the industry b is determined by:

$$TVLc_b = \sum_{o=1}^{q} Cf_o^b * \tau_o * \Theta_b \tag{2}$$

where Cf_o^b the amount of final consumption expenditure of goods or services o of industry b and τ_o[1] is the VAT rate that applies to goods or services o and q is the number of goods and services o, and Θ_b[2] is the share of the contribution of entities subject to VAT registration in GDP.

The amount of theoretical VAT liability paid by producers in industry b on inputs when producing exempt goods and services is determined by:

$$TVLp_b = \sum_{o=1}^{q} (IC_o^b + GFCF_o^b) * \tau_o * (1 - e^b) * r_b \tag{3}$$

where IC is the Intermediate Consumption. $GFCF$ is the Gross Fixed Capital Formation. r_b[3] is the proportion of value-added in industry b produced by entities registered for VAT, and e^b represents the proportion of non-exempt production.

Box 1: *Who pays VAT and in which cases ?*
VAT is a real tax applied to all commercial transactions, at each step of the selling of goods or services. It is an indirect tax paid by the consumer and collected by registered firms. They can collect VAT and thus deduct the VAT paid on their purchases of goods or services. Finally, the registered firm pays the amount of VAT on its margin to the treasury, hence the name *Value Added Tax*. Then, the total amount of VAT collected by the tax authorities on the chain of sales or services is equal to the VAT paid by the final consumer to the last seller or service provider. The *registered firm for VAT* is any person who independently carries out an economic activity on a regular basis such as the supply of goods or services. It should not be confused with the *taxpayer* who is under liability to pay VAT : you thereby understand that a taxpayer is always subject to VAT but that the reverse is not the case. However, being registered for VAT does not necessarily mean that you will have to charge VAT on your invoices and deduct the VAT paid. There are indeed exemptions and specific VAT regimes, for example, exports generally subject to zero rate. Any transaction that therefore does not fall within the scope of VAT is not subject to VAT.

[1] This is the first tax policy variable in the model. In reference policies, the single VAT rate is applied. Over the period of our study, this rate is 18.0% for all WAEMU Member States, except Niger which applies a rate of 19.0% and Guinea Bissau which does not apply VAT.

[2] The share of the contribution of entities subject to VAT registration in GDP (Θ_b), is calculated by the proxy $(1-\lambda_b)$, where λ denotes the share of the informal sector's or industry's contribution of GDP with data available by sector and by industry at national statistical institutes. Admittedly, this proxy does not take into account the existence of a VAT registration threshold set for example, at FCAF 30.0 or 50.0 million for goods, and 15.0 and 25.0 million for services, of annual turnover in the country's Financial Acts. However, this bias should be mitigated by the existence in the informal sector of some firms whose turnover exceeds the registration threshold for VAT.

[3] This is the second tax policy variable, to account for the formal and the existence of a VAT registration threshold for formal firms. The tax authority may decide to widen or narrow the base of entities subject to VAT. In the reference policy, all entities trading in goods and services are subject to VAT, which leads to $r^b = 100.0\%$ for each industry. As regards data related to tax policy and administration, notably the vector of VAT rates per item (τ) and the proportion of deductible VAT on inputs subject to the deduction system (θ) they come from the General Tax Code of WAEMU countries, supplemented and modified by the Finance acts over the period $2006-2015$.

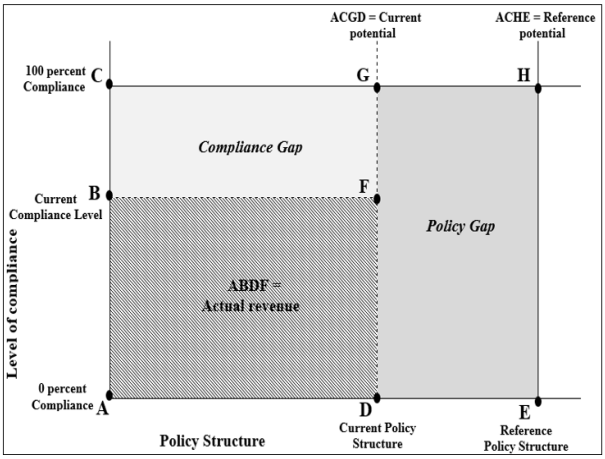
Measuring and reporting the gap

The VAT gap is determined by subtracting from the theoretical VAT liability, the amount of actual VAT collected, available in the national accounts data. Specifically, the determination of the VAT gap involves subtracting the amount of VAT receipts, determined on the accrued collections basis, from the amount of the theoretical VAT liability, estimated using the reference policy framework. Then, the VAT gap would be expressed as:

$$VATGap = \frac{TheoreticalVATLiability,reference policy framework - VAT receipts,accrued collections}{TheoreticalVATLiability,reference policy framework}$$

In our econometric model, this variable represents the dependant variable and is called VAT gap share meaning that the VAT gap which is the difference between the theoretical VAT liability and VAT actually collected, is expressed as a share of the theoretical VAT liability. But generally, the VAT gap could be expressed in absolute or relative terms as a ratio of the theoretical VAT liability or GDP. The following Figure shows our model for estimating the VAT gap and its two components.

Fig. 2: Illustration of the components of the Tax Gap



Source: Adapted from Hutton (2017)

With regard to the reference policy framework, we provide an overview of the evolution of the scope of VAT application in the WAEMU, guided by the Union's VAT directives, and the specific legislation of member States as set out in their general tax codes or finance acts.

The VAT legislations of the Member States are harmonized by two main directives, in particular directive n^{o}02/98 and directive n^{o}02/2009. The first one defines the scope of application of VAT, establishes a community list of goods and services that can be exempted, sets the VAT liability threshold for goods and for services,

frames the statutory single rate of VAT, as well as the framework for the VAT credits refund by defining the deductible activities, an optional refund threshold and the time limit for refund, and all this in order to guarantee the neutrality of VAT for subject firms. This neutrality has been reinforced by the adoption of directive n^{o}02/2009 modifying the registration thresholds for goods and services. It also authorizing a reduced rate for a limited number of products. In addition, two specific directives were also adopted: a first directive n^{o}06/2002/CM/UEMOA determining the common list of medicines, pharmaceutical products, equipment and specialized products for medical activities, and a second one, notably the directive n^{o}02/2010 harmonizing the taxation applicable to securities, including provisions relating to VAT and assimilating to exports the supply of services related to financial market operations carried out by financial intermediaries approved by the CREPMF[4], exempting them from any tax other than VAT. You will find further details in Table 1 on the evolution in VAT application in the zone and the specific dispositions implemented by each Member State.

