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The tax burden on mobile network operators in Africa

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Abstract: We estimate the tax burden on the mobile telecommunication sector in twenty-five African countries. This tax burden encompasses not only standard and special taxes under the control of the Ministry of Finance (MoF) but also fees raised by the national telecommunication Regulatory Agency (RA). Given the lack of financial data at the country level, we build a representative mobile network operator named TELCO, using the GSMA Intelligence database. We compute the Average Effective Tax Rate (AETR) for this firm considering general and special taxes and fees levied only on the telecommunication sector. We develop a web application (<https://data.cerdi.uca.fr/telecom/>), allowing the reader to replicate our analysis or modify TELCO and tax parameters. The AETR varies significantly across countries, ranging from 33 percent in Ethiopia to 118 percent in Niger. Special taxes and fees represent a large share of the AETR, illustrating some taxation by regulation and a potential tax competition (a race to the top) between the MoF and the RA. We compare TELCO's AETR with that of a representative gold mining plant and a standard company with a similar gross return. The tax burden of the telecommunications sector is higher than that of the mining sector in 15 of the 19 countries for which we have data on the gold mining sector.

Keywords: Taxation; Telecommunication sector; Project analysis; Developing countries.

JEL Codes : H25; L96; O22; O55.

1 Introduction

The tax on internet voice calls such as WhatsApp, Skype, and Viber had triggered massive protests in Lebanon, which brought down the government. Several other countries, especially in Sub Saharan Africa (Uganda, Zambia, Kenya) raised or tried to raise (Benin¹) similar taxes. These experiments illustrate governments' efforts to tax new bases and the political sensitivity of some bases, and the poor design of these taxes, which often take the form of a specific excise.² Such taxes add up to a lot of others, which are particular to the telecommunication sector. This sector is nevertheless one of the most dynamic economic sectors in sub-Saharan African countries. It participates in the region's economic development by improving market efficiency (Aker and Mbiti, 2010). However, it still has a substantial capacity to grow further as unique subscribers market penetration remains low. It is around 45 percent on average in Africa compared to more than 60 percent in other developing countries in 2017 (GSMA intelligence, 2018).

Despite the globalization process, the telecommunication markets remain highly fragmented with heterogeneous national regulations and tax systems. Several studies (e.g., Noll, 2000; Li and Xu, 2004; Howard and Mazaheri, 2009; Faccio and Zingales, 2017) focus on the role of privatization, competition, and regulation of the telecommunication sector in developing countries. Particularly, Howard and Mazaheri (2009) consider internet usage and mobile phone adoption in 154 countries over the period 1990-2007.³ The authors conclude that the independence of the Regulatory Agency (RA) reduces the "digital divide", but its full depoliticization has a negative effect by reducing the RA's capacity to effectively regulate and develop information infrastructure. Beyond the studied regulation reforms (privatization, market liberalization, the independence of RA and its depoliticization), we stress here the central role of the taxation of this sector, which is particularly complex given the variety of special taxes and regulatory fees raised not only by the Ministry of Finance (MoF) but also by

¹ Decree 218-34 of July 25, 2018, raised a tax on the use of social media at a rate of 5 FCFA or equivalently USD 0.009 per megabyte. However, Online and street protests push the government to cancel this tax a few months later.

² The tax is specific when its base is a quantity (e.g., minutes, megabytes, etc.).

³ In line with Henisz et al. (2005), they consider four policy reforms of the telecommunication sectors: the privatization of the national telecommunication provider, the market liberalization allowing some competition among Mobile Network Operators (MNOs), the creation of an independent Regulatory Agency, and the depoliticization of the latter. These authors build an annual index of technology adoption for each country around several dimensions: Internet bandwidth, hosts and users, personal computers, and mobile phones.

the telecommunications RA. These two institutions may even compete in taxing the same base: the activity of Mobile Network Operators (MNOs). Such a tax competition can trigger a race to the top (excessive taxation) as described by Berkowitz and Wei (2000) in the context of Russia and China or Keen and Kostogiannis (2002) in federal States.

Our analysis participates in the debate regarding the adequate level of taxation that should apply to the sector. On the one hand, some authors such as Matheson and Petit (2020) consider that MNOs extract rents from operating their exclusive licenses. Therefore, the tax regime applied to the telecommunication sector should follow a similar logic as for the extractive industries. On the other hand, other authors advocate the merits of telecommunication firms to bridge the digital divide. They justify potential tax incentives, such as exemptions or reduced rates, to enhance mobile phone devices and services affordability (Mistry, 2005; GSMA, 2017). According to Henry (2019) and West (2015), taxation increases the cost of access and use of mobile services. This impacts negatively MNOs' revenues and discourages their investments. For Katz et al. (2010), the telecommunication sector's taxation models generate some economic distortions. This debate is not particular to the telecommunication sector. It reflects a well-known trade-off, prominent in developing countries, between fostering an economic activity through tax incentives and collecting tax revenues for public funding purposes.

Our approach complements previous studies on the taxation of the telecommunication sector, particularly those provided by GSMA (Katz et al., 2010, Rogers and Pedros, 2017 or Pedros and Sivakumaran, 2019) and the International Telecommunication Union (ITU, 2013). These works study the affordability of mobile phone services, especially in developing countries. Consequently, they focus mainly on indirect taxation such as Value Added Tax (VAT), excise taxes, and special mobile networks taxes, such as fees or surtax on SMS, Sim cards, and incoming international calls. In contrast, we consider all taxes a firm must pay to operate its mobile network license. These include direct taxation such as Corporate Income Tax (CIT) and some indirect taxes, which increase the production cost of mobile phone services unambiguously. Consequently, we do not consider VAT and some excises collected by the firm but borne by the final consumer. However, our choice remains subjective given

the potential incidence of any tax on the consumer price.⁴

We estimate the tax burden borne by mobile phone companies in some African countries. We, therefore, compute the Average Effective Tax Rate (AETR), which summarizes the main taxes and fees paid by an MNO over the length of a telecommunication license (15 years by assumption). Our methodology follows the standard approach of forward-looking AETR through a representative firm (see Devereux and Griffith, 1998; Djankov *et al.*, 2010; Steinmüller *et al.*, 2019 for general economic activity; Daniel *et al.*, 2010 for the extractive industry). Given the lack of public firms' financial data, we build TELCO, a representative mobile phone company, using the GSMA Intelligence database. TELCO's financial data and economic activities are expressed in terms of percentage of final consumption or subscribers for each country. Next, we consider the tax regime relevant in 2018 over the length of a typical license period (15 years by assumption). An important assumption concerns the evolution of final consumption and mobile subscribers in each country over the 15 years license length. Multiple factors impact the development of this market: technological innovations, the number of license owners, demand elasticity, and any tax or fee, which would have an incidence on prices, etc. Given the induced complexity of the final effect on the market, we use observed data rather than projected estimates. Thus, we consider 2018's tax regime and apply it to a representative firm, which operates its license from 2003 to 2018.⁵ We determine the AETR given the actual development of the 25 national mobile phone markets since 2003. Given the buoyancy of the telecommunication sector in Africa, many countries have modified their tax regime every year since 2018: Some countries raised the rate of the studied taxes (for instance, Burkina Faso increased the rate of the telecommunications network access tax from 5 percent to 7 percent in 2020); Others introduced additional new taxes especially excises on Over-The-Top (OTT) services (Tanzania, Uganda, and Zambia), which we do not consider in our study. The associated web application (<https://data.cerdi.uca.fr/telecom/>) allows the

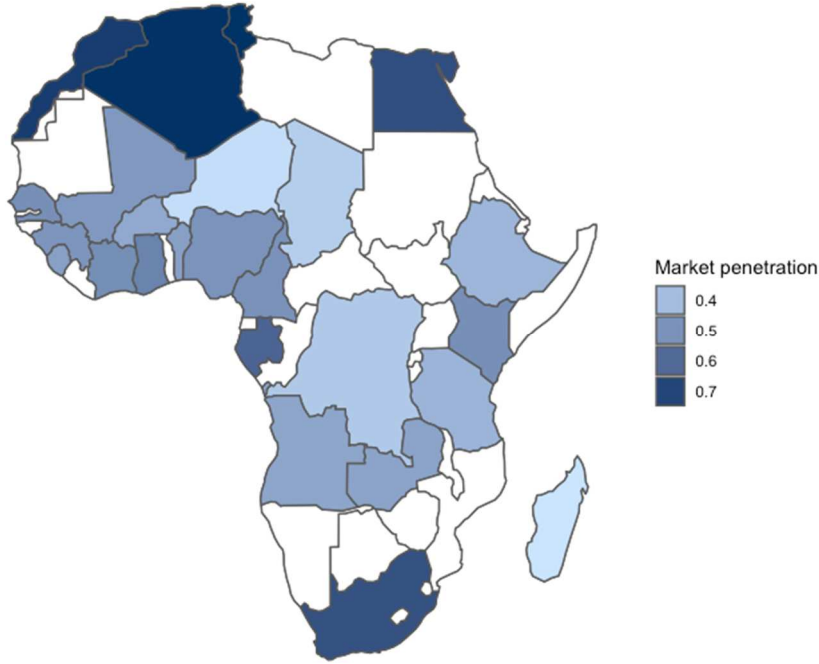
⁴ Weyl and Fabinger (2013) develop a theory of pass-through. They show how the tax burden's sharing between producers and consumers differs significantly depending on the market structure, demand characteristics, and the level of taxation. More recently, Baker *et al.* (2020) study CIT's incidence on consumer prices, estimating a price elasticity to net corporate tax rates of 0.17.

