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DOES DIGITALIZATION REDUCE TAX EVASION? EMPIRICAL EVIDENCE FROM WAEMU[1] COUNTRIES

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ABSTRACT

This article analyzes the effect of digitalization on tax evasion in WAEMU countries. To this end, we estimated a panel data model covering WAEMU countries over the period 2002-2019. The results obtained by the within estimator indicate, on one hand, that digitalization through internet penetration has a significantly negative effect on tax evasion. It therefore contributes significantly to reducing tax evasion in WAEMU countries. Mobile phone penetration and broadband subscriptions have positive but non-significant effects on tax evasion. On the other hand, we find that the improvement in living standards and education in the sub-region is accompanied by a reduction in tax evasion in union countries. Furthermore, the increase in unemployment rates and urbanization leads to an increase in tax evasion. In terms of economic policy implications, this study suggests intensifying digitalization through access to new technologies and related training. Improving living conditions and education, combating unemployment, and better monitoring of urban activities are necessary for reducing tax evasion and improving WAEMU's tax revenue.

Keywords: digitalization, tax evasion, panel data, within estimator.

JEL Code: L86; H26; C13.

1. Introduction

Understanding the factors contributing to the improvement of domestic resource mobilization in developing countries in general has always been one of the primary objectives of governments. Taxation occupies a prominent place in public policies, serving not only as a source of revenue

[1]WEAMU is a monetary union made up of eight countries: Benin, Burkina Faso, Ivory Coast, Guinea Bissau, Mali, Niger, Senegal and Togo.

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but also as an economic policy instrument to stimulate or curb various activities. It ensures financial independence for a state from external donors (Ba & Diagne, 2016). Adequate budgetary resources enable developing countries to finance programs aimed at achieving sustainable development goals. Domestic resources facilitate poverty and inequality reduction programs, provision of quality public services, particularly in education and health sectors, and investment in infrastructure to support more inclusive growth (IMF, 2018; Doghmi, 2020). Developing countries need to collect tax revenues representing at least 20% of their Gross Domestic Product (GDP) to achieve Sustainable Development Goals (SDGs). Therefore, tax evasion behaviors pose a serious problem for societies. Tax fraud challenges governments and undermines public financing (Mitchell & Sikka, 2011; Picur & RiahiBelkaoui, 2006), having a devastating impact on economic development. Hence, finding the best strategies to reduce the harmful effects of this phenomenon is a constant government concern. Governments continuously seek ways to deter tax evasion and strengthen fiscal discipline. Some of these policies aim to improve services and develop information infrastructure. It is worth noting that the main challenge facing governments is how to track taxpayers' activities and incomes and verify the accuracy of their declarations. The reason behind this is the inability to collect comprehensive and timely information on taxable income because, in the business world, "transactions were in cash, so there was no 'paper trail' that could be used" (Alm, 2021).

In Sub-Saharan Africa (SSA), domestic resources remain, on average, below 17% of GDP (World Bank, 2019). SSA is the region with the lowest fiscal effort[2] score among the seven world regions[3], after East Asia and the Pacific, during the period 1980-2019. Indeed, it stands at 0.82 compared to 0.88 in Latin America and the Caribbean, 0.86 for the two regions of Europe and Central Asia and North America, and 0.83 for the South Asia region. The East Asia and Pacific region display a fiscal effort index of 0.81. Furthermore, SSA's fiscal effort score remains below not only the global average of 0.84 but also the fiscal effort level of all low-income countries, which stands at 0.84. The SSA region could increase its public revenues by some 3% to 5% of GDP, on average, which is $50 to $80 billion. A figure significantly higher than the $36 billion (estimated) in official development assistance received by the region in 2016 (IMF, 2018). In West Africa, the contributions of tax revenues to economic financing remain low and well below the minimum of 20% of GDP set in the WAEMU area (OECD, 2023). Similarly,

[2] Regarding the tax effort, it is the gap between the tax potential and the amount of revenue actually generated by the administration (Ba and Diagne, 2016).