[4] CREPMF-Regional Council for Public Savings and Financial Markets

Table 1: Historical application of VAT in the Zone and countries specificities

	VAT framework in the WAEMU	Country specificities
Tax base	The price of the goods or service, the accessories such as commission, packing, transport and insurance fees charged by the supplier to the purchaser or the contractor, as well as the amount of customs duties, excise duties and any other tax applicable to the goods or service, with the exception of VAT itself. Directive n^{o}02/98/CM/UEMOA	The VAT base remains in all Member States as mentioned in the Directive n^{o}02/98/CM/UEMOA
Scope of VAT application	Agricultural sector is excluded from the VAT scope, with the ability for Member States to submit it under the conditions and modalities they define themselves (art. 4, Directive n^{o}02/98/CM/UEMOA). Article 5 allows the exclusion of transport activities from the scope of application on a transitory basis.	For some member states, are excluded from the scope of VAT application, agricultural activities (Cote d'Ivoire, Togo, Niger and Mali) but some producers may be by option in Cote d'Ivoire: coconuts, plants and flowers, bananas and pineapples. While agricultural activities are included by option in Benin and Burkina Faso. Transport included by option in Benin (including public transport and passengers) and Cote d'Ivoire (open to people and goods transport companies of the real regime) while it is included by full right in Burkina and Togo (except maritime and air transport). The transport sector is also included in Mali and Niger. Are excluded in Senegal, telecommunications services rendered by a telecommunications operator established in Senegal on behalf of a natural or legal person licensed outside Senegal.
VAT Threshold	Turnover, all duties and taxes between 30 and 50 million FCFA for goods, and between 15 and 25 million for services, art.16, Directive n^{o}02/98/CM/UEMOA. In 2009, a new directive n^{o}02/2009/CM/UEMOA in his article 16 status on a turnover between 30 and 100 million FCFA for goods, and between 15 and 50 million for services.	Annual turnover excluding tax of 50 million FCFA (goods and services) for all member States. In 2018, Togo raised this amount to FCFA 60 million in violation of the legislation set by WAEMU defining a range of 15 and 50 million for services. See Togo LFI 2018
VAT rate	A statutory rate applicable for all transactions between 15 and 20% set by the n^{o}02/98/CM/UEMOA in Art. 29. Prior to this harmonization, rates were comprised of 10 and 20% in the member states. Togo, Burkina Faso and Cote d'Ivoire had a single rate of 18%. The other countries had more than one rate, except Senegal with a rate of 17%. Reduced rates between 5 and 10% applicable to a maximum of 10 goods and services have been authorized by the directive n^{o}02/2009/CM/UEMOA. All the goods and services concerned are included in the Community list including (i) goods: edible oils, sugar, manufactured milk, pasta, livestock and poultry feed, day-old chicks, flour of maize, millet, sorghum, rice, wheat and fonio, agricultural and computer equipment, solar energy production equipment. (ii) services: accommodation and food services provided by hotels, restaurants and similar approved organizations and services provided by the organizers of approved tourist circuits, rental and maintenance of agricultural equipment; and services related to the activities of undertakers. Article 12 of Directive n^{o}02/2010/CM/UEMOA on the harmonization of the taxation of securities in the member states exempts the supply of services related to financial market transactions by financial intermediaries approved by the CREPMF (treated as exports for VAT purposes).	The statutory rate is 18% in all member states except Niger where it is 19%, as well as Guinea Bissau which has not yet introduced VAT but uses a general sales tax of 15%. Benin and Burkina Faso have a single rate of 18%. A reduced rate of 5% exists in certain countries such as Mali on computer, solar and agricultural equipment (Art. 229 Mali LFI n^{o}2011 − 078, the products are listed in point D of sub-sec.1 of sec. 1 of chap. 1 of title 2 of the CGI 2011) and in Niger on the import or wind operations of products such as: sugar, edible oil, livestock feed, manufactured milk, flour of maize, millet, sorghum, rice, wheat and fonio, computer equipment for technical and vocational schools, excluding consumables (Art. 226 Niger LF 2018 − 82). Cote d'Ivoire has a reduced rate of 9% on products such as milk, pasta, solar energy production equipment and petroleum products, Art.359 Cote d'Ivoire CGI, Ord. n^{o}2011-480. The reduced rate of 10% in Togo (Togo, LFI 2017) on cooking oils, sugars, cereal flours, milk, pasta, chicks, agricultural equipment, livestock and poultry feeds, and in Senegal but only for accommodation and food services provided by senior tourist establishments.
VAT exemption	VAT exemptions on activities and transactions listed in the common list defined in Articles 21 and 22 of the Directive n^{o}02/98/CM/UEMOA. The list includes in particular exports of goods and services, imports of goods whose supply is exempt from VAT within the country, as well as imports placed under a customs suspensive regime and supplies of services related to goods placed under a customs transit regime, supplies of non-processed and basic foodstuffs, hospitalization and medical care, the supply of medicines and pharmaceutical products and specialized materials and products for medical activities, sales of postage and tax stamps, books, newspapers and periodical publications of information, original works of art, banking operations and insurance and reinsurance services, social installments of water and electricity supplies, transfers of buildings and rentals of buildings for domestic use. This list was amended by the Directive n^{o}02/2009/CM/UEMOA in its article 21, adding gas for domestic use to the list of exemptions, and defining the list of non-processed food products and basic necessities exempt from VAT (see annex to the Directive n^{o}02/2009/CM/UEMOA of 27 March 2009), while the article 22 remained unchanged.	Most of the member states have taken additional dispositions and products in violation of WAEMU regulations, outside the common list Directive n^{o}02/2009 Art.21 among which Benin (public transport operations, procurement of agricultural equipment, equipment for the manufacture of packaging, light-sensitive devices, buildings for maritime navigation, computer equipment, tankers, coaches, minibuses, motorcycles and bicycles) Togo (computer equipment, cell phones and solar panels which may be subject to reduced rates according to the Directive but are not exempted) Cote d'Ivoire (road, rail, waterway, marine and lagoon transport, log wood, natural latex, agricultural equipment and inputs including cocoa processing equipment, pesticides, fungicides and fertilizers, animal feed and feed packaging, and new and used transport vehicles), Burkina Faso (acquisition of agricultural equipment for the manufacture of packaging, sales of packaging for the conditioning of fruits and vegetables, hulling and conditioning of cereals, sales of livestock and poultry feed, photosensitive devices), Mali (exemptions for petroleum products) and Niger (transport of goods and passengers by road and mining products)
VAT credit refund	According to Art. 34 of the Directive n^{o}02/98/CM/UEMOA, VAT credits on inputs to export products and inputs to taxable products (with the exception of meals and entertainment expenses, tourist or mixed-use vehicles, except those acquired by professional lessors or financial lessors) and fuel expenses. VAT taxpayers are eligible for the VAT credits refund on request at the end of a calendar half-year, except for products resulting from resale without further processing (Art. 39). Member States may set a repayment threshold of a minimum amount which may not exceed 1 million FCFA, Art. 40 The examination period is limited to three months for requests made at the end of a calendar half-year, and two months for those made at the end of a two-month period, while the execution of the refund is carried out within fifteen days following the date of the request, see Art. 41	The activities eligible for reimbursement according to the general tax codes of the Member States are compliant with the Directive n^{o}02/98/CM/UEMOA, No refund threshold is set in some Member States such as Benin, Cote d'Ivoire, Mali, Niger and Togo. This is fixed at FCFA 1 million in Burkina Faso while in Senegal the repayment must concern an amount at least equal to 500,000 FCFA. The processing time is 2 to 3 months in Burkina Faso and Togo, 2 months in Cote d'Ivoire and Senegal with the possibility of an accelerated processing time of 15 days. The refund must be made within 15 days following the approval of the application in Senegal, within 8 days following the order of payment in Cote d'Ivoire (in the form of a tax exemption certificate) while the refund of VAT credits is limited to 60% (Mali) and 75% (Benin) within 30 days of receipt of the application. In Togo, it is reimbursed by tax exemption certificates valid for 6 months.