⁵ An implicit assumption is that we do not consider any tax change over the period. There is no best solution to profile the future revenue or turnover. For instance, the Doing Business model (TaxpayerCo) assumes a constant activity expressed in terms of Gross National Income (GNI) per capita over five years. The Fiscal Analysis of Resource Industries (FARI) model of the International Monetary Fund (IMF) considers a production plan resulting from actual feasibility studies or an average estimation of the extraction process. However, the main weakness of this approach is the predicted commodity prices over a very long period (20 to 40 years), which are assumed to be constant or increasing at a given rate.

reader to replicate our analysis, update national tax systems, and modify any parameter of the firm TELCO.

We study 25 African countries: Algeria, Angola, Benin, Burkina Faso, Cameroon, Chad, Cote d'Ivoire, DRC, Egypt, Ethiopia, Kenya, Gabon, Ghana, Guinea, Madagascar, Mali, Morocco, Niger, Nigeria, Senegal, Sierra Leone, South Africa, Tanzania, Tunisia, and Zambia. These countries represent 60 percent of Africa's total GDP, 79 percent of the total population, and 81 percent of unique African subscribers in 2018. However, they differ in the development of their respective telecommunication sector.⁶ For instance, the 3G network coverage in 2018 varies from 31.6 percent in Mali to 99.2 percent in South Africa, and the market penetration of mobile phones from 30.9 percent in Madagascar to 75.4 percent in Tunisia (see Figure 1).

Figure 1: Market penetration (unique subscribers in 2018) of the studied countries.



Source: Authors.

The AETR varies significantly across these countries. It goes from 33 percent in Ethiopia or 35 percent in Morocco to 97 percent in DRC and even 118 percent in Niger, with a mean of 64 percent. Ethiopia is an outlier in our sample since the liberalization of its telecommunication

⁶ Appendix A displays some characteristics of these countries.

sector is still ongoing (see Table A in Appendix).⁷ We can expect significant changes in the Ethiopian tax regime of the telecommunication sector in the coming years. With an AETR superior to 100 percent, TELCO would lose money in Niger. This country has the highest tax on international calls at 0.13 Euro per minute and significant cumulated turnover fees of 5 percent. The recent leaving of Niger by Orange SA results partly from this excessive tax burden.

We break down the AETR into two components: the Average Special Tax Rate (AESTR), which summarizes all special taxes and fees raised on MNOs; and the Average General Tax Rate (AEGTR), which captures “standard” taxes and which applies to all firms in the country. We observe that special taxation represents the largest share of the final tax burden in 14 countries: The AEGTR is on average 26 percent, while the AESTR is 38 percent over our sample. We also compute the AETR of CIT only for a standard firm and an MNO. Our results are close to Steinmüller et al. (2019) with an average CIT AETR of 27.9 percent. We also observe that TELCO's CIT AETR is lower than the CIT AETR of the standard firm since several special telecommunication taxes and fees are deductible from the CIT base. As in previous studies adopting the AETR approach, we do not address profit shifting through mispricing or thin capitalization. That involves an overestimation of paid CIT and consequently of the AETR computation. We estimate in appendix O.IV the impact of an increase in the debt-to-equity ratio from 60 percent to 90 percent or even 100 percent. As a result, the AETR decreases on average only by 2 to 3 percentage points. For each country, we compare the AETR of TELCO to the AETR of a standard firm and a representative gold mining plant, which both have the same gross return of 60 percent. Indeed, the standard firm only supports general taxation. In contrast, the mining firm pays specific sectoral taxes such as mining royalties, surface taxes, and other fees.⁸ Unambiguously, the AETR of TELCO is higher than that of the other two sectors in all countries except Angola, Chad, Kenya, and South Africa. Telecommunication is more taxed than mining.

The rest of the paper is organized as follows: Section 2 presents our AETR computation methodology, results, and some comparisons with the mining and the standard sector; Section 3 presents the results; and Section 4 concludes and presents some correlations

⁷ Our analysis remains hypothetical in the case of Ethiopia since we consider a private MNO, which did not exist in this country in 2018. Indeed, the Ethiopian government has engaged very recently in the liberalization of the telecommunication sector. In 2021, it privatized Ethio Telecom (the State-Owned Company) partly by selling a 45 percent stake. It has also offered two new telecom licenses. However, only one license has been awarded to an international consortium.

⁸ We use the FERDI online database and its mining industries simulation tool (<https://fiscalite-miniere.ferdi.fr/en>).

between the computed AETRs and market penetrations or GNI per capita in 2018.

2 The AETR approach

We consider a representative MNO named TELCO. This firm operates a 15-year telecommunications license. It generates cash flows (revenue minus expenses) shared between the investor (the owner of TELCO), the government, and other regulatory authorities, which tax TELCO. The AETR captures this distribution of cash flows by measuring the effective tax burden on the telecommunication sector. We consider the general taxation system such as the Corporate Income Tax (CIT), professional taxes or payroll taxes, customs duties, and the special telecommunication taxation, including taxes on international or national traffic. Our analysis also integrates quasi-tax levies⁹ such as the pre-shipment inspection fees and contributions to the RA. However, we do not consider indirect taxation such as VAT, excises, and Personal Income Tax (PIT), which are collected by the firm but are due either by customers or firm's employees.

Our approach follows previous analyses computing AETR for a general economic sector or a specific one such as the extractive industry. For instance, Djankov et al. (2010) study the effect of corporate taxes on investment and entrepreneurship. The authors build a five-year business plan for a representative firm named TaxpayerCo, producing and selling ceramic pots. The World Bank Doing Business survey uses this fictitious firm to rank countries every year. Blake and Roberts (2006), Daniel et al. (2010), Luca and Mesa Puyo (2016), and Diouf and Laporte (2017) apply the AETR approach to the extractive industry (mining and petroleum). Daniel et al. (2010) and Luca and Mesa Puyo (2016) present the Fiscal Analysis of Resources Industries (FARI) model, which the International Monetary Fund (IMF) used extensively to simulate tax policy reform in the mining and upstream petroleum sectors.

The cash flows sharing model is based on Net Present Values (NPV). The AETR is given by:

$$AETR = \frac{\sum_{t=1}^{15} \frac{T_t}{(1+d)^t}}{\sum_{t=1}^{15} \frac{R_t - C_t - K_t}{(1+d)^t}}, \quad (eq. 1)$$

where T_t denotes tax revenues in year t , R_t turnover, C_t OPEX, K_t CAPEX, and d is the discount rate. A rate of 50 percent would mean that tax payment is 50 percent of before-tax cash flows

⁹ Quasi-taxes are not raised by the tax administration nor the customs.

over the license life length.

2.1 TELCO's accounting data

Given data availability and the diversity of market structures, we build TELCO, a standard representative MNO, which obtains its exploitation license in 2018 for 15 years. We model TELCO's financial statements during its license exploitation period using the GSMA Intelligence database, covering 237 countries and territories. This database encompasses market data (e.g., market shares, numbers of subscribers, market penetration, etc.), financial data (e.g., turnover, OPEX, CAPEX, and their decompositions, etc.), and communications volumes (e.g., outbound and inbound national and international minutes, SMS and data volumes).

To design the profile of TELCO, we consider all firms that were granted a mobile operating license in Africa over the period 2000-2017. We assume that the turnover and other data for each firm depend on its market penetration rate. We first define TELCO's turnover in each country as a share of the final national consumption. We consider national final consumption instead of Gross Domestic Product (GDP) since the former approximates better national demand for goods and services. That will allow us to consider market diversity by building different cash flow profiles depending on national demands. Final consumption data come from the World Development Indicators (WDI) of the World Bank. We express total OPEX and CAPEX as a proportion of turnover. We also consider the ratio of personnel and equipment costs over total OPEX. We determine national and international voice traffic in terms of inbound and outbound minutes per unique subscriber.¹⁰ We then compute the weighted average of each variable for each year over the length of the license to obtain TELCO's data. The weight is the individual market penetration rate. Each variable, denoted by \bar{x}_t , is then given by the following formula:

$$\bar{x}_t = \frac{\sum_{i=1}^n MP_{it} * x_{it}}{\sum_{i=1}^n MP_{it}}, \quad (\text{eq. 2})$$

¹⁰ The use of the number of subscribers allows us to consider the market size, which may vary across countries. Since our initial year is 2018, we would need data on final consumption and the number of subscribers from 2018 to 2032. However, such data is not available. We thus prefer to use observed data over the last 15 years and deduce TELCO's financial profile.

where MP_{it} and x_{it} represent respectively firm i 's market penetration rate at time t and its considered financial variable at time t .¹¹ TELCO's pre-tax Internal Rate of Return (IRR) is on average 60 percent across studied countries. Our web application allows users to modify TELCO's profile and apply the profile of actual MNOs.

2.2 Assumptions

We make several assumptions regarding TELCO's accounting and financial data (see the online appendix OI). First, we assume a straight-line depreciation rule, which determines CAPEX depreciation charges.¹² Second, we assume that TELCO finances its activity by combining debt and equity. We consider a debt-to-capital ratio of 60 percent with a repayment period of 5 years. These borrowings are subject to an interest rate of 10 percent. We consider a discount rate of 10 percent.¹³ We also make a sensitivity analysis by considering a lower interest rate of 6 percent.