[3] According to the World Bank ranking, 2023. (https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

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WAEMU[4] countries as a whole have a very low fiscal effort index. It stands at 0.43, below 0.5, indicating that these countries face difficulties in recovering even half (50%) of their tax capacity. For these states, tax revenues fall below the community standard of 20% of GDP. UEMOA countries, like most developing countries, find themselves in a situation of fiscal sub-optimality (World Bank, 2022). The fiscal potential of some countries in this area remains largely underexploited (Larwin, 2022; Adanle & Chabossou, 2022). Therefore, identifying factors likely to reduce tax evasion appears crucial to enable UEMOA countries to increase their domestic resources and thus pursue policies of inclusive, sustainable, and autonomous development.

Similarly to other Sub-Saharan African countries, WAEMU's tax performance falls short of its potential. Comparative analysis of tax performances shows that WAEMU countries record low or moderate collection rates compared to other Sub-Saharan African countries and relative to their tax capacity (YAO, J.PA, 2023). Indeed, tax performance in this region is limited by an inefficient tax collection process (Trinnou, 2021), a complex macroeconomic environment characterized by a predominant informal sector, administrative burdens, poor quality, and collection of erroneous information, which promote tax evasion, avoidance, and fraud of all kinds (Senou 2014; OECD, 2023). In most of these countries, the state budget has remained structurally deficit, partly due to inefficiencies in tax collection despite their tax transition efforts (Chambas et al., 2005). External financing has continued to play a major role in development policies in the sub-region. For example, in Benin, the country's public debt stood at 54.05% of GDP in 2022. A debt level certainly below the WAEMU community threshold (70%), but its external component has continued to increase to reach 65.85% in 2022. Moreover, 85.01% of the total debt is held by non-residents (CAA[5], 2023). This situation is almost similar in other community countries (WAEMU, 2022). This upward trend in external resources reflects the good rating[6] on international financial markets, particularly by the IMF and the World Bank, of WEAMU economies. However, it makes financing their programs largely dependent on foreign sources, and uncertainties in the global economy can at any time limit the capacity of these countries to mobilize funds (WAEMU, 2022). Additionally, external financing constantly puts these countries under structural adjustment programs imposed by donors to benefit from loans or repay borrowed funds (Culpeper and Bhushan, 2010). Furthermore, WAEMU countries' strong dependence on global commodity prices[7] makes them vulnerable to exogenous shocks. However, maintaining a sustained development trajectory in a developing country requires stable funding

[4]Based on data from McNabb & al. (2021), Statistics from the United States Agency for International Development (USAID's Collecting Taxes Database (CTD).

[5]according to statistics from the autonomous sinking fund of Benin

[6] Although countries in the sub-region such as Benin, Ivory Coast, Senegal and to some extent Togo are so far.

[7]Cotton for Benin and Burkina Faso, cocoa for the Ivory Coast, uranium for Niger, bauxite for Guinea, etc.) over which these countries have practically no control in terms of prices , these being incapable of transforming them

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for at least the entire program implementation period. The absence of such resources increases uncertainty about the quality and timeliness of the programs implemented (Lawin, 2022; Adanle & Chabossou, 2022).

Empirically, several studies have also focused on the relationship between digitalization and tax evasion. But like theories on the matter, empirical conclusions are not unanimous. Some authors find a negative relationship between digitalization and tax evasion (Strango, 2021; Gnangonon, 2020; 2019; Nkoa & Song 2022). Other authors find a non-linear relationship between the two concepts (Yamen et al., 2022). Another group of authors finds negative effects of digitalization on tax performance. Indeed, for these authors, e-commerce can contribute to narrowing the tax base due to difficulties in expanding the tax base to include most of the services and intangible products sold over the internet to households (Reddick Coggburn, 2006; Bardopoulos, 2015). Digitalization can offer new opportunities for tax evasion to economic agents by helping them conceal sensitive information (Etim et al., 2023). Therefore, from both theoretical and empirical perspectives, the results obtained are not unanimous and, in some cases, even contradictory.