3.2 Top-down estimates of the VAT Gap

This section presents the results of our top-down[5] estimation of the VAT Gap across West African Economic and Monetary Member States. Hence, the Table 2 sets out the VAT gap for each Member State over the period 2006 – 2015. In the last column of the table, the VAT gap is expressed as a share of the theoretical VAT liability. This variable measures the proportion of theoretical liability that is not remitted. The third column includes the total VAT gap, expressed in FCFA million.

The VAT gap were estimated from 2006 to 2015 for 6 of the 8 countries covered by this study. So there are no VAT gap estimates for Senegal because no use national accounts data are available for it, and Guinea Bissau is also excluded because it has not yet adopted the VAT but instead uses a general sales tax. We can observed that the estimated VAT Gap have decline for many Member States over the period 2006 – 2015, consequently in the latter half of the sample period. For example, we observe that in Togo, the VAT Gap fell from 58% in 2010 to 38% in 2015, and over that same period it dropped from 64% to 50 in Niger. For Burkina Faso, we estimated the VAT Gap falling from 57 to 52 between 2010 and 2015. The potential explanations of the remarkable fall of the fall in the VAT gap in theses countries is due to the reforms of VAT legislation adopted in 2009 harmonizing the VAT applying in the Member States, modifying the VAT liability threshold for goods and for services, revising the list of exemptions, and authorizing a reduced rate on a maximum number of goods and services chosen from a defined Community list. Nevertheless, the estimates for those Member States contradict such comments. We can notice that the VAT gap have increase between 2010 and 2015 from 51% to 59% in Benin and from 63% to 65% in the case of Cote d'Ivoire.

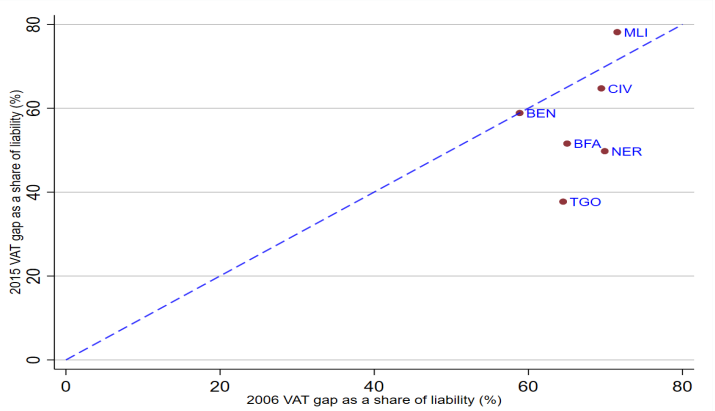
The Figure 3, providing a cross-country analysis of the trend in estimated VAT gap between 2006 and 2015, reinforces the comments we set out above. Thus, we plot the estimated VAT gap expressed as a share of theoretical VAT liability in 2015 against the estimate we obtained for 2006. The dashed diagonal line in the figure is a 45 degree line. For those Member States lying above this diagonal line, the VAT gap is estimated to have increased between 2006 and 2015. For those below the diagonal line, the VAT gap is estimated to have fallen. As can be observed from the Figure 3, most Member States are in the latter group. Indeed, over the period from 2006 to 2015, while the estimated VAT gap increased in Mali, they remained almost stable in Benin, and instead fell in the other countries, with a steeper decline in Togo.

[5] The top-down approach based on the final consumption model and other demand-side data, as is the case with most recent studies (Reckon, 2009; Barbone et al., 2013). The design principle behind such a model is a construct a VAT revenue model that tries to better target VAT base. It is a methodological approach with three stages. The theoretical VAT liability is first estimated, then the VAT revenue actually collected is determined, and finally the VAT gap are calculated and reported as a percentage of the theoretical VAT liability or nominal GDP. The method of estimating the VAT gap and its components (see Figure 2).

