Fiscal Regimes and Digital Transformation in Sub-Saharan Africa

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Benno Ndulu, Cornel Joseph and Karline Tryphone

BLAVATNIK SCHOOL OF GOVERNMENT UNIVERSITY OF OXFORD

Digital Pathways at Oxford

Benno Ndulu was the Senior Adviser for Digital Pathways at Oxford and a Visiting Professor at the Blavatnik School of Government, University of Oxford (in memoriam); ***Cornel Joseph*** is a Lecturer at the University of Dar es Salaam; and ***Karline Tryphone*** is a Research Assistant at Mwalimu Nyerere Professorial Chair of Development Economics, University of Dar es Salaam.

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Abstract

In this paper we investigate how the fiscal authorities, through tax policies or fiscal incentives, can play an important role in supporting digitalisation of the economy (digital transformation) to exploit its opportunities. Our approach is to track the influence of these policies indirectly through relevant determinants of internet adoption (connectivity and user enablers). Hence, we first establish empirically the influence of these enablers on internet use by estimating a reduced form equation of determinants of internet adoption (both demand- and supply-side factors). Then we assess the influence of a country's fiscal policy stance on some of these enablers or determinants (direction and extent) throughout the internet value chain. Using these transmission mechanisms, we estimate the influence of the fiscal regime on digitalisation. We draw on our own empirical analysis and other relevant studies to support our recommendations to the fiscal authorities. Our findings emphasise the importance of trade-offs between short-term revenue objectives and the longer-term opportunity costs of higher revenue, enabled by the large positive externality effects of the sector, generating higher social returns than those accruing privately.

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1. Introduction

> "We do not believe that taxation should be designed on the basis of short-term considerations – it should be designed on the basis of achieving the best long-term economic interests for the society and in a way that accelerates the extension of services to the poor. The indirect benefits to the economy of having affordable access to telecommunications services far outweigh any short-term benefit to the budget."
> Mohsen A. Khalil, Director, World Bank (Cited in GSMA Report (2008) on *Taxation and the growth of mobile services in sub-Saharan Africa*)

In Sub-Saharan Africa (SSA) one adult out of three uses the internet. This average compares unfavourably with a global average of one in every two adults. The huge gap is in spite of the fact that the region has made considerable progress in network coverage – with 2G and 3G network covering 85% and 75% of the population respectively, putting it almost at the level of global average network coverage. These averages, however, mask huge diversity across and within countries in the region. As we show later, although on a downward trend, the rural–urban divide in internet use is much higher in SSA than other regions, with the latest estimate being 60% (GSMA, 2020). The income divide mirrors this gap and, as we will show in this report, there is a strong relationship between the level of internet use and per capita income across countries and within them when inequality of income distribution is taken into account. The gender gap in internet use in SSA is only second to South Asia and stood at 37% against women in 2019 (GSMA, 2020). Therefore, to address the challenge of under-digitalisation is not only an issue of addressing the shortfall in key enablers of internet use – connectivity, affordability and user capability challenges – but, more importantly, to do so with inclusion in mind if the region is to catch up with the rest of the world.

1.1 Internet use in SSA

We designate 'internet use' or 'internet adoption' to represent digital transformation, fundamentally because that is the main conduit or passport to economy-wide digitalisation. This is particularly important for a region where the bulk of the population depends on the poorly connected informal sector for their livelihoods, and which has huge spatial challenges in the delivery of public services. The internet's powerful networking ability can play a pivotal role in raising productivity, efficiency and returns to expended effort by the majority of Africans, particularly by connecting them to the higher productivity formal sectors (Pathways for Prosperity, 2018). The opportunity cost of the lag in digitalisation in Africa therefore can be very significant. Any stifling of the sector's growth in producing digital services, through fiscal disincentives or other factors, would have a damaging effect on the economy at large.

1.2 The roles of tax and fiscal incentives in the digital economy

In this paper we investigate how the fiscal authorities, through tax policies or fiscal incentives, can play an important role in supporting digitalisation of the economy (digital transformation) to exploit its opportunities. Our approach, as presented in the analytical framework, is to track the influence of these policies indirectly through relevant determinants of internet adoption (connectivity and user enablers). Hence, we first establish empirically the influence of these enablers on internet use by estimating a reduced form equation of determinants of internet adoption (both demand- and supply-side factors). Then we assess the influence of a country's fiscal policy stance on some of these enablers or determinants (direction and extent) throughout the internet value chain. Using these transmission mechanisms, we estimate the influence of the fiscal regime on digitalisation. We draw on our own empirical analysis and other relevant studies to support our recommendations to the fiscal authorities.

1.3 Recommendations for supporting digital transformation

Our analysis highlights four major considerations for choosing an appropriate fiscal regime to help SSA close the gap that is preventing digital transformation.

1. Fiscal authorities need to balance short- and long-term revenue objectives. We appreciate that there are potential revenue losses from increased intangibility of the tax base with digitalisation (eg by moving to e-commerce), and from tax evasion by multinational digital firms operating in the region without tax presence (the nexus challenge). But overtaxation of the sector can stifle the pace of digitalisation, and with it the loss of economy-wide productivity growth and efficiency. This would, in turn, lead to loss of potential growth in the tax base, which some studies estimate to be larger than the forgone short-term revenue (GSMA 2008; Katz et al. 2010 and 2015; Cremer, 2015; Deloitte 2013, 2017). In a study for GSMA, following a short initial period where the total tax take may be lower than if the status quo were maintained, in the medium to long term, tax levels rise exponentially above the base case.

2. Sector-specific taxation policies have tended to be distortionary and regressive, resulting in a 'double whammy' challenge: discriminating against the sector that is supposed to be the engine of new sources of productivity growth and efficiency; and excluding low-income users (the majority of those excluded from internet use). It is instructive that SSA has the highest percentage of countries levying sector-specific taxation relative to other regions, and has seen that proportion increase from 43% in 2011 to 63% in 2017 (GSMA, 2019).

3. Connectivity challenges and its quality are still relatively important at the current stage of digitalisation in most SSA countries, especially in the rural areas. Taxes that increase investment costs stifle rollout of network coverage or encourage use of costly (to the user) obsolete equipment.

4. Much as the primary target of this paper is fiscal authorities, business models can play an important complementary role, particularly in addressing exclusion. Policy interventions need to work in unison with private sector providers to enhance effectiveness of affirmative action. The challenge is to avoid co-ordination failure between the two crucial actors.

1.4 Contribution to the research

We make two main empirical contributions in this paper:

- We systematically identify and confirm the relative importance of the key enablers of digitalisation across SSA countries. We do