Tax evasion is always definitively defined unlike tax avoidance. Tax evasion is a deliberate action by which taxpayers use fraudulent means to escape tax payment (Alm, 2012; Alm et al., 2016). Thus, the intention is to misrepresent reality and render things completely different from what they are supposed to be. In contrast, tax avoidance aims to reduce taxes by using legal tools and means (Therefore, Alm, 2012; Alm et al., 2016). individuals are allowed to shape and plan events to decrease or underestimate their tax obligations within legal conditions (Alm, 2018; Alm et al., 2021. According to Kemsley et al. (2022), two fundamental conditions must be met to define an act of tax evasion. First, there must be a deliberate action aimed at paying fewer taxes, and second, there must be an underestimation of the tax base. Consequently, there will be no tax evasion if either of these conditions is not met.

The digitalization of a country refers to both the public administration, businesses, and the population (World Bank, 2021). It "describes how the use of information and communication technologies change the economic model of an organization, including creating new or improved means of service delivery, communication, and improving the quality of offerings" (Brenner & Hartl, 2021). In this study, we use the term digitalization to explain the adoption of digital technologies such as the Internet, mobile phones, and all other tools used by the economy.

Therefore, this article aims to examine the effect of digitalization on tax evasion in WAEMU's countries. In this regard, WAEMU's countries appear to represent a relevant empirical field for such analysis. Indeed, it allows addressing the issue of weak revenue mobilization (IMF, 2018; World Bank, 2022; OECD, 2023) and especially to assess the implications of digitalization on the fiscal performances of "small" countries. However, in this article, we are exclusively

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interested in the influence of digitalization on tax evasion in WAEMU's countries: Does Digitalization contribute to the reduction of tax evasion in WAEMU's countries? This choice stems from the fact that digitalization policies are increasingly occupying a prominent place in Union countries[8]. The affirmative answer to the previous question is conditioned by the need to address three specific questions, namely: (i) what is the effect of internet usage on tax evasion in WAEMU's countries? (ii) Does broadband subscription reduce tax evasion in WAEMU's countries? (iii) Does mobile phone usage influence tax evasion in WAEMU?

The objective of this work is to evaluate the effect of digitalization on tax evasion in WAEMU's countries. Referring to the teachings of the New Institutional Economics (NEI) developed by (North, 1990; Coase, 1937), we postulate that digitalization, by contributing to the reduction of transaction costs, significantly contributes to the reduction of tax evasion in UEMOA.

The above developments reinforce the interest of the study which can be envisaged on several levels: Firstly, the use of ICT is experiencing rapid[9] growth in Sub-Saharan Africa including WAEMU's countries (Ofori et al., 2021). Moreover, on March 31, 2023, all these countries ratified the regional program for the development of the digital economy of WAEMU. This should accelerate ongoing transformations aiming to accelerate the digitalization of their economy. The ultimate goal of these measures is to improve economic performances, including fiscal ones. Since the development and implementation of these multiple digitalization programs, no study, it seems, has sought to evaluate its real impact on tax evasion in WAEMU. However, the need for external evaluation (outside the internal monitoring carried out by the competent bodies of the States) is important for WAEMU's authorities to assess the scope of the programs. Secondly, the repercussions of exogenous shocks and the identification of factors that improve the mobilization of own resources thus constitute an opportune development strategy to limit the extent of possible exogenous shocks, the occurrence of which will probably be frequent in a globalization context. Thirdly, this study enriches the empirical literature dealing with the impact of digitalization on economic performances. Indeed, since the seminal study by Teltscher (2002) dealing with the influence of digitalization on fiscal performances, several authors have focused

[8]For example: In Benin, considerable progress in digital infrastructure and dematerialization of services has been recorded since the establishment of the national digital plan adopted in 2017. In Togo, the government has implemented the program Togo digital 2025 which revolves around two main points. This involves defining, on the one hand, the digital transformation of public administration and, on the other hand, accelerating the development of a true digital economy. In Senegal, the government is implementing its vision of development through its Senegal Digital 2025 program in place since 2016. Ivory Coast has implemented a series of three programs to support its digital transformation. These include the national digital development strategy 2025 (PS1), the national innovation strategy 2021-2025 (PS2) and the national cybersecurity strategy 2021-2025 (PS3).