Table 2: Estimates of the VAT Gap based on top-down approach

Member States	Year	Theoretical VAT liability	VAT receipts	Total VAT gap (current FCFA)	VAT gap share (%)
Benin	2006	390 460	160 616	229 844	58.9
Benin	2007	411 753	192 831	218 922	53.2
Benin	2008	469 642	216 263	253 379	54.0
Benin	2009	482 710	228 322	254 388	52.7
Benin	2010	502 121	244 653	257 468	51.3
Benin	2011	524 089	253 634	270 455	51.6
Benin	2012	589 611	260 109	329 502	55.9
Benin	2013	635 172	392 319	242 853	38.2
Benin	2014	675 518	293 408	382 110	56.6
Benin	2015	694 641	285 705	408 936	58.9
Burkina Faso	2006	401 568	140 453	261 115	65.0
Burkina Faso	2007	419 637	159 010	260 627	62.1
Burkina Faso	2008	466 625	181 719	284 906	61.1
Burkina Faso	2009	514 433	214 409	300 024	58.3
Burkina Faso	2010	544 494	231 842	312 652	57.4
Burkina Faso	2011	642 290	280 023	362 267	56.4
Burkina Faso	2012	700 484	364 389	336 095	48.0
Burkina Faso	2013	763 046	423 261	339 785	44.5
Burkina Faso	2014	771 452	385 471	385 981	50.0
Burkina Faso	2015	802 072	388 347	413 725	51.6
Cote d'Ivoire	2006	1 051 946	321 254	730 692	69.5
Cote d'Ivoire	2007	1 067 237	371 573	695 664	65.2
Cote d'Ivoire	2008	1 141 133	413 054	728 079	63.8
Cote d'Ivoire	2009	1 212 232	386 800	825 432	68.1
Cote d'Ivoire	2010	1 329 431	498 683	830 748	62.5
Cote d'Ivoire	2011	1 333 655	286 860	1 046 795	78.5
Cote d'Ivoire	2012	1 482 770	503 340	979 430	66.1
Cote d'Ivoire	2013	1 612 805	526 533	1 086 272	67.4
Cote d'Ivoire	2014	1 799 084	588 592	1 210 492	67.3
Cote d'Ivoire	2015	1 948 549	687 021	1 261 528	64.7
Mali	2006	667 698	190 125	477 573	71.5
Mali	2007	473 670	187 179	286 491	60.5
Mali	2008	538 278	190 258	348 020	64.7
Mali	2009	566 872	241 706	325 166	57.4
Mali	2010	634 989	250 269	384 720	60.6
Mali	2011	704 948	275 954	428 994	60.9
Mali	2012	723 689	244 993	478 696	66.1
Mali	2013	869 111	288 168	580 943	66.8
Mali	2014	956 784	252 821	703 963	73.6
Mali	2015	1 010 054	220 717	789 337	78.1
Niger	2006	286 109	86 105	200 004	69.9
Niger	2007	281 475	99 500	181 975	64.7
Niger	2008	313 292	105 434	207 858	66.3
Niger	2009	345 879	122 724	223 155	64.5
Niger	2010	374 367	136 966	237 401	63.4
Niger	2011	400 699	144 824	255 875	63.9
Niger	2012	433 543	146 518	287 025	66.2
Niger	2013	506 395	176 488	329 907	65.1
Niger	2014	448 062	198 661	249 401	55.7
Niger	2015	477 657	239 913	237 744	49.8
Togo	2006	213 800	75 887	137 913	64.5
Togo	2007	198 878	84 633	114 245	57.4
Togo	2008	229 149	90 023	139 126	60.7
Togo	2009	240 062	92 535	147 527	61.5
Togo	2010	259 809	109 214	150 595	58.0
Togo	2011	289 068	134 014	155 054	53.6
Togo	2012	309 555	156 455	153 100	49.5
Togo	2013	328 370	184 012	144 358	44.0
Togo	2014	347 995	210 249	137 746	39.6
Togo	2015	389 342	242 424	146 918	37.7

Fig. 3: Comparison of estimated VAT gap in 2006 and 2015



Source: Based on author's estimates

Table 3 reports the aggregate estimates of VAT gap and its components as illustrated in the Figure 2 in section 3. We notice that the overall VAT gap (as a share of theoritical liability) in the 6 WAEMU Member States has declined, in value terms, by approximately 7 percent over the period 2006 to 2015 despite a rise from 2010 to 2011. The compliance gap expressed as a share of VAT collected under the current policy, is fell by 12 percentage points between 2006 and 2013 and remained stable at the end of the sample period. As a share of theoritical liability, the estimated policy gap remained stable over the period.

Table 3: Aggregate estimates of the VAT gap and its components, 2006-2015

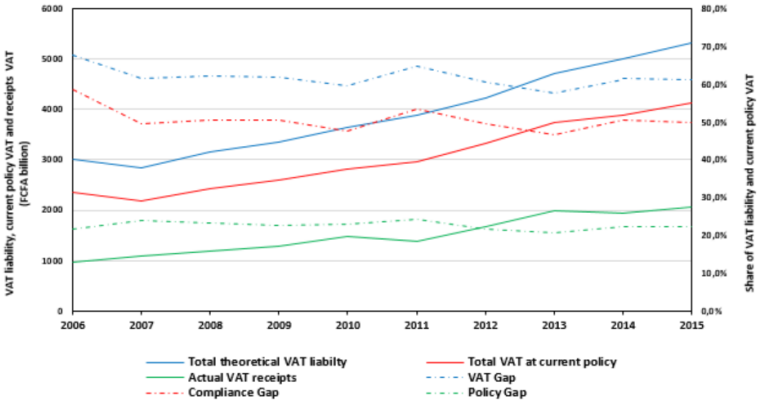
WAEMU-6	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
VAT gap[a]	68	62	62	62	60	65	60	58	61	61
Compliance gap[b]	59	50	51	50	48	53	50	47	50	50
Policy gap[a]	22	24	23	23	23	24	22	21	22	22

Note: WAEMU-6 exclude Guinea Bissau and Senegal
[a] as a share of theoritical liability (%)
[b] as a share of current policy VAT (%)

Nevertheless we note a few changes in annual data. The Figure 4 shows the annual trends in the aggregate estimates of the VAT gap and its components. On the left we plot in billion FCFA the amounts of theoritical VAT liability, current pol-

icy VAT and VAT receipts and on the right we plot the VAT gap and components (compliance and policy gaps) in percentage terms.

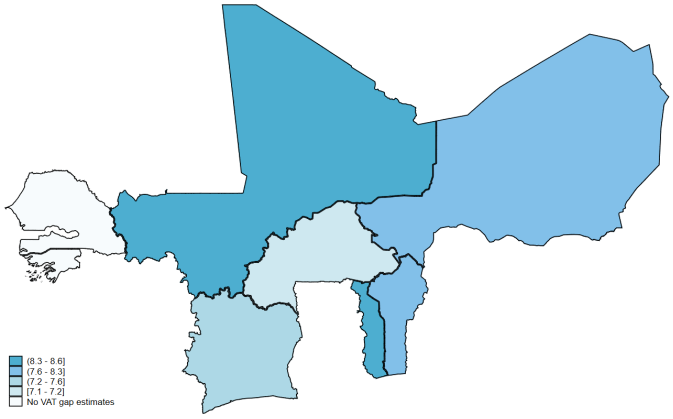
Fig. 4: WAEMU VAT Gap and its components, 2006-2015



Source: Based on author's estimates

Furthermore, we also underline the importance of expressing VAT gaps as a share of GDP. This ratio allows particularly for both trend analyses while still making the fiscal evident. However, trend analysis can be affected by changes in the relative size of relevant tax base to GDP. For example, an increase in the relative size of final consumption to GDP will appear to rise, even if the ratio VAT gap to GDP remained constant. Thus, we note some cross-country similarities as shown in the Figure 5. The average ratio of the VAT gap to GDP ranges from 7.1% in Cote d'Ivoire to 8.6% in Mali.

Fig. 5: Average VAT gap ratio to GDP in WAEMU Member States, 2006-2015



Source: Based on author's estimates

3.3 Econometric analysis of the VAT Gap

We present in Table 4 the relevant variables identified based on the analysis of referenced earlier works and our own intuitions. In this table, we are also presented a brief description of the reasons for which they were introduced, and the source from which they where obtained. Several of these variables have been used in Agha and Haughton (1996); Aizenman and Jinjarak (2005); Christie and Holzner (2006); Reckon (2009); Zídková et al. (2014) and Zídková and Pavel (2016) studies cited earlier.