We consider that the upfront license cost is part of tax revenue since it is paid by the investor to the government.¹⁴ An alternative approach would be considering the license cost as a market entry cost, a necessary investment to operate a mobile phone network.¹⁵ To define employer costs such as payroll taxes, we assume that wages and salaries represent 70 percent of labor costs. For professional or business licensing taxes, we consider that the rental value of business property corresponds to 5 percent of the total OPEX, excluding the cost of personnel and equipment.

While our approach is close to this developed by the IMF for the extractive sector's rent sharing,¹⁶ it differs significantly in its price structure assumptions. Indeed, oil and most mineral resources have a well-established world price, depending on global demand and supply variations. Commodity prices are thus an exogenous parameter for any individual mining or petroleum project, independent of its size. In other words, the extractive firm is a

¹¹ Indeed, for each operator in the sample, we determine a variable t that takes the values 1, 2, ..., and 15 for the first, second, ..., and the fifteenth year of operation, respectively. Aggregation of the data is performed for each period using a market penetration weighted average. TELCO's data for each operating period would therefore represent the mean profile of firms.

¹² We consider that tangible CAPEX represents 95 percent of total CAPEX.

¹³ These parameters are chosen according to Ferdi's gold mining representative firm's borrowing parameters for comparison purposes.

¹⁴ We consider a one-off license payment at the beginning of the exploitation.

¹⁵ The cost of the license would then be integrated into the denominator in deduction of the gross cash flows.

¹⁶ Fiscal Analysis of Resource industries: www.imf.org/external/np/fad/fari/.

price taker, and its production has no impact on the global price.¹⁷ The definition of prices is more complex in the telecommunication sector since markets are national and oligopolistic (see Faccio and Zingales, 2017). Telecommunications firms set their prices depending on the demand and the behavior of their competitors at the national level. On the supply side, interactions may take the form of a pure price or price-quality competition, which can significantly reduce firms' profits.¹⁸ Many developments in industrial economics aim to study the competition structure of a market and its impact on prices and consumer surplus.

We use historical data to determine the profile of turnover of TELCO during the exploitation of its license. We express this turnover in terms of final national consumption (see the online appendix). We focus only on the initial MNO core business in Africa: Selling prepaid access to voice and data services. Despite their recent rise, especially in East Africa, we do not regard complementary markets such as mobile phone banking or insurance. Considering these services would complexify our analysis significantly and involve additional fragile assumptions given the lack of sufficient hindsight over these activities.¹⁹ The discount rate captures the opportunity cost of invested capital in TELCO on the investor side. However, the discount rate also represents the government's preference for the present. That may explain the difference between the investor discount rate and the State discount rate. They can then vary across countries depending on risks and stakeholders' preferences. For example, we can expect higher discount rates for developing countries, given the short-term liquidity preference of their governments. However, choosing the appropriate discount rate is not easy given the preference divergence between governments and investors. Several analyses discuss factors such as the level of uncertainty, capital expenditures valuation, and other risk factors in the discount rate determination (Boadway and Bruce, 1984; Fane, 1987; Bonds and Devereux, 1995). For simplicity, we consider the same 10% discount rate for the investor and the government.²⁰ We propose a sensitivity analysis by setting the discount rate to 0, 5, and 12 percent in the online appendix O.IV.

¹⁷ This hypothesis can be discussed for minerals such as uranium or mining deposits such as Simandou's in Guinea for iron. The production capacity of the latter would represent a significant volume of worldwide production.

¹⁸ A classical result in the economic literature is the equivalence between Bertrand's duopoly equilibrium and pure and perfect competition. In both equilibria, prices are equal to marginal cost, and profits are zero.

¹⁹ Consequently, we do not consider special taxes levied on mobile banking.

²⁰ Chennells and Griffith (1997), Djankov et al. (2010), Luca and Mesa Puyo (2016), and Diouf and Laporte (2017) consider a discount rate of 10 percent. However, Luca and Mesa Puyo (2016) differentiate their discount rate for the government (10 percent) and the contractor (12.5 percent).

Following Chennells and Griffith (1997), we consider exchange rates and inflation in the AETR computation. We convert all tax variables in Euro, which is the currency of the GSMA database. Using data in nominal or real terms will not affect the AETR results, as the conversion rate will be the same for the numerator and the denominator of the AETR expression. In addition, the potentially substantial upfront license payment takes place on Year 0 and is not impacted by inflationary concerns. We then choose to keep the data in a nominal term as expressed in the GSMA database.

2.3 Tax data

The study considers the tax regimes applicable in 2018 to MNOs in 25 African countries. General taxation applies to all firms operating in the country. Tax and Customs Codes, Laws, and Acts define the standard tax regime. In addition, some special sources such as Investment Codes and other legal sources (act, decree, ministerial ruling, etc.) may provide tax incentives by reducing tax rates or the taxable base (see Appendix B). The taxation of the telecommunication sector is buoyant, and the current tax regimes may differ from these presented here. For instance, Burkina Faso increases the telecommunications network access tax rate from 5 percent to 7 percent (Article 28 of 2020's Finance Act).

General taxation includes direct and indirect taxation, as well as tariff duties collected at the borders. Direct taxation includes CIT, a minimum tax usually based on turnover, employer contributions on wages, and professional taxes based on rental or fixed asset value (see Table 1). CIT rates vary from 20 percent in Madagascar to 40 percent in Zambia. Three countries: Cote d'Ivoire, Tunisia, and Zambia, raise a higher CIT rate on MNOs than the standard rate. Moreover, Algeria, Ghana, Nigeria, and Tunisia also have an additional ad valorem tax applying to profits. Many African countries have an alternative mechanism for CIT purposes, which taxes turnover. This mechanism is called Minimum Income Tax and has a rate varying from 0.2 percent in Tunisia to 3 percent in Kenya. The employer contribution raised on wages ranges from 0.5 percent in Gabon to 20 percent in Chad. Cote d'Ivoire and Niger, for example, distinguish between the rate applied to local workers and foreigners. The professional tax has two components in Burkina Faso, Guinea, and Niger: a fixed lump sum from 279 Euro in

Guinea to at least 4,573 Euro in Niger;²¹ and a proportional one based on the rental value of the business property from 8 percent in Burkina Faso to 15 percent in Guinea. In the other countries, it is expressed as a percentage of turnover (Algeria and Senegal, for example) or assets value. Niger also has a commercial tax based on the number and types of billboards and advertising activities. Finally, Cote d'Ivoire, Gabon, Nigeria, and Tanzania have ad valorem taxes based on the turnover of MNOs, which aim to finance some activities such as arts, education, and local services.

Appendix B presents tax incentives, which apply to MNOs operating in the studied countries. Several countries such as Egypt, Ethiopia, Ghana, Senegal, and South Africa apply standard CIT rates. On the opposite, Tunisia displays a very generous mechanism by providing ten years CIT exemption and a reduced rate by half for the next ten years. Losses carry-forward significantly increase the effective length of CIT exemptions. Almost all countries have reduced or zero rates of customs duties for equipment and capital goods.

We only consider certain indirect taxes, which increase TELCO's production cost (see Table 2).²² These taxes are customs duties, non-deductible VAT on oil products, and the different levies associated with imports. We do not consider VAT in general and several excises, i.e., those raised on mobile handsets or OTT mobile communication applications.²³ These taxes are assumed to be transferred immediately to consumers. VAT is a tax on consumption as long as its mechanism of debit and credit is respected. VAT becomes a cost for the firms when it is not deductible (e.g. petroleum goods).²⁴ The taxation of OTT services aims at taxing the apps providers and not the MNO operating the telecommunication license. By contrast, customs duties directly increase the cost of production since networks equipment is imported. They range from zero to 30 percent. They are some specific fees or levies collected at the border.²⁵ For instance, customs unions such as the Eastern African Community (EAC) or the Western African Economic and Monetary Union (WAEMU) raise fees or quasi-tax for the budget of their respective Commissions. In addition, several African countries also use private firms to assist their own customs administration through Pre-Shipment Inspection (PSI)

²¹ In Niger, the fixed lump sum is determined depending on the turnover value going from 4,573 Euro to 45,734 Euro.

²² The AETR computation does not consider VAT, sales tax, and excise duties on telecommunication services.

²³ Uganda raised such tax in 2018. The latter corresponds to a daily payment of 200 shillings (0.053 USD) to use any one of 58 applications such as Facebook, Twitter, Instagram, LinkedIn, WhatsApp, Snapchat, Skype, Tinder, Grindr, etc...

²⁴ VAT rates vary from 5 percent in Nigeria to 20 percent in Madagascar and Morocco.