[9] Growth in the overall amount of transactions generated on sharing economy platforms amounted to 175% between 2013 and 2015 (Van Heaperen, 2017).

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on the effect of digitalization on tax evasion. However, most of their studies focus on developed countries (Strango, 2021). To our knowledge, very few works on the issue have focused on African countries. Presumably, there would be no specific study on WAEMU. This gap deserves to be filled. Moreover, at the theoretical and empirical levels, the debate on the impact of digitalization on economic performances remains open and very fertile (cf. supra). The literature dealing with the link between digitalization and fiscal performance is relatively recent.

Following this introduction, the structure of this article is as follows. In the second section, we present a brief review of the theoretical and empirical literature related to the subject of the study. The third section is dedicated to the presentation of the study's methodology. In the fourth section, we present and interpret the results. Then, in the fifth section, the conclusion and economic policy implications.

2. Digitalization and Fiscal Performances: Insights from the Literature

In this section, we briefly present a reminder of the theoretical and empirical considerations underlying the relationship between digitalization and fiscal performances.

2. 1. Theoretical Aspects

Without claiming to be exhaustive, the economic literature delineates two groups of theories for assessing revenue mobilization: traditional theories and modern theories (Nkoa and Song, 2022).Regarding traditional theories, the neoclassical theory of optimal taxation (Ramsey, 1927) proposes a model of fiscal management whose resolution through the "Ramsey rule" is based on minimizing the incidence of state intervention in the economy. This rule, which ensures that goods for which compensated demand varies little with respect to all prices must then be relatively more heavily taxed (Gauthier, 2001). Similarly, the theory of deadweight loss (Harberger, 1954) presents the necessity for governments to conduct fiscal taxation that does not induce waste of resources or overproduction of public goods. Simply put, deadweight loss is the gap between the production of a good and its level of consumption in society. Thus, the state must ensure that the collection of tax revenues does not exceed what society needs in terms of public goods. Keynesian theory (Keynes, 1936), on the other hand, without addressing the question of fiscal optimality, relies on the fiscal multiplier to highlight the use of fiscal policy as a means of economic stimulus or stabilization. Thus, taxation constitutes a central element of public policies, and their economic consequences are considerable (Gerolf & Grjebine, 2019). In line with these traditional theories, we can also mention the Pigouvian tax (Pigou, 1920), the theory of fiscal exchange (Niskanen, 1971), and the theory of public choice (Buchanan & Tollison, 1972).

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In contrast to this first category of theories, modern theories, which incorporate the modern theory of optimal taxation (Mirrlees, 1971), institutional theory (North, 1990), and the theory of New Public Economy (Alesina & Roubini, 1992), argue that the improvement of fiscal performance is accompanied by technological advances (Barreix & Zambrano, 2018). They are thus in perfect agreement with the theory of endogenous growth, which suggests that economic and financial development would pass through technological development. Specifically, the analysis of the effect of digitalization on revenue mobilization begins with the theory of modernization, the theory of the digital divide, and the theory of information poverty (Dlodlo, 2009). These theories have contributed to the emergence of two schools of thought. On one hand, progressive taxation, whose values are social and technical progress, then efficiency and effectiveness. It elaborates a standardized fiscal approach (Oz-Yalaman, 2019). On the other hand, there is tax culture, whose values are the fulfillment of the rights and duties of stakeholders in compliance with tax legislation (Capasso &Jappelli, 2013). Thus, the improvement of public revenues is within the scope of digitalization due to the cost reduction it induces through an intelligent approach. Similarly, for Coase (1937), the theory of neoclassical perfect markets ignores an important aspect of the economy: the existence of transaction costs. He understands transaction costs in a sector or in an economy as all costs related to information search, market failures and prevention of opportunism by other agents, etc. Williamson (1975) relies on the concept of limited rationality[10] of agents and their opportunistic behaviors to justify the existence of these transaction costs. These are responsible for the coordination failure among agents and can significantly encroach upon information gathering, the level of economic activity, tax control, and tax compliance.