Three of variables in the following table are not available on a time series basis. The data of the judicial/legal effectiveness index that we consider as a proxy for the punishment rate and the audit rate, are downright not available for WAEMU Member States. The poverty gap at the national poverty line used to measure the effect of poverty on VAT gap, contains only two or three observations at most for countries and does not contain any at all for Mali. Likewise the data of the share of tertiary education, used to capture the impact of the level of education on VAT gap, are available for a single year only or two for some countries, over the study period considered. Therefore, we estimate the model without introducing the judicial/legal effectiveness index, poverty rate and the share of tertiary education.

Table 4: Candidates Explanatory Variables

Variable	**Underlying factor captured by the variable**	**Source of Data**
Final consumption per Capita	Size of potential VAT base and also level of development	Own calculation based on World Bank (national accounts)
GDP	Size of economy	World Bank (national accounts)
GDP Growth	Business cycle	World Bank (national accounts)
GDP per Capita	Wealth/level of development	World Bank (national accounts)
Government Consumption expenses on GDP	Size of public sector	World Bank (national accounts)
Gross Fixed Capital Formation of construction products divided by GDP	Construction services	Own calculation based on World Bank and National accounts data
Household Final Consumption of Restaurants and Hotel Services (% of total consumption)	Proxy for effect of Tourism	Own calculation based on National accounts data
Inflation	Change in the general level of price	World Bank (national accounts)
Share of Final consumption of Household and NPISH on GDP	Size of potential VAT base	World Bank (national accounts)
Share of intra-community trade total imports	Openness of economy, Carousel-type fraud	WAEMU Commission
Unemployment	Business Cycle and income inequality	World Bank (national accounts)
Value Added in Agriculture on GDP	Share of Agriculture	World Bank (national accounts)
Value Added in Construction on GDP	Relative size of construction industry	Own calculation based on World Bank and National accounts data
Difference between Standard and Reduced rate (if multiple then average thereof)	Tax policy and complexity of VAT system	Own calculation based on financial acts and generals tax codes
Implicit Tax Rate of Consumption (revenue from all consumption taxes divided by total consumption)	Tax burden	Own calculation based on Eco-mac.Ecowas data and CBWAS
Number of VAT rates	Complexity of VAT system/fiscal policy	Financial acts and generals tax codes
Standard VAT rate	VAT burden	WAEMU commission report
Tax Quota (total tax revenue incl. Social security) on GDP	Total Tax Burden	World Bank (national accounts)
Theoretical VAT Liability divided by GDP	VAT burden	Own calculation based on top-down estimate
VAT on Total Tax Revenues	Significance of VAT in Tax Structure	Own calculation based on Central Bank and national accounts data
VAT revenues on GDP	Tax quota (VAT burden)	Own calculation based on World Bank and National accounts data
GINI coefficient	Income inequality	SWIID
Poverty gap at the national poverty line	Poverty	World Bank (national accounts), Global Poverty Working Group
Population	Country size	World Bank (United Nations, World Urbanization Prospects).
Urban population	Urbanization of population	World Bank (United Nations, World Urbanization Prospects).
Judicial/legal effectiveness index	Proxy for the punishment rate and the audit rate	NA
Government Effectiveness	Quality of the government	Worldwide Governance Indicators (WGI)
Perception of Corruption Index	Level of corruption, confidence of people in public sector	Transparency International Report
Regulation of political participation	The degree of organization and institutionalization of participation	INSCR data
Durability of political regime	The number of years since the most recent regime change	INSCR data
Share of Shadow Economy	Significance of Shadow economy	Hassan and Schneider (2016)
Share of Tertiary Education	Level of education	World Bank (education statistics)

3.3.1 Econometric Model

Since the purpose of this paper is to analyse the impact of the different factors identified on the VAT gap, we consider the following linear regression model:

$$VATGap_{it} = \theta_0 + \theta_{1j}X_{j,it} + \theta_{2k}W_{k,it} + \theta_{3l}Z_{l,it} + \alpha_i + \nu_{it} \quad (4)$$

where, i denotes the country, t the year, $VATGap_{it}$ is the VAT gap share, θ_0 is a constant, the θ_{1j} is the regression coefficient representing impact of exogenous tax variables $X_{j,it}$, θ_{2k} is the regression coefficient representing impact of exogenous economic variable $W_{k,it}$, θ_{3l} is the regression coefficient representing impact of exogenous social variable $Z_{l,it}$. α_i is the random component constant over time and ν_{it} is the random component varying over time.

With respect to the estimation process adopted, we start our analysis by estimating a random effects model. We have chosen to use random effects given that this model decomposes the error term in to a country-specific component or a random effect that is fixed over time and an unrelated noise component that varying over time or between countries. We do not use the fixed effect models that includes a specific intercept term for each country. Including a such intercept characters in the regression, may surely mask the impact of any candidate explanatory factors that do not change so much over time or very close to being invariant over time even though there may be remarkable differences between countries. In this instance, the standard VAT rate and the difference between standard and reduced rates could be such a case. Considering that we are interested in estimating the impact of such variables, the random-effects model seems appropriate in our analysis.

However, one of the key assumptions of the random effect specification is that the noise component of the disturbance term in the the model is not autocorrelated and homoskedastic i.e has a constant variance. Therefore, the estimated standard errors can lead to misleading inferences about statistical significance when hetereskedasticity or autocorrelation are present in the model.

To identify those variables that exhibit a not-insignificant relationship with the VAT gap share, we have adopted a general-to-specific approach. This technique consist starting with the most general model that includes all the candidate explanatory variables. We then drop, one at a time, variables from the model, starting with the one that has the highest p value, so that the final model should contain only variables significant at a level of 95 per cent or more.

Descriptive statistics for the dependant and explanatory variables used in our case study are presented in Table 5. With the exception of some variables such as GDP per capita, final consumption per capita and GDP all the others are expressed in relative forms as a ratio in decimal term. The difference between standard and reduced VAT rates is expressed in percentage points while the standard VAT rate is in percentage. These details are very useful in interpreting the results.