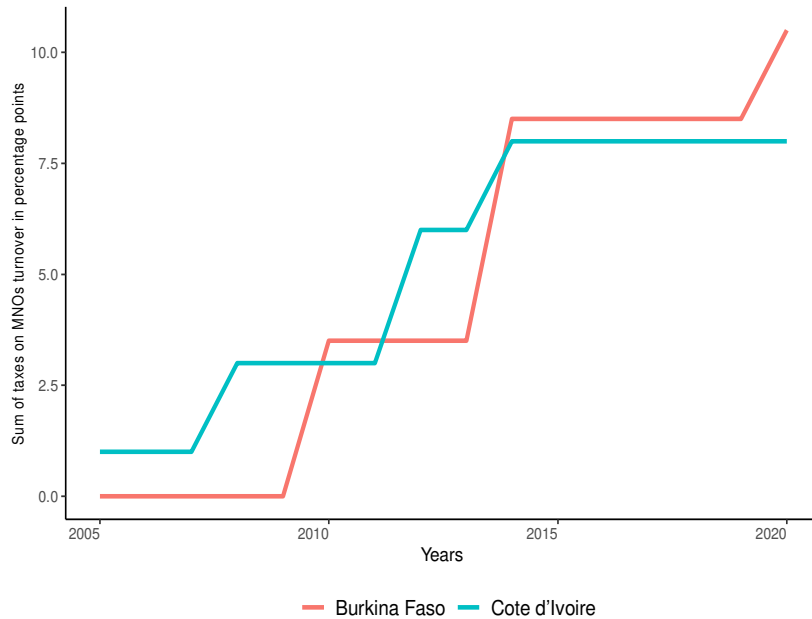
²⁵ Those are collected on network equipment and mobile device imports for TELCO.

programs. These firms provide additional information on the value of imported goods. The importers must pay this service through a fee equivalent to a quasi-tariff on importations (see Dequiedt et al., 2012).

Special taxation on the telecommunication sector results from specific laws and decrees, which regulate this sector (see Table 3). We consider the following taxes and fees: taxes on national and international traffic, telecommunication network access tax, numbering fees, Universal Service Fund, research and development fund, and RA levy and particular fees.²⁶ These taxes may be ad valorem (based on turnover) or specific (nominal amount based on some activity measures such as minutes, data, and SMS). This special taxation is similar to excise duties collected by firms but legally due by consumers. However, given the incidence of this mobile-specific taxation and the demand elasticity of the sector, we assume that this special taxation is due by MNOs themselves. The sum of special ad valorem taxes and fees raised on turnover varies from 0.55 percent in South Africa to 8.5 percent in Burkina Faso. We express specific taxes in Euro. Taxes on MNOs have increased significantly over time. Figure 2 illustrates the case of Burkina Faso and Côte d'Ivoire. For the former, the sum of tax rates on MNOs turnover increased from 0% in 2005 to 10.5% in 2020, while it increased from 1% in 2005 to 8% in 2014 for the latter.

²⁶ We have used GSMA reports on telecommunications sector taxation to ensure that we have captured most of the taxes applied to telecommunications companies. Indeed, GSMA conducts studies on telecommunications taxation at the country level and regional or global levels. These reports present all taxes paid by MNOs in the countries we study. In addition, we compared studied taxes with those mentioned in Matheson and Petit (2021). Finally, we had several interviews with the CFOs of some MNOs, who provided us with the details on some contributions.

Figure 2: Evolution of special taxes on MNOs' turnover in Burkina Faso and Cote d'Ivoire



Source: Authors.

Spectrum fees are the main component of regulatory fees. Table 3 displays an estimation of these fees in terms of turnover, which is based on the average relevant payment reported in the GSMA database. However, spectrum fees vary significantly in their form across countries and from one year to another. For example, DRC raises a specific tax of 53,500 USD/MHz for GSMs, 6,000 USD/MHz for microwaves, and 3,000 USD/MHz for the internet. The Guinean spectrum fees have the following structure: 5,525 Euro/MHz for WiMAX networks, 110 Euro for ARMC's, 7,735 Euro for GSM 900's and DCS 1800's, 5,525 Euro for VSAT's and from 1,547 to 9,282 Euro paid annually for digital terrestrial networks depending on the size of beams.

Table 1: Direct taxes in 2018

Taxable base	Corporate	CIT	Apprenticeship	Other direct taxes			Other taxes
	Income Tax (CIT)	minimum perception	tax	Professional tax	Property tax	Commercial publicity tax	
	Profits	Turnover	Wages	Turnover, lump sum, rental value of property or turnover	Fixed assets value inclusive of all taxes	Number or area of advertising mediums days or operations	Turnover
Algeria	0.26	-	-	0.02	-	-	-
Angola	0.3	-	0.08	-	-	-	-
Benin	0.3	0.0075	0.04	-	-	-	-
Burkina Faso	0.275	0.005	0.03	Fixed duty: 610 Euro Proportional duty: 0.08	-	-	-
Cameroon	0.33	0.022	-	0.00156 [1]	-	-	-
Chad	0.35	0.015	0.20 [2]	-	-	-	-
Cote d'Ivoire	0.30	0.005	Nationals: 0.035 Foreigners: 0.155 [3]	0.007 [1]	-	-	0.003 [4]
DRC	0.35	0.01	0.02	-	-	-	-
Egypt	0.225	-	-	-	-	-	-
Ethiopia	0.3	-	0.11	-	-	-	-
Gabon	0.30	0.01	0.005 [2]	-	-	-	0.01 [5]
Ghana	0.25	-	-	-	-	-	0.05 [6]
Guinea	0.35	0.015	0.075 [3]	Fixed duty: 279 Euros Proportional duty: 0.15 [1]	-	-	-
Kenya	0.3	0.03	0.05 [7]	-	-	-	-
Madagascar	0.2	0.005	0.13	-	-	-	-
Mali	0.30	0.01	0.085 [8]	Fixed duty: 1,524 Euro Proportional duty: 0.10	-	-	-
Morocco	0.31	0.005	-	0.10	-	-	-
Niger	0.30	0.015	Nationals: 0.03 Foreigners: 0.05	Fixed duty: 4,573 to 45,734 Euro Proportional duty: 0.10	0.01	0.3 to 7,6 Euro/day, M2, or operation	-
Nigeria	0.3	0.0025	0.01 [9]	-	-	-	0.03 [10]
Senegal	0.30	0.005	0.03	0.003 of the before tax turnover [11]	-	-	-
Sierra Leone	0.3	-	0.1	-	-	-	-
South Africa	0.28	-	0.01 [12]	-	-	-	-
Tanzania	0.3	0.005	0.06 [12]	-	-	-	0.003 [13]
Tunisia	0.35	0.002	0.1857 [14]	-	-	-	0.002 on turnover + 0.01 on CIT base [16]
Zambia	0.4	-	0.055 [17]	-	-	-	-

Source: Countries' General tax codes and finances acts.

[1] Business licence tax.

[2] It includes the lump-sum tax on salaries at a rate of 7.5 percent, the tax on salaries at a rate of 11.5 percent, and the apprenticeship tax at a rate of 1.2 percent.

[3] Including the national levy for economic, cultural and social development of the nation at the rate of 1.5 percent, the apprenticeship tax at the rate of 0.5 percent; and additional taxes for continuing professional training at the rate of 1.5 percent. For foreigners, the employer levy at the rate of 11.5 percent is included.

[4] Including artistic creation tax at the rate of 0.2 percent and equipment special tax at the rate of 0.1 percent.

[5] Special solidarity levy.

[6] National fiscal stabilisation levy which applies on the CIT base. It is expected to apply from 2018 to 2025.

[7] Employer contribution.

[8] Including the employer lump sum contribution at the rate of 3.5 percent, professional training tax at the rate of 2 percent, young people employment tax at the rate of 2 percent, and housing tax at the rate of 1 [9] Industrial training cost.

[10] Including the tertiary education tax of 0.02 and the international technology tax of 0.01.

[11] It is about local economy levy which replace the busing licensing tax in 2018.

[12] Skill development levy.

[13] Local service tax.

[14] Including the professional training tax at a rate of 0.02 and the social security levy at a rate of 0.1657.

[15] Tax on establishments of an industrial, commercial or professional nature for the benefit of local authorities.

[16] Social solidarity levy.

[17] Including the skill development levy at a rate of 0.5 percent and the national pension scheme at a rate of 5 percent.

Table 2: Indirect taxes, customs duties, and fees in 2018

Indirect taxes	Custom duties	Non deductible VAT	Community Solidarity levy	Statistical import charge	Community levies [1]	OHADA levy [2]	Pre-shipment inspection tax
Taxable base	CIF imports value	Before tax Goods and services value			CIF imports value		
Algeria	0.3	0.19	0.01	-	-	-	-
Angola	0.1	0.14	-	-	-	-	-
Benin	0.05; 0.1; 0.2; 0.35	0.18	0.008	0.01	0.005	-	0.01
Burkina Faso	0.05; 0.1; 0.2; 0.35	0.18	0.008	0.01	0.005	-	0.01
Cameroon	0.05; 0.1; 0.2; 0.30	0.1925	0,01	0.01	0,004	0.0005	0,002
Chad	0.05; 0.1; 0.2; 0.30	0.16	0,01	0.01	0,004	0.0005	0,002
Cote d'Ivoire	0.05; 0.1; 0.2; 0.35	0.09	0.008	0.01	0.005	-	0.01
DRC	0.05; 0.1; 0.2; 0.30	0.16	0,01	0.01	0,004	0.0005	0,002
Egypt	0.05-0.4	0.1	-	-	-	-	-
Ethiopia	0-0.35	0.15	-	-	-	-	-
Ghana	0 - 0.2	0.15	0.035 [3]	0.01	0.005	-	-
Gabon	0.05; 0.1; 0.2; 0.30	0.18	0,01	0.01	0,004	0.0005	0,002
Guinea	0.05; 0.1; 0.2; 0.35	0.18	0.008	0.01	0.005	-	0.01
Kenya	0 - 0.25	0.16	0.015 [3]	0.02	-	-	-
Madagascar	0.05 - 0.2	0.2	-	-	-	-	-
Mali	0.05; 0.1; 0.2; 0.35	0.18	0.008	0.01	0.005	-	0.01
Morocco	0-0.25	0.20	-	-	-	-	-
Niger	0.05; 0.1; 0.2; 0.35	0.19	0.008	0.01	0.005	-	0.01
Nigeria	0 - 0.24	0.05	0.005	0.01	-	-	-
Senegal	0.05; 0.1; 0.2; 0.35	0.18	0.008	0.01	0.005	-	0.01
Sierra Leone	0.05; 0.1; 0.2; 0.35	0.15	-	0.01	0.005	-	-
South Africa	0 - 0.4	0.14	-	-	-	-	-
Tanzania	0 - 0.25	0.18	0.015 [4]	0.02	-	-	-
Tunisia	0.3	0.19	-	-	-	-	-
Zambia	0 - 0.25	0.16	-	-	-	-	-

Source: Countries' General tax codes and finances acts.