2.2. Empirical Aspects

Since Teltscher's seminal study (2002), research on the effects of digitalization on economic performance has been quite extensive.

Bogdan & al. (2023) use the Global Digitalization Indicator developed by the World Bank. Using a linear model and multiple regression on 155 countries, the authors find that overall digitalization, including that of public administrations, private enterprises, and the population, helps reduce tax evasion worldwide. The study by Yamén &al. (2023) is also revealing. Indeed, these authors found that digitalization reduces tax evasion, but they add that the beneficial effect of digitalization is further accentuated in countries with a low level of corruption. In their study covering 102 developing countries over the period 1995-2015, using a panel model and resorting to the generalized method of moments, Myovella & al. (2020) find that digitalization promotes

[10]Developed by Herbert Simon, limited rationality is any situation in which an individual's decision-making capacity is impaired by a set of constraints such as lack of information, cognitive biases or lack of time.

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economic growth and thus increases tax revenues. Heinemann&Stiller (2023) use a panel and the difference-in-differences method on Italy's trade with 27 EU countries over a period of 24 months. The authors find that digitalization of tax control significantly reduces tax fraud on the country's foreign trade. Similarly, Brun & al. (2016), using a fixed-effects panel model and a Within estimator on 96 developing countries during the period 2005-2016, find that the diffusion of ICTs positively affects tax revenues, direct taxes, and VAT. Nkoa and Song (2022) examine, from a sample of 54 African countries, estimating a panel data model by Generalized Least Squares (GLS) over the period 1996-2019. The results show that digital transformation, due to ICT penetration, significantly stimulates revenue mobilization in Africa. Moreover, its effects pass through financial development, trade openness, energy, and human capital. Heinemann and Stiller (2023), working on the Italian economy, find that the digitalization of the Italian economy not only intensifies exchanges by reducing transaction costs between agents but also increases tax compliance and tax civism, while reducing administration costs for tax collection and control. The digitalization of the Italian economy accelerates the country's economic activity and reduces tax evasion related to its international trade. Governments can quickly collect taxes, minimize tax evasion, and reduce the burden on citizens (Ouédraogo & Sy, 2020). Digitalization enables financial institutions to use tools to detect and reduce fraud, money laundering, and anomalies in transactions (Alam & al., 2019; 2012; 2021). In the same vein, Kitsios & al. (2022) found that digitalization reduces cross-border commercial tax fraud by improving information collection and processing by governments. Tax authorities could detect cases of non-compliance and suspicious transactions using advanced technologies to detect and mitigate the risk of tax evasion (see, for example, Yamén & al., 2023). Digitalization reduces costs for administrators and taxpayers, as digital infrastructures eliminate many manual processes related to tax filing, calculation, collection, and payment, and strengthens the tax base by reducing the use of cash and facilitating the analysis of transaction chains, clarifying tax rules, and accelerating processes (Zabsonré & Dial, 2023). It also helps reduce tax evasion (Alm, 2021).

On the other hand, many authors have also mentioned the risks posed by digitalization for economies, particularly those in developing countries. Indeed, digitalization could offer new opportunities for tax evasion to individuals or companies by helping them conceal sensitive information. Indeed, some individuals or companies may find new ways of tax avoidance or tax evasion. Hamilton and Stekelberg (2017) concluded that companies with high-quality information technology could avoid more taxes while incurring fewer tax risks than others. The results obtained by Strango (2021) show that tax evasion decreases with the increase in the digitalization of public services, but only up to a certain level. Beyond the mentioned level, tax evasion continues to grow. According to Etim & al. (2020), digitalization negatively influences tax compliance in Nigeria. This is mainly due to the ineffective taxation of e-commerce activities and other online transactions (see, for example, Oseni, 2015). In addition, the attention paid to

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base erosion and profit shifting has highlighted a set of taxation problems in countries. These are mainly related to the introduction into economies of new business models based on digital technology as well as the increased fluidity of transactions. They facilitate the concealment of activities from authorities and the shifting of profits from foreign companies to their parent companies (OECD, 2015 and 2017; Adigbole & Olaoye, 2018). In the same line, Blix and Bustos (2020) warn against the amplifying effect of digitalization on tax base erosion. This is mainly due to the destruction of jobs it causes and the complications it entails in international taxation. In the same vein, Valenduc (2017), highlighting the controversial relationships between digital technologies and employment, renews the call for profound discussions on the place and impact of digitalization in the development process.