Table 5: Summary statistics of dependant and independant variables

VARIABLES	Minimum	Maximum	Average	Standard Error
VAT gap Share (% VAT liabilties)	37.73	78.49	59.58	8.84
GDP per Capita (million CFA francs)	0.13	0.69	0.30	0.15
Growth of GDP (Annual growth)	-4.39	11.85	4.67	2.79
GDP (trillion FCFA francs)	1.25	15.96	4.48	3.71
Agriculture value added (% of GDP)	20.98	43.21	31.44	7.01
Inflation	-1.09	20.38	2.57	3.54
Unemployment, % of population	0.32	11.71	3.54	2.79
Households and NPISH FC expenditure (% of GDP)	58.35	91.96	72.33	7.73
Urban Population, % of population	16.21	49.44	34.38	10.91
Tax Quota (Tax revenue incl. social security) on GDP	11.86	21.40	14.76	1.95
Gross fixed capital formation (% of GDP)	8.95	38.89	22.10	7.51
Government Consumption Expenses on GDP	8.38	23.85	15.59	3.56
Perception of Corruption Index	20.00	39.00	29.52	4.99
GINI Coefficient	35.00	45.70	40.66	2.95
Share of Shadow Economy	29.45	56.63	39.24	7.28
Government Effectiveness	-1.54	-0.46	-0.86	0.31
Durability of politcal regime	0.00	24.00	9.95	8.01
Regulation of political participation	2.00	3.00	2.59	0.50
Share of Intra-community Trade in Total Import	1.83	60.62	15.89	16.29
Standard rate (%)	18.00	19.00	18.17	0.38
Number of VAT Rates	1.00	2.00	1.20	0.40
Age of VAT	11.00	56.00	25.17	12.59
Difference between standard and reduced rate of VAT	9.00	19.00	16.90	2.67
Final consumption per Capita (million CFA francs)	0.12	0.83	0.32	0.17
Household FC of RHS on Total Consumption	0.71	9.13	4.13	2.64
VAT on Total Tax Revenues	19.21	58.72	36.59	9.28
VAT Revenues on GDP	2.40	9.81	5.39	1.59
Theoretical VAT Liability divided by GDP	9.94	18.51	13.22	1.84
Implicit Tax Rate	7.23	16.51	11.91	2.18
GFCF in Construction on GDP	4.69	16.50	11.27	3.02
Population (millions)	5.84	23.11	14.13	4.96
Square of population (millions)	34.08	534.00	223.85	137.08

4 Results

The results of estimating random effects specification using a general to specific approach over the period 2006-2015, are presented in the Table 6. Various diagnostic tests including those verifying the assumptions about the disturbance term that is expected to be homoskedastic and not autocorrelated, are also presented.

First, we perform the Hausman test. It concludes that there is a low risk of a possible bias in the estimated coefficients in terms of the correlation between the explanatory variables and random effects. But, a such correlation might have expected such a correlation with one of the explanatory variables, i.e. VAT liability as a proportion of GDP. This concern has been previously raised in Reckon (2009) considering that errors in estimating a country's theoretical VAT liability, and consequently its VAT

Table 6: Random effects estimates

Dependent variable	VAT Gap as a share of theoretical VAT liability	
Explanatory variables	Coefficient	Standard Error
GDP per Capita (million CFA francs)	9.821	4.275
GDP (trillion FCFA francs)	-0.688	0.190
Growth of GDP (Annual growth)	-0.148	0.033
Theoretical VAT Liability divided by GDP	2.455	0.065
Households and NPISH FC expenditure (% of GDP)	0.090	0.024
VAT Revenues on GDP	-7.386	0.111
Share of Intra-community Trade in Total Import	0.023	0.008
Agriculture value added (% of GDP)	0.107	0.024
Age of VAT	0.141	0.028
Number of VAT Rates	1.443	0.352
GINI Coefficient	0.505	0.072
Share of Shadow Economy	-0.139	0.027
Perception of Corruption Index	-0.072	0.027
Government Effectiveness	2.937	0.592
Implicit Tax Rate	0.159	0.049
Constant	40.375	3.159
Statistical indicators		
Number of observations: 49	Number of countries : 6	
Diagnostic tests		
Hausman test statistic: 3.19 (p = 0.9994)		
Likelihood ratio test for heteroskedasticity: 28.58 (p = 0.0000)		
Wooldriedge test for autocorrelation: 7.1548 (p = 0.0441)		

gap, are arguably affect the estimate of the VAT burden for that country. Thus, we suspect a endogeneity problem in the estimated model. We have also checked for the presence of autocorrelation and heteroskedasticity. Wooldridge's test for autocorrelation was carried out. The null hypothesis of no first-order autocorrelation was rejected by p-value 0.04. Moreover, we have also carried out a likelihood ratio test that concludes on a presence of heteroskedasticity implying that the null hypothesis on homoskedastic i.e. the noise term has a constant variance across countries was rejected.

These two diagnostic tests indicate that the fundamental assumptions of the validity of the random effects model are not fulfilled. The assumptions of homoskedasticity and no autocorrelation are violated and under such conditions the estimated standard errors cannot be relied for statistical testing. Christie and Holzner (2006) and Reckon (2009) have found similar results when they, respectively, carried out the same tests on their estimated random effects model. Then, the estimated random effects appear to be non-consistent. We thus use two different alternative estimation techniques that are robust to the detected autocorrelation and heteroskedasticity. First, we use the Panel Corrected Standard Errors in combination with guessing a non first-order autocorrelation of the disturbance term. The second approach consists of estimating the model by Ordinary Least Squares (OLS) and then correcting the standard errors that the are *robust* to homoskedasticity and autocorrelation. To do so, the *robust* and *cluster* options were used after the *regress* command. We noticed that this approach does not specify the form of the autocorrelation but uses itself

the detected correlation in the data to estimate the standard errors. The general-to-specific approach was applied to each of these techniques.

The following Table 7 presents the findings of the estimation using the panel corrected standard errors approach. The model assumes that there is first-order autocorrelation with a specific coefficient of the AR(1) process for each panel and the disturbances terms are assumed to be panel-level heteroskedastic only with no contemporaneous correlation across panels. The results suggest the following:

Firstly, the relationship between the VAT gap and the VAT burden is subject to controversy. Reckon (2009) and Zídková et al. (2014) have found similar conflicting signs. A one standard deviation in the theoretical VAT liability divided by GDP and the standard VAT rate increase the VAT gap share of 2.237 and 3.027 percentage point respectively. The contradiction stems from the negative sign of the VAT revenues on GDP that is associated with a decreasing effect with the VAT gap of 7.413 percentage point. However, the obtained signs are conforms to the previous one. For example, Barbone et al. (2013) showed that a positive association between the VAT burden and the VAT gap can only be observed in countries with a low level or corruption. Reckon (2009) considers that the result is probably biased by mistakes in the estimate of the theoretical VAT liability, also used as the variable representing the VAT burden. After correcting for endogeneity by instrumenting the VAT burden by standard VAT rate and government final consumption, he found a negative and non significant relationship between the VAT burden and the VAT gap share. The unexpected negative association between the VAT revenues on GDP and the VAT gap share could be lead to the better compliance of citizens satisfied with the services provided by the government financed by an increase in VAT revenues that are well allocated by politicians in countries with low levels of corruption. It is also necessary to note that VAT revenues also depend on other parameters such as the size and structure of the tax base, and therefore this may eventually compromise the expected positive sign with the VAT gap.