[1] Community integration levy: Communauté des Etats d'Afrique Centrale (CEMAC), Eastern Africa Community (EAC), Economic Community of West African States (ECOWAS), South Africa Custom Union (SACU), Western African Economic and Monetary Union (WAEMU).

[2] Organisation pour l'Harmonisation en Afrique du Droit des Affaires.

[3] Including the special import levy at a rate of 0.01 in place from 2018 to 2025 and the national insurance levy at a rate of 0.025.

[4] Railway development levy.

Table 3: Special taxation in 2018

Special taxes	Tax on national traffic	Tax on international inbound traffic	Numbering fees	Telecommunication network access tax	Universal service fund	Research and development fund	Regulatory agency financing levy	Annual fees on turnover [5]	Spectrum fees
Taxable base	Number of interconnected national minutes (Euro/minute)	Number of international inbound minutes (Euro/minute)	Number of assigned/booked phone numbers (Euro/number)			Gross turnover			Turnover (Computed)
Algeria	-	-	-	0.01	0.03	0.003	0.005	0.01	0.0074
Angola	-	-	0.20598	-	0.01	-	-	-	0.0074
Benin	-	*0.1 [1]	0.2286	0.02	0.01	0.005	0.01	-	0.0074
Burkina Faso	-	-	0.61	0.05 [2]	0.02	0.005	0.01	-	0.015
Cameroon	-	-	0.23	0.03 [3]	-	-	0.015	-	0.016
Chad	-	0.0762	0.2515	-	0.025	0.01	0.035 [4]	-	0.0074
Cote d'Ivoire	-	-	0.15	0.05	0.02 [5]	0.005	0.005	-	0.017
DRC	0.00367 [6]	0.0678 [7]	0.38	-	-	-	-	0.03 [8]	0.025
Egypt	-	-	-	0.03	0.005	-	-	-	0.02
Ethiopia	-	-	-	-	-	-	-	-	0.0074
Gabon	-	0.0716 [9]	0.686	-	0.01	0.02	-	-	0.016
Ghana	-	0.0508 [10]	0.42379	-	0.01	-	-	0.01	0.0061
Guinea	0.00279 [11]	0.1	0.07	0.03	0.015	0.01	-	-	0.03
Kenya	-	-	-	-	0.005	-	-	0.004	0.0185
Madagascar	-	-	-	0.02	0.02 [12]	-	-	-	0.03
Mali	-	-	0.3	0.05	0.01	-	-	-	0.011
Morocco	-	-	-	0.01	0.02	-	-	-	0.016
Niger	-	0.1311 [13]	0.15	-	0.02	0.01	0.02	-	0.013
Nigeria	-	-	0.02348	-	0.025	-	-	-	0.0017
Senegal	-	-	0.3	0.05 [14]	-	-	-	-	0.02
Sierra Leone	-	-	0.1926	0.005	-	-	-	0.01	0.035
South Africa	-	-	-	-	0.002	-	-	0.0035	0.0074
Tanzania	-	0.0419 [15]	0.1695	-	0.003	-	-	0.01	0.0047
Tunisia	-	-	0.1614	0.05	-	-	-	-	0.0074
Zambia	-	-	0.0244	-	-	-	-	0.03	0.0074

Source: National legislations.

[1] Turnover relating to international incoming calls.

[2] Specific tax on telecommunication companies.

[3] Telecommunication special fund levy.

[4] ARCEP administration fee.

[5] In addition to the 3 percent annual fees on turnover DRC raises also some management fees on interconnection activities at the rate of 15 percent of the cost of interconnected minutes.

[6] Local interconnection tax.

[7] Telecommunication regulation tax.

[8] Telecommunication special fund levy.

[9] The tax on international incoming traffic rate is 0.2086 Euro/Minute, of which 65.7 percent is refunded to MNOs.

[10] Applicable to telecommunication operators and internet providers.

[11] National interconnection fees.

[12] Contribution to the development of telecommunication fund.

[13] This tax was repealed in FY 2018 and restored by the 2019 Finance Law.

[14] Special levy on telecommunications.

[15] It represents the share returned to the government.

3 Results

Table 4 displays the AETR results. The tax burden on TELCO exceeds 50 percent in several countries and even 100 percent in some of them, meaning that TELCO's investors would lose money.²⁷ The AETR varies from 33 percent of generated cash flows in Ethiopia to 118 percent in Niger, with an average value of 64 percent across the sample (column 1 of Table 3). We previously emphasized the fictitious case of a private MNO in Ethiopia since the telecommunication sector was still State-owned in 2018. The market liberalization process began in this country only in June 2019. The AETR in Niger is above 100 percent (118 percent), meaning that our representative MNO will lose money by operating its license in this country. Special taxation explains 65 percent of this excessive tax burden. Among the studied countries, Niger levies the heaviest tax on international calls at 0.13 Euro per minute and significant cumulated turnover fees (5 percent)²⁸, while it provides one of the most generous incentives regimes with a total CIT exemption for seven years. The tax on international calls was cancelled in 2018 and restored in 2019. This tax regime appears particularly distortionary, burdensome, and uncertain. It may explain why Orange SA, the French MNO, which operates in 18 African countries, decided to leave Niger by selling its subsidiary Orange Niger in 2019.²⁹ Some countries such as Guinea and DRC also apply specific taxes on traffics and experience high tax burdens. For others (e.g., Mali and Senegal), the high cost of the exploitation license represents a large share of the AETR.

We compute the AETR considering only CIT (column 3 in Table 3). It ranges from 8.5 percent in Tunisia to 37.6 percent in Zambia, with an average value of 27.9 percent. This average is close to the estimation of the AETR for the information media and telecommunication sector, equal to 24.3 percent in Steinmüller et al. (2019). These authors calculate the average firm-industry-level ETR for 142 countries over the period 2004 to 2014.

Columns 4 and 6 provide a breakdown of the AETR in terms of general (AEGTR) and special taxation (AESTR). The former expresses the burden of general taxation in each country, as the national Tax and Customs Codes (or Acts) define it. At the same time, the AESTR summarizes

²⁷ In such a case, MNOs may obtain additional and particular tax advantages, which may not be publicly disclosed.

²⁸ These fees finance the Universal Service fund (2 percent of the turnover), the Research and Development fund (1 percent), and the Regulatory Agency (2 percent).

²⁹ Orange Niger disputed a tax claim of 33 million euros and was ordered to close offices in 2018.

special taxation applied to the telecommunication sector. The high level of AETRs results mainly from mobile-special taxation. The AESTR ranges from 2 percent of the pre-tax cash flows in Ethiopia to 106 percent in Niger, with an average value of 38 percent. The AESTR is significantly higher than the AEGTR in 14 countries. The online appendix O.IV displays a sensitivity analysis of our results depending on the discount rate and the interest rate. Our results remain robust to these variations.

Some special taxes are deductible from CIT. Table 4 displays a striking result in several countries (Benin, Chad, DRC, Gabon, Niger, Senegal, Tanzania, Tunisia), where the AEGTR is below the CIT AETR. It may appear surprising since the computation of the AEGTR encompasses the CIT and other direct taxes. However, the taxable base of the AEGTR is smaller since special taxes are deductible for CIT purposes and are not considered in the computation of the CIT AETR. For instance, DRC displays a gap of 21 percent: its CIT AETR is equal to 37.2 percent, while its AEGTR amounts to 16.4 percent. DRC raises numerous and significant special taxes on MNOs, its AESTR reaching 81.1 percent.

Table 4: AETR (percentage)³⁰

	AETR	Statutory rate (CIT)	AETR (CIT)	AEGTR [2]	% AETR	AESTR [1]	% AETR
Algeria	48.77	26.0	26.75	28.84	59.1%	19.92	40.8%
Angola	43.25	30.0	30.43	32.76	75.7%	10.49	24.3%
Benin	78.84	30.0	29.46	28.19	35.8%	50.66	64.3%
Burkina Faso	87.29	27.5	31.67	23.53	27.0%	63.75	73.0%
Cameroon	66.38	33.0	25.41	25.41	38.3%	40.97	61.7%
Chad	70.54	35.0	32.3	23.61	33.5%	46.93	66.5%
Cote d'Ivoire	81.38	25.0 ; 30.0 [3]	22.0 ; 26.4	23.67	29.1%	57.71	70.9%
Congo, DR	97.49	35.0	37.22	16.36	16.8%	81.13	83.2%
Egypt	41.17	22.5	23.92	21.4	52.0%	19.77	48.0%
Ethiopia	33.08	30.0	28.79	31.2	94.3%	1.88	5.7%
Gabon	64.84	30.0	34.78	31.08	47.9%	33.76	52.1%
Ghana	54.23	25.0	25.7	29.23	53.9%	25.00	46.1%
Guinea	93.69	35.0	34.26	17.93	19.1%	75.76	80.9%
Kenya	43.16	30.0	31.67	34.37	79.6%	8.79	20.4%
Madagascar	46.71	20.0	21.85	22.39	47.9%	24.33	52.1%
Mali	93.83	30.0	20.69	20.8	22.2%	73.02	77.8%
Morocco	35.06	31.0	16.78	18.58	53.0%	16.48	47.0%
Niger	118.16	30.0	19.84	12.37	10.5%	105.79	89.5%
Nigeria	40.51	30.0	27.66	32.63	80.5%	7.88	19.5%
Senegal	92.53	30.0	34.79	32.23	34.8%	60.3	65.2%
Sierra Leone	70.05	30.0	28.46	28.14	40.2%	41.91	59.8%
South Africa	37.2	28.0	32.73	31.58	84.9%	5.62	15.1%
Tanzania	63.2	30.0	28.9	27.03	42.8%	36.16	57.2%
Tunisia	46.93	25.0 ; 35.0 [3]	6.2 ; 8.5	25.22	53.7%	21.71	46.3%
Zambia	50.55	25.0 ; 40.0 [3]	32.9 ; 37.6	37.8	74.8%	12.75	25.2%

Source: Authors computations.