In summary, the literature on the relationship between digitalization and tax evasion is not univocal, neither theoretically nor empirically. Despite the benefits it can generate, the digitalization of the economy raises questions. Thus, in-depth and informed research is needed to better guide decision-makers.

3. Study Methodology

3.1. Model Specification

The empirical study in this work draws inspiration from the specifications used by Nkoa and Song (2022) and Koffi (2022). In general terms, the model is formulated as follows:

$$SI_{i,t} = \boldsymbol{f}(\boldsymbol{X}, \boldsymbol{Y}) (1)$$

Where$SI_{i,t}$ represents the level of tax performance apprehended by the level of tax evasion,

X = (Nui, Abon_hd, Ntelm, Nsi) represents the vector of explanatory variables capturing the level of digitalization, and **Y** represents the vector of control variables. Similarly to Yamen & al. (2023), Medina & al (2018), Shadow economies around the world: What did we learn over the last 20 years? International Monetary Fund. who in their respective works also tried to highlight the role of digitalization in tax evasion.

Thus, we have the following specification:

$$SI_{i,t} = \alpha_0 + \alpha_1 Nui_{i,t} + \alpha_2 Ntelm_{i,t} + \alpha_3 Abon\_hd_{i,t} + \alpha_4 Pib_{i,t} + \alpha_5 Urb_{i,t} + \alpha_6 Dev\_fi_{i,t} + \alpha_7 T\_chom_{i,t} + \alpha_8 corr_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} (2)$$

Where **SI**: Represents the size of the informal economy. The underground economy index is used as an indicator of tax evasion. It is the share of legal economic activity not declared to the

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authorities. This type of activity is generally carried out by very small-sized enterprises and also relies on informal employment. This variable is used as a proxy for tax evasion.

Nui : Represents the proportion of the total population with internet access.

Abon_hd : The percentage of people in the population with a broadband subscription.

Ntelm: The number of mobile phone users, also known as the mobile telephony penetration rate.

PIBh: The real GDP per capita. Real GDP is obtained by deflating nominal or current GDP by a deflator that generally includes the inflation rate.

Urb: Reflects the level of population concentration in urban areas.

T_chom: Represents the percentage of people in the active population seeking employment.

Edu: The level of education.

$\boldsymbol{\mu_i}$: Represents the unobserved specific effect of countries.

$\boldsymbol{\delta_t}$: Represents the temporal effect common to all countries in the sub-region, such as global economic conditions and sub-regional regulations.

$\boldsymbol{\varepsilon_{i,t}}$: The error term.The parameters to be estimated are denoted by

$$\boldsymbol{\beta_i} \quad \boldsymbol{i} = \{\mathbf{0}, \dots, \mathbf{11}\} \text{and } \boldsymbol{\alpha_j}, \qquad \boldsymbol{j} = \{\mathbf{0}, \dots, \mathbf{7}\}$$

3.2. Data Presentation

The data for this study represent a panel of countries in the WEAMU[11] described over the period from 2002 to 2019. These data come from three sources: the WDI (World Development Indicators) and WGI (World Governance Indicators) databases of the World Bank, the WEO (World Economic Outlook) database of the IMF, and data from theCentral Bank of West African States (CBWAS). The choice of the study period is related to data availability. The table below lists all the variables in this study and their respective sources.

3.3. Choice of Estimation Method

Equation (2) represents a heterogeneous panel model, where the only source of heterogeneity comes from the unobserved individual constants μ_i of each country. The factor δ_t on the other

[11]The countries concerned by this study are: Benin, Burkina Faso, Ivory Coast, Mali, Niger, Senegal and Togo. Due to missing data over a large number of years and on virtually all variables of interest, Guinea-Bissau was removed from this analysis.