Two other significant variables characterizing the tax system are also shown in the final model. The estimated coefficient of these variables have the expected sign. The implicit tax rate appears to increase with the share of the VAT gap supporting the hypothesis that a higher tax burden increases the incentive for taxpayers to commit tax evasion. The number of VAT rates is also rise with the VAT gap share. This positive association between the number of VAT rates and the VAT gap was also reached by Agha and Haughton (1996). The more VAT rates there are, the greater the VAT gap grows. So, the result confirms the assumptions that the VAT compliance is low in complex VAT system.

Some of the economic variables used in the model have proven to be determinants of the VAT gap. We have found that the level of development reduces the VAT gap. An increase of 1 million of francs CFA in GDP per capita coincides with a decrease in the VAT gap share by 14.2 percentage points. As expected, the share of agriculture have a positive relationship with the VAT gap share. The coefficient estimates for the government consumption expenses on GDP have unexpected sign. We have found instead a positive relationship. A possible explanation of this surprising positive sign may be the argument we mentioned above that a large tax

burden pushes tax payers to evade paying taxes. The share of shadow economy is expected to increase with the VAT gap but the estimates coefficient have a negative association. For example, one standard deviation in the share of shadow economy is associated with a fall in the VAT gap share by approximately 0.1 percentage point. This opposite sign may hide a punitive VAT policy of the informal sector. Informal sector firms that are not subject to VAT because of specific measures (for example turnover below the VAT threshold) do not charge VAT and therefore cannot deduct it. However, when they purchase intermediate products (exempt or not) from firms charging VAT, import inputs, or carry out export transactions, they cannot deduct the VAT paid since they do not collect it. In absence of compensatory measures, the failure to reimburse VAT to informal sector firms, creating the phenomenon of VAT remanence, can increase the efficiency of VAT and thus reduce the VAT gap. However, this undermines the principle of VAT neutrality because the concerned firms, whether informal or not, cannot recover the input VAT paid, which increases their production costs.

We also found a number of patterns in the coefficients of the social and others factors. The perception of corruption index downfalls the VAT gap, as it was found, for example, in Reckon (2009) that a lower perception of corruption appears to reduce the VAT gap share. The durability of political regime also has a negative association with the VAT gap share, and the result is in line with that of Aizenman and Jinjarak (2005) who have found that the political stability system including the durability of political regime and regulation of political participation enhances the efficiency of VAT. A positive relationship is found between GINI coefficient and the VAT gap share i.e. countries with a high income inequality have a higher VAT gap share. Aizenman and Jinjarak (2005) also showed that urbanization improves the efficiency of VAT collection. We note a contradiction on this point in relation to our results which show a positive influence of the urban population share on the VAT gap meaning that an increase in the share of urban population accentuates the VAT gap.

However, we believe that a number of conflicting signs that have been observed could be due to the endogeneity bias raised above or to some other important variables that have been removed from the model because of the general-to-specific approach that we use. But we expect that the estimation by the instrumental variable (IV) method could provide partial or perhaps full confirmation of these assumptions.

The results of the *robust* regression are shown in Table 8 and suggest once again the conflicting signs about the link between the VAT burden and the VAT gap. The estimates coefficient of final consumption of households and NPISH[6] share has a positive correlation with the VAT gap share as expected. An increase of 1 percentage point in the share of final consumption of households and NPISH results in an increase of 0.1 percentage point in the VAT gap share. The age of VAT also have a positive relationship with the VAT gap i.e. countries that introduced VAT at an early date have a larger VAT gap share. This is for example the case of Cote d'Ivoire, second country in the world to have introduced VAT in 1959, after France, which has

[6] NPISH - Non-Profit Institutions Serving Households

Table 7: Panel Correction Standard Error modelling results

Dependent variables	VAT Gap as a share of theoretical VAT liability	
Explanatory variables	Coefficient	Panel Correction Standard Error
GDP per Capita (million CFA francs)	-14.186	2.475
Theoretical VAT Liability divided by GDP	2.372	0.058
Government Consumption Expenses on GDP	0.161	0.050
VAT Revenues on GDP	-7.413	0.083
Agriculture value added (% of GDP)	0.108	0.020
Standard rate (%)	3.027	0.529
Number of VAT Rates	0.787	0.248
GINI Coefficient	0.447	0.046
Share of Shadow Economy	-0.086	0.021
Perception of Corruption Index	-0.045	0.022
Durability of political regime	-0.086	0.021
Implicit Tax Rate	0.087	0.035
Urban Population	0.297	0.045
Constant	-12.736	10.599
Statistical indicators	Number of observations : 48 Number of countries : 6 R-squared : 0.9998	

a VAT gap as a share of theoretical VAT liability of 64.9% against 49.8% in Niger, which introduced VAT in 1985, or 37.7% for Togo, which introduced it in 1995. In addition, Togo is the last country to have introduced VAT in the country sample but it is the most efficient in closing the VAT gap share between 2006 and 2015, as showed by the Figure 3. However, a focus on the case of Mali could contradict this assertion. Mali introduced VAT in 1990 but its VAT gap share is estimated to be 78.1% in 2015, which represents the maximum value of the estimated VAT gap share (see Table 5). The case of Mali seems nevertheless particular because of the increase in the VAT gap share, over the study period, for which the causes are obviously other than the age of VAT. One might have expected that the more time goes on, the more States will be able to implement measures allowing VAT compliance and those ensuring VAT neutrality. By contrast, member States' VAT systems (even countries where VAT was adopted very early, such, e.g. Cote d'Ivoire) are designed with incentive exemptions or exemptions on final consumption, reduced rates and complex refund mechanisms, which constitute poor VAT practices.

Table 9 shows the results of our instrumental variable modelling based on the model presented in Table 8. Reckon (2009) points out that there may be a possible problem of endogeneity which can be attributed to the use of VAT burden as an explanatory variable though the Hausman test supports random effects modelling. Considering the findings presented in Tables 7 and 8, the VAT gap share and VAT liability as a share of GDP have a positive connection that is theoretically and intuitively satisfying meaning that levying a large share of the wealth produced through VAT amplifies VAT evasion and avoidance. However, if it proves that a problem of endogeneity is present, this implies that the magnitude of this positive effect has probably been overestimated. In this case, the estimated coefficients reported in Tables 7 and 8, and the association between the VAT gap share and the VAT burden

Table 8: Robust regression modelling results

Dependent variables	VAT Gap as a share of theoretical VAT liability	
Explanatory variables	Coefficient	*Robust* Stand.Error
Theoretical VAT Liability divided by GDP	2.531	0.233
Households and NPISH FC expenditure (% of GDP)	0.094	0.026
VAT Revenues on GDP	-6.869	0.225
Age of VAT	0.056	0.016
Constant	54.961	1.277
Statistical indicators	Number of observations : 60 Number of countries : 6 R-squared : 0.992	

could be trapping the effect of any errors in the computation of theoritical liability of VAT.