[1]: Average Effective General Tax Rate.

[2]: Average Effective Special Tax Rate.

[3]: Côte d'Ivoire, Tunisia and Zambia apply a higher CIT rate for MNOs, respectively 30, 35 and 40 percent instead of 25 percent.

Figure 3 depicts the AETR by type of tax. We distinguish special telecommunication taxes from standard general taxes. We notice that license fees represent more than 50 percent of the AESTR (57 percent of the AESTR in Benin, 67 percent in Mali, 63 percent in Senegal, and 60 percent in Sierra Leone). In the other countries, the other special mobile phone companies' taxes explain more than 50 percent of the AESTR. Their share in TELCO's pre-tax cash flows varies from 2 percent in Ethiopia to 76 percent in Niger. We complete our analysis by breaking down the AETR within all beneficiary institutions, namely States and local governments, RAs, and other stakeholders such as Customs Unions³¹ or other institutions as the pre-shipment inspection firms (see Figure 4). State and local governments are the main beneficiaries of tax revenues, with an AETR ranging from 20 percent of TELCO's pre-tax cash flows in Morocco to 98 percent in Niger. Indeed, they receive direct taxes, non-deductible

³⁰ Online Appendix O.II illustrates our approach for the case of Cameroon.

³¹ WAEMU, CEMAC, and ECOWAS, for example.

VAT on petroleum products, customs duties, and a share of special telecommunication taxes. RAs are the second most important beneficiary as they receive the remaining part of special telecommunication taxes, including universal services fund, regulatory taxes and fees, and research and development contributions.

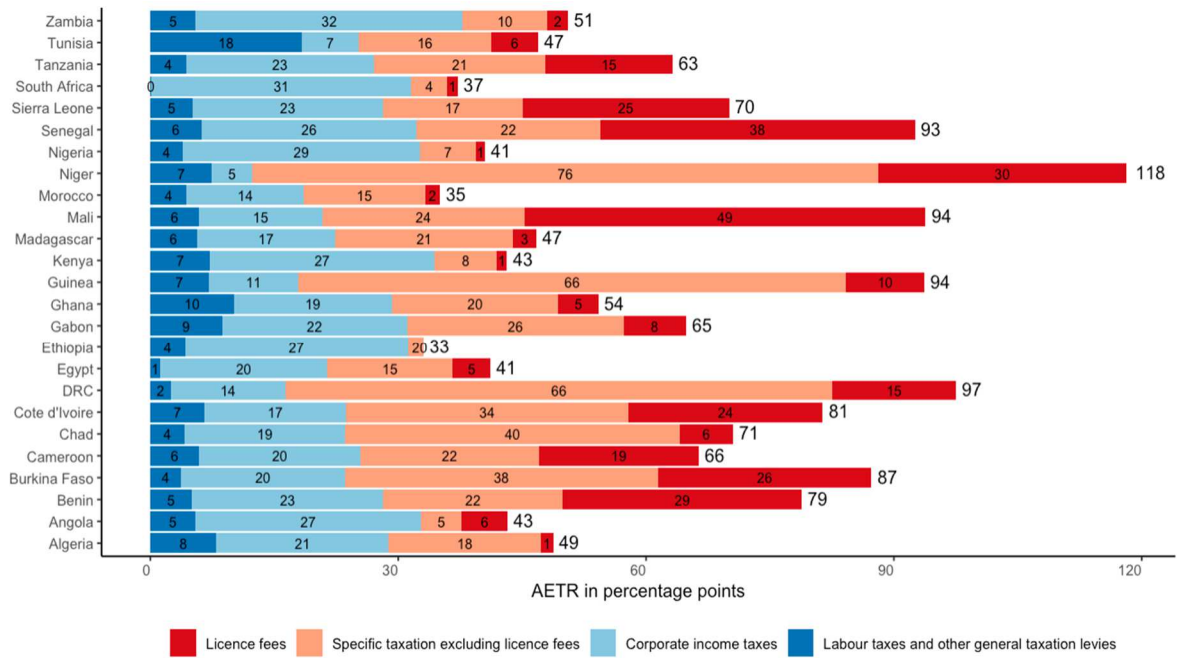
The autonomy or independence of the Telecommunication RA may trigger a race to the top with the Ministry of Finance, which means an excessive tax burden. Keen and Kotsogiannis (2002) formalize the vertical tax competition between two levels of government in federal State. Both institutions tax the same base, and this competition, or equivalently the lack of cooperation among them, induces higher tax rates. Such interactions contrast with the standard view of horizontal tax competition (see Wilson, 1986, Zodrow and Mieszkowski, 1986, and Rota-Graziosi, 2018) and its race to the bottom. Beyond vertical tax competition, Berkowitz and Li (2000) develop the notion of tax rights that is the property rights that a government or an agency has on a particular tax base. Multiple tax agencies' over-exploitation of the same tax base involves an excessively high aggregated tax rate, low investments, inefficient public expenditures, and poor economic performance. The competition or cooperation between the Telecommunication RA and the Ministry of Finance can explain the level of the AETR of TELCO and its heterogeneity across countries.

We now compare the AETRs of three sectors in each country: telecommunications, gold mining,³² and, a standard economic one.³³ An immediate result (see Figure 5) is that MNOs face a higher tax burden than the gold mining sector in fifteen (15) countries. The AETR in the gold mining sector varies from 31 percent in Nigeria to 72 percent in Chad. Its average value is around 46 percent against 68 percent for the mobile sector. In several countries, the special taxation on telecommunications alone is higher than the total tax burden applied to the mining sector. The mining sector remains, however, more taxed than the standard economic one except in Nigeria.

³² The AETR computation for the gold mining sector comes from <https://fiscalite-miniере.ferdi.fr/en> consulted on June, 21th 2019. We retained simulations with a medium-grade open-pit mine (3g/t) and a price of 1,300 USD/oz. Details on the FERDI's representative mining firm are given in the online appendix O.III (for more details, see Laporte et al., 2019). The gold price is considered to be 1,300 USD regarding its observed value on June 17, 2019, at 10h30 (1,333.2 USD/oz on <https://www.banque-france.fr/en/statistics/rates/gold-prices-0> consulted on June 17, 2019). Algeria, Egypt, Ethiopia, Morocco, Tunisia, and Zambia are not covered in the FERDI analysis of the gold mining sector.

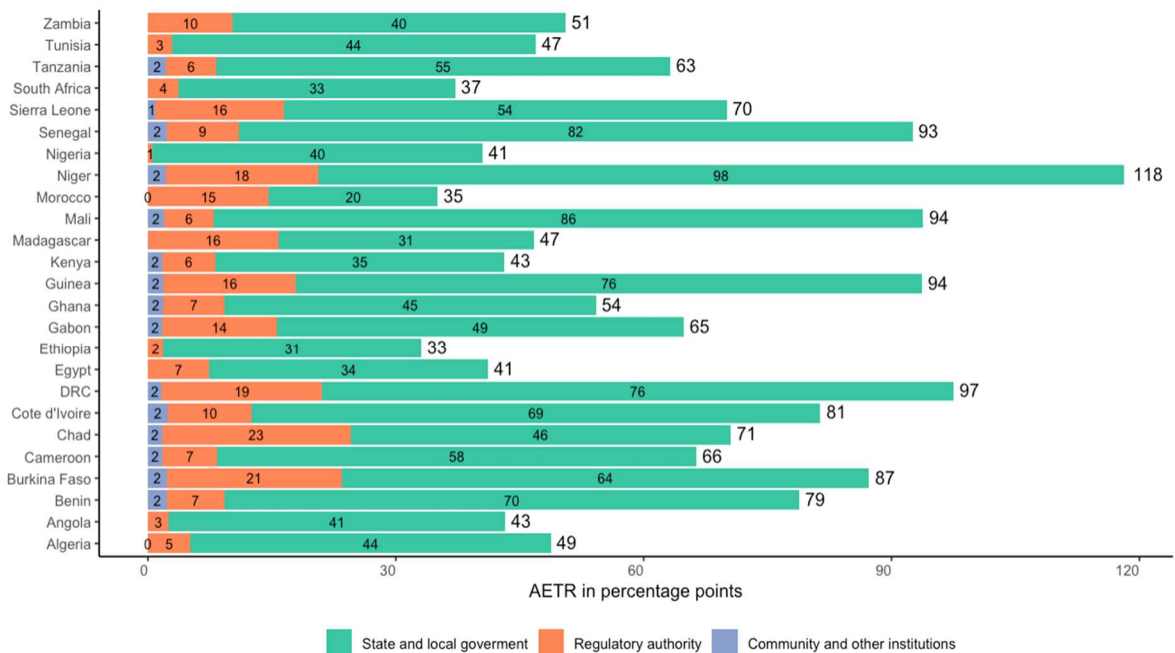
³³ We also compute the AETR of a firm operating in a standard economic sector under the general tax regime and with similar financial features (turnover, OPEX, CAPEX...) than TELCO.