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hand, measures the effect of the evolution over time of unobserved variables common to all countries in the sub-region, such as global economic conditions, sub-regional regulations, etc. In this context, two models are conceivable: a first model that takes into account the existence of individual fixed effects and a second one that considers individual effects as random. For the case of a fixed-effects model, the coefficients $\mu_i$are constants, meaning that unobserved variables have different effects on the endogenous variable, and the effects of these variables tend to remain constant over time. For the case of a random-effects model, the μ_i , representing all the unobserved structural specificities of each country, are considered as random variables. The choice of estimation method depends on the fixed or random nature of the individual effects. According to our specification, the literature favors two estimation techniques: the fixed-effects estimator (Within) and the Generalized Least Squares (GLS) estimator. In the presence of random individual effects, the Within estimator is an unbiased and convergent estimator. However, in the presence of random individual effects, the GLS estimator is more suitable because, in this case, unlike the Within estimator, which is no longer of minimum variance, the GLS estimator is BLUE[12] (Baltagi, 2008). This situation is interesting for discriminating between the two models (fixed-effects and random-effects) and constructing an appropriate specification test, namely the Hausman test (1978). Thus, in estimating the final model, this test will be performed to decide between a fixed-effects model or a random-effects model. After this step, we proceeded with diagnostic tests of time series and model validation. The main results of these tests are conclusive and presented in the annex.

4. Presentation and interpretation of results

The table below presents the estimation results of tax evasion.

Table 1: estimation results of tax evasion

VARIABLES	Model
Nui	-0.0346**
abon_hd	0.683
Ntelm	0.00342
Lnpibh	-14.38***
Edu	-7.922***
Urb	0.479***

[12]Best Linear Unbiased Estimator

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t_chom	0.111**
Constant	132.7***

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

In the light of this table, it emerges that digitization through internet penetration contributes to reducing tax evasion. However, it is observed that its effect on the share of the economy escaping tax control remains very low. Furthermore, other variables capturing the level of digitization in the WAEMU, notably mobile phone penetration and subscriptions to broadband, have non-significant but amplifying effects on tax evasion in the sub-region. This state of affairs can be explained by the difficulty of WAEMU countries in defining an effective digital tax regime and regulating the use of digitalization tools such as ICT.

As for the control variables, it is noted that the increase in living standards and education in the sub-region is accompanied by a reduction in the informal sector's share of the economy. This can be explained by the fact that the increase in these two variables contributes to the establishment of more productive and responsible activities at the expense of precarious activities characteristic of the informal sector. Moreover, the rise in the unemployment rate leads to an increase in tax evasion. Indeed, a high level of unemployment generally accompanies the proliferation of precarious activities, the main characteristic of the informal sector in the WAEMU. Urbanization, on the other hand, increases tax evasion, undoubtedly due to the anarchic development of activities in the cities of developing countries like those in the WAEMU.

5. Conclusion and Economic Implications

The aim of this study was to analyze the effect of digitization on tax performance within the WAEMU space, measured by tax evasion. From this study, it emerges that digitization significantly contributes to reducing tax evasion. Indeed, digitization through internet penetration reduces tax evasion and significantly contributes to improving the tax revenues of the union's member countries. However, the contributions recorded for other digitization variables, such as mobile phone penetration and broadband subscriptions, have positive but non-significant effects on tax evasion in the sub-region. The effects of these components are quite weak, and the descriptive statistics of these variables show a digitization still in its infancy, having evolved very little since the 2000s. These results indicate an underutilization of the potential offered by digitization in tax matters, reinforce the choice of digitization as a catalyst for economic development in the sub-region, and justify the implementation of large-scale digital expansion programs throughout the WAEMU. Moreover, the increase in living standards and education in the sub-region is accompanied by a reduction in the share of the informal sector in the economy.

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However, the rise in the unemployment rate and urbanization increases tax evasion in the WAEMU countries.