To take into account this possible bias, we perform the Durbin-Wu-Hausman endogeneity test that rejects the null hypothesis of regressor is exogenous. Following Reckon (2009), we test for endogeneity of the variable VAT burden using a set of variables as instruments of VAT burden including the standard VAT rate, the VAT revenue on GDP and the government final consumption on GDP. The sine qua non condition is that the instruments should be correlated with the VAT burden, but they must not be correlated with the error term. Since, the test of Durbin-Wu-Hausman was failed, estimates coefficients from OLS may be biased, we use the instrumental variables approach to obtain an unbiased estimate of the effect of the VAT burden, which results are showed in the Table 9. The reported standard error are robust to autocorrelation and heteroskedasticity as in Table 8.

Table 9: Instrumental variable robust regression modelling results

Dependent variables	VAT Gap as a share of theoretical VAT liability	
Explanatory variables	Coefficient	*Robust* Standard Error
Theoretical VAT Liability divided by GDP[b]	-8.630	2.124
Households and NPISH FC expenditure (% of GDP)	1.371	0.244
Constant	74.603	17.159
Statistical indicators	Number of observations : 59 Number of countries : 6 R-squared : not printed Root Mean square error: 11.9	

[b]The variable theoretical VAT Liability divided by GDP is treated as endogenous and is instrumented by the standard VAT rate, VAT revenue on GDP and government final consumption on GDP

The outcomes in Table 9 reveal that after having instrumented the VAT burden, its sign becomes negative suggesting that countries with a larger VAT burden have a lower VAT gap share. The change of sign in the IV model is consistent with the fact that the positive relationship found in Tables 7 and 8 can be assigned to the bias occurring from correlations between the estimate VAT burden and the error in the estimating the VAT gap. We have also tested the validity of exogenous instruments used with the overidentification test of Stock and Yogo (see Stock and Yogo, 2005). This

test confirms that the exogenous instruments are jointly valid by the F-test statistic of 15.1. According to the results in Table 9 we conclude on a negative and significant relationship between the VAT burden and the VAT gap share. Reckon (2009) concluded that there is no reliable statistical evidence of any relationship between the VAT burden and the VAT gap, once the VAT burden has been instrumented. Christie and Holzner (2006) as to them have found a positive correlation between VAT gap and the VAT burden measured by a weighted average VAT. Reckon (2009) points out that these results is vulnerable to a risk of bias due to correlations between VAT gap and VAT burden arising from possible errors in computing the theoritical VAT liability or the weighted average VAT rate, when compared to his own based on robust and panel corrected regressions, as is the case with results in our estimates reported in Tables 7 and 8. Reckon (2009) criticises Christie and Holzner (2006) to not use an instrumental variable approach or any other way to address this of bias, and considers that the authors does not therefore, provide reliable statistical evidence of any relationship between the VAT burden and the VAT gap. Far from closing the debate, our investigation is not subject to this criticism and asserts, after controlling for the risk of bias in the estimation of the theoretical VAT liability, that there is a statistically and significantly negative relationship between the VAT burden and the VAT gap.

5 Conclusion and discussion

The paper estimated the VAT gap for each West African Economic and Monetary Union (WAEMU) Member State using the top-down approach over the period $2006-2015$, except Senegal and Guinea-Bissau. Senegal is not included in our analysis because no use tables are available for it while Guinea-Bissau is not included since it has not yet adopted VAT, and therefore we have only computed the VAT gap for 6 Member States.

We also conducted an econometric analysis in order to identify factors that can cause differences in the VAT gap between countries and over time. The results of the various econometric techniques adopted have led to the following lessons. Firstly, we found a strong positive relationship between the VAT gap and the share of final consumption of households and NPISH in GDP. This relationship implies that a larger size of potential VAT base further widens the VAT gap share. The result is consistent with the literature and the assumption that a larger VAT base should lead to higher levels of VAT evasion. Secondly, our study is the first to have established a significant negative relationship between the VAT gap and the VAT burden, after controlling for endogeneity using the instrumental variable method. Initially, when the variable VAT liability as a proportion of GDP is included as an exogenous variable, we find a significantly positive association with the VAT gap as expected, reasoning with the existing literature on this topic based on the presumption that a higher tax burden should accentuate levels of tax evasion and non-compliance. But, we have subsequently identified the risk that this estimated result could be biased

by the measurement errors in the computation of the theoretical VAT liability. After taking into account this risk of measurement bias in the estimation of theoretical VAT, we conclude that the VAT burden is negatively and significantly associated with the VAT gap share.

It should be remembered that if the negative sign is contrary to our expectations, it may be due to fact that the VAT burden combines economic and tax factors and each one can have an impact in one or other sense on VAT compliance, and may probably symptomatic of the unreliability of the measurement of the theoretical VAT based on national accounts data. In fact, we note some shortcomings that may be related to the use of national accounts data for the estimation of VAT gap. First, it is necessary to question the reliability of the available data as well as what it actually measures, because it should not be ignored that the availability of extremely detailed information on the structure of the transactions would guarantee correct treatment in VAT application on goods and services exchanged.

Another type of limitation lies in the use of the top-down approach. On the one hand, this method rather requires an exercise of judgment to identify those exchanges that are likely to have a significant impact on the measurement of net VAT liability at the level of the economy as a whole. In most cases, food product expenditure is taxed less than that of beverages, but both are significant part of household consumption expenditure. We therefore believe that taking into account the details of very ready-made items, for example by distinguishing between non-alcoholic and alcoholic beverages (proposed by Reckon, 2009) can have a significant impact on the estimated VAT gap, but unfortunately the national accounts data used do not provide these details. On the other hand, the top-down approach relies on the extent of overlap between taxable activities and those contributing to the national accounts. Some activities, such as the exemptions for small businesses or construction of own house building, do not overlap. Finally, this approach does not take into account the legal avoidance of VAT liability on which the VAT gap estimates also depend. Other factors can also be evoked such as the unpaid VAT liability due to insolvencies, and the lack of completeness in the national accounts measuring legal or illegal activities.

However, the use of data outside of the national accounts, when such data are available, can help to mitigate the limitations of this work. In view of these points, we believe that our estimated VAT liability can be affected by these different factors, some of which may have marginal impacts, and others which may have a significant impact on the results obtained.

It is up to political decision makers to implement their tax policy, particularly that of an efficient VAT system based not only on VAT rate, but also taking into account the structure of the tax base. Nevertheless, it is obvious that WAEMU countries have to broaden the VAT base by gradually abolishing VAT exemptions, whether they are incentives or based on final consumption, limiting the reduced rate to one if necessary, setting up compensatory mechanisms for businesses exempt without the ability to deduct the VAT paid, and improving the fluidity of VAT credit refunds, to ensure VAT neutrality.

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