Figure 3: AETR breakdown by taxation type.



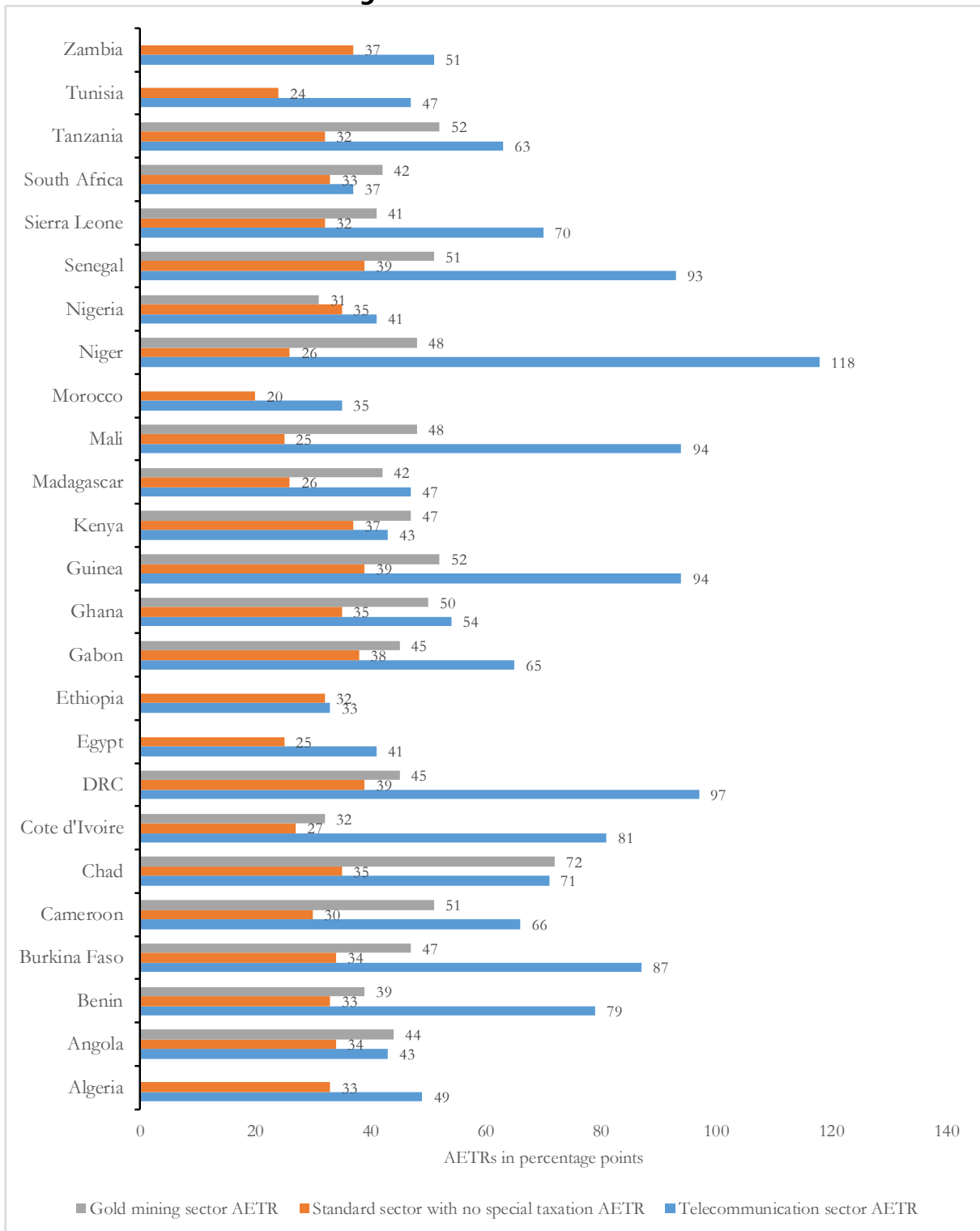
Source: Authors.

Figure 4: AETR breakdown by beneficiary institutions.



Source: Authors.

Figure 5: AETRs across sectors.



Source: Authors.

The difference in taxation between the mining and telecom sector results from the number and the rates of special taxes. It may appear surprising, even inconsistent, given the tax base: a non-renewable resource on one side and a limited resource with significant positive externalities on the other side. This difference can reflect better coordination or lower tax

competition between the MoF and the Minister in charge of the Mining and Petroleum sector than between the former and the Telecommunication RA. Another potential explanation is the more efficient lobbying activity from the extractive industries. For instance, the mining sector enjoys tax stability clauses, which protect investors against any modification of general and special tax rates. The main justification of these clauses is the risky nature of mining investments, given the profile of generated cash flows. Furthermore, extractive industries have to invest a significant level of capital at the beginning of the exploitation to build the mining plant. This investment is irreversible and linked to the deposit. These characteristics expose the sector to the risk of partial expropriation through increased taxation or even complete expropriation through nationalization. Nevertheless, initial investments in the telecommunication sector are also substantial, irreversible, and linked to a given territory. Moreover, they may represent a significant share of total capital expenditures (more than 50 percent for our representative firm). Finally, a last explanation of the higher tax burden for MNOs is the history of each sector, which shapes their respective tax regime: The extractive industry is in place for some time in almost all the studied countries, while the telecommunication sector is relatively new.

4 Conclusion

We estimate the AETR for a standard representative firm, TELCO, in twenty-five (25) African countries using a cash flow model over the length of a telecommunication license. The tax burden varies significantly from one country to another depending on the weight and the characteristics of special taxes applied to telecommunications companies. The AETR varies from 33 percent in Ethiopia to 118 percent in Niger. We distinguish general taxation from special telecommunications taxation highlighting the risk of tax competition between the MoF and the Telecommunication RA. The results show that the MNOs' special taxation component explains more than 50 percent of the AETR in many countries. States and RAs are the main beneficiaries of tax revenues. We also compute the AETR for CIT only. We observe that this measure is lower for TELCO than for a standard firm since several special telecommunication taxes and fees are deductible from the CIT base.

Telecommunication is generally more taxed than the mining sector. We compare the AETR of TELCO with a representative gold mining firm and a standard firm, which both display the same gross return of investment, around 60 percent. The tax burden of TELCO is higher in

fifteen (15) countries out of the nineteen (19) countries for which we have information covering their mining tax regime. We mention some potential explanations such as a more efficient lobbying activity of the mining sector or a vertical tax competition between the MoF and Telecommunication RAs³⁴, which deserve more investigations.

Our analysis is not sufficient to deduce the right level of an optimal tax burden. That is a delicate issue in general and for some specific economic sectors as the extractive industries. Moreover, beyond the level of taxation, the form of taxation (based on profit, turnover, or volume) matters too in terms of economic distortions, telecommunication development, and digital inclusion (see Ndung'u, 2017). Figure 6 displays a correlation analysis between computed AETRs and market penetration and Gross National Income (GNI) per capita.³⁵ We find a negative correlation between the AETR and these two variables. Countries with lower market penetration rates and GNI per capita experience higher AETRs. Special taxes and fees drive these results since the correlation between AESTRs and market penetration or GNI per capita is also negative. The correlation is by contrast positive between the standard taxes captured by the AEGTRs and the two variables. We stress that telecommunication RAs can raise very distortionary taxes or fees, as Hausman (1998) emphasized in the case of the US Telecommunication sector.³⁶ The deductibility of some special taxes from the CIT base may increase the economic inefficiencies of special taxation. Alternatively, these correlations may also illustrate that more advanced countries in terms of mobile phone market penetration rely less on special taxation. This relationship could result from more powerful lobbying of MNOs in these countries.

We restricted our analysis to the exploitation of the telecommunication license. However, multiple services may be related to this license, particularly mobile money services, which are booming in Africa and contribute to the financial inclusion of populations. The importance of these services differ across countries. On average, mobile money barely accounted for less than 10 percent of the telecommunication firm's turnover in 2018 (see GSMA database). However, several countries raise new taxes on firms' turnover or mobile money transactions. The analysis of the impact of these taxes on financial and digital inclusions is beyond the

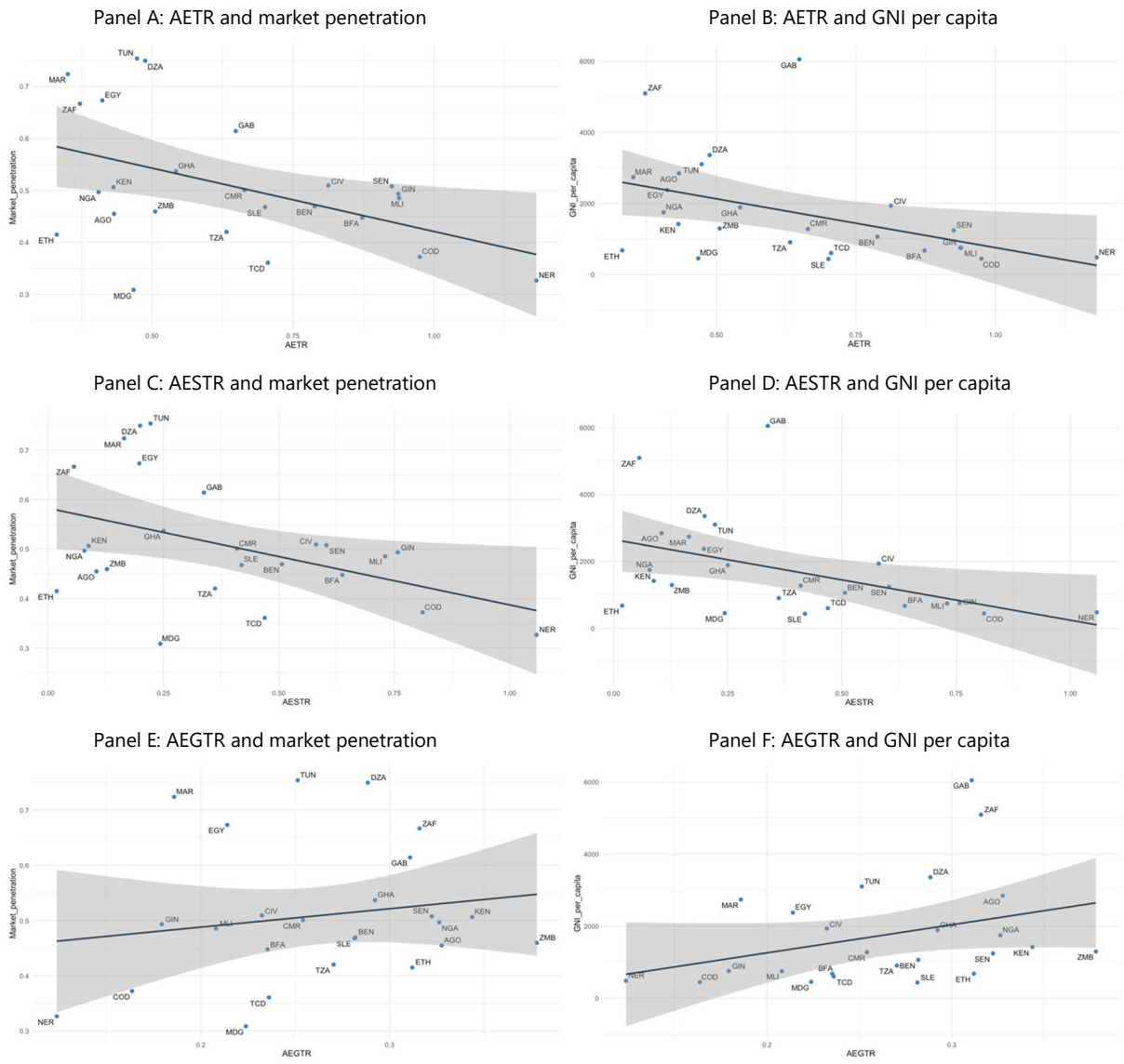
³⁴ However, it is worth noting that RAs may not be independent from the political influence in practice in some countries.

³⁵ The small number of countries limits our capacity to conduct rigorous empirical analysis.

³⁶ The author highlights the inefficiency of fees raised by the Federal Communications Commission to fund a program providing free internet access to schools and libraries. Despite all the technological innovations in the telecommunication sector over the past decades, several issues addressed in this paper remain highly relevant.

scope of this paper and could be addressed in further research.

Figure 6: Correlation analysis.



Source: Authors.

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Appendix A: Some characteristics of the studied countries in 2018

	Population	GDP/capita EUR (2018)	Unique subscribers Market penetration	Number of MNOs	Date of liberalization	ARPU by subscriber in EUR	3G network coverage by population	SIM cards per subscriber
Algeria	42 228 429	3487.6	74.97%	3	2002	5.19	90.00%	1.57
Angola	30 809 762	2913.9	45.50%	2	2001	14.12	61.00%	1.04
Benin	11 485 048	1099.1	46.94%	4	2000	6.07	63.36%	1.66
Burkina Faso	19 751 535	726.5	44.78%	3	2000	4.85	65.00%	2.15
Cameroon	25 216 237	1359.2	50.08%	4	1998	5.54	74.99%	1.51
Chad	15 477 751	643.2	36.09%	3	1998	5.5	36.89%	1.71
Congo, Dem. Rep.	84 068 091	493.4	37.22%	4	2001	2.42	53.10%	1.23
Cote d'Ivoire	25 069 229	2039.6	50.94%	4	1997	9.52	94.44%	2.48
Egypt	98 423 595	2160.6	67.33%	4	2003	2.2	99.00%	1.51
Ethiopia	109 224 559	653.9	41.50%	1	-	0.85	85.00%	1.38
Gabon	2 119 275	7047.7	61.43%	3	2000	19.15	63.64%	2.23
Ghana	29 767 108	1950.7	53.69%	6	1990	7.13	85.00%	2.29
Guinea	12 414 318	871.0	49.34%	4	2005	5.58	65.00%	1.75
Kenya	51 393 010	1512.9	50.64%	3	2000	6.41	88.00%	1.6
Madagascar	26 262 368	467.2	30.86%	4	1998	4.18	81.46%	1.21
Mali	19 077 690	797.3	48.54%	3	2003	7.59	31.63%	2.36
Morocco	36 029 138	2854.1	72.40%	3	2000	8.11	98.00%	1.7
Niger	22 442 948	506.2	32.66%	4	2002	5.37	62.76%	1.45
Nigeria	195 874 740	1800.5	49.69%	4	1999	5.75	70.00%	1.57
Senegal	15 854 360	1298.2	50.78%	3	1997	6.86	85.00%	2.00
Sierra Leone	7 650 154	473.0	46.79%	3	2003	6.33	40.02%	1.64
South Africa	57 779 622	5645.9	66.69%	4	1994	16.16	99.20%	2.36
Tanzania	56 318 348	939.8	42.03%	6	2005	3.38	48.96%	1.61
Tunisia	11 565 204	3046.0	75.41%	3	2002	3.93	97.00%	1.95
Zambia	17 351 822	1378.5	45.96%	3	1995	4.42	40.00%	1.77
Africa	1 303 404 680	2319.0	49.15%	2.76	-	5.7	69.99%	1.65
World	7591932906.5	9646.9	69.58%	3.08	-	17.55	89.85%	1.544

Sources: WDI, GSMA Intelligence, ITU Measuring the Information Society Report 2018 – Volume 2, and google search.

Note: 3G network coverage by population corresponds to "3G mobile coverage, expressed as a percentage of the total market population, at the end of the period."

ARPU by subscriber is the average revenue per user and measures "total recurring (service) revenue generated per unique subscriber per month in the period."

Appendix B: Tax advantages (exemption and reduced rates) in 2018

	CIT			Custom duties on equipment		Other advantages	
	Advantage	Number of years	Losses carry forward (Nb. Years)	Advantage	Number of years	Allowance for special taxes on turnover (% of turnover)	Other taxes
Algeria	Exempt.	3	4	Exempt.		0,15	Professional tax (exempt.), 3 years
Angola	Reduced rate: 20%	2	3			0,15	
Benin	Exempt.	5	3	Exempt.		0,15	
Burkina Faso	Exempt. CIT min. tax	1	4	Exempt.		0,15	Apprenticeship tax (exempt.), 7 years.
Cameroon	Reduced rate by 75% by 50%	5 Year 6 to 10	4	Reduced rate: 5%		-	Bussiness licensing fees (exempt.), 2 years.
Chad	Exempt.	5	3	Exempt.		0,15	
Egypt			5	Reduced rate: 2%		0,15	
Ethiopia			5	Exempt.	6	0,15	
Gabon	Exempt.	2	5	Reduced rate: 5%		-	
Cote d'Ivoire	Tax credit		5			0,05	Tax credit (25%) on Bussiness License fees and payroll charges for national employees.
DRC	Exempt.	1	Infinite			0,15	
Ghana			3			0,15	
Guinea	Exemption Reduced rate by 50% by 25%	Year 1 and 2 Year 3 and 4 Year 5 and 6	3			0,15	Lump-sum levy on salaries, Apprenticeship tax: Reduction by 100% for the first 2 years, 50% for year 3 and 4, 25% for year 5 to 8.
Kenya	Reduced rate at 27%	3	9			0,15	
Mali	Reduced rate at 25%	15	3	Exempt.	3	0,1	
Morocco	Exemption Reduced rate at 17.5%	5 Infinite	4			0,15	Local taxes (exempt.), 5 years
Niger	Exempt.	7	3	Exempt.	7	0,22	
Nigeria	Exempt.	5	Infinite			0,15	Apprenticeship tax reduced by 50%.
Senegal			3	Exempt.	3	0,2	Lump-sum levy (exempt.), 3 years.
Sierra Leone	Exempt.	5	10			0,15	
South Africa			Infinite			0,15	
Tanzania	Exempt.	5	Infinite	Exempt.		-	
Tunisia	Exemption Reduced rate by 50%	Year 1 to 10 Year 11 to 20	5			0,15	
Zambia	Exempt.	5	5	Exempt.	5	0,15	

Source: Discussions with financial services of some telecommunication companies, investment and general tax codes, and authors assumptions.