In view of the various results of these analyses, and without claiming to be exhaustive, we suggest to the authorities of the WAEMU countries to accelerate the establishment of digitization infrastructure such as digital centers, fiber optics, etc., to achieve, in the short term, a level of digitization conducive to communicating tax procedures, collecting relevant information in real-time across the territory at low transaction costs, and ultimately promoting tax inclusion of activities. Consolidate in all education and vocational training programs, the need to master computer tools in order to boost digitization in the private sector and among the population. Define a tax system adapted to the digital boom to take into account the proliferation of online activities in the countries. This should reduce tax evasion in activities related to this sector and improve tax revenue mobilization as recommended for years by sub-regional and international organizations.

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Appendix 1

Table I.2: Correlation Matrix of Exogenous Variables with Tax Evasion

Variables	(1)	(2)	(3)	(4)	(5)	(10)	(11)	(12)	(14)
(1) SI	1								
(2) nui	-0.087*	1							
(3) abon_hd	-0.058	0.701*	1						
(4) ntelm	-0.024	0.747*	0.657*	1					
(5) pibh	0.304*	0.553*	0.499*	0.468*	1				
(10) edu	0.018	0.411*	0.568*	0.372*	0.497*	1			
(11) idf	-0.22*	0.489*	0.359*	0.56*	0.617*	0.506*	1		
(12) urb	0.302*	0.487*	0.565*	0.533*	0.811*	0.734*	0.525*	1	
(14) t_chom	0.079*	0.029	0.268*	0.049	0.402*	0.127*	0.08*	0.36*	1

Source: Authors

2- HSIAO Specification Test for the Tax Evasion Model

```
.
. di in y "PvalF1 = " in gr `PVF1'
PvalF1 = .

.
. di in y "PvalF2 = " in gr `PVF2'
PvalF2 = .

.
. di in y "PvalF3 = " in gr `PVF3'
PvalF3 = 3.382e-63
```

Source : Authors

3. Hausman Test: Tax Evasion Model

```
                    b = Consistent under H0 and Ha; obtained from xtreg.
     B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

chi2(13) = (b-B)'[(V_b-V_B)^(-1)](b-B)
         = -639.81

Warning: chi2 < 0 ==> model fitted on these data
         fails to meet the asymptotic assumptions
         of the Hausman test; see suest for a
         generalized test.
```

Source: Authors

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4- Tax Evasion Estimation

```
. xtreg SI nui abon_hd ntelm lnpibh edu t_chom Infl urb  , fe cluster(code_pays)

Fixed-effects (within) regression               Number of obs      =       110
Group variable: code_pays                       Number of groups   =         7

R-squared:                                      Obs per group:
     Within  = 0.8994                                         min =        13
     Between = 0.1415                                         avg =      15.7
     Overall = 0.0527                                         max =        18

                                                F(6,6)             =         .
corr(u_i, Xb) = -0.7031                         Prob > F           =         .

                                (Std. err. adjusted for 7 clusters in code_pays)
------------------------------------------------------------------------------
             |               Robust
          SI |      Coef.   Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
         nui |  -.0340379   .0102828    -3.31   0.016    -.0591991   -.0088768
     abon_hd |   .5734475   .4257958     1.35   0.227    -.4684373    1.615332
       ntelm |   .0034239   .0045266     0.76   0.478    -.0076524    .0145002
      lnpibh |  -14.52126   1.444755   -10.05   0.000    -18.05644   -10.98607
         edu |  -8.020324   1.163327    -6.89   0.000    -10.86688   -5.173764
      t_chom |   .1166145   .0448874     2.60   0.041     .0067789    .2264501
        Infl |  -.0019119   .0191026    -0.10   0.924    -.0486542    .0448305
         urb |   .4468971   .0807998     5.53   0.001     .2491872    .6446071
       _cons |   134.7139   9.273352    14.53   0.000     112.0228     157.405
-------------+----------------------------------------------------------------
     sigma_u |  6.9820705
     sigma_e |  .47557635
         rho |  .99538192   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Source: Authors

5. Normality Test of Tax Evasion Residuals

Skewness and kurtosis tests for normality

Variable	Obs	Pr(skewness)	Pr(kurtosis)	Joint test Adj chi2(2)	Joint test Prob>chi2
es1	110	0.3385	0.3574	1.80	0.4061

Source: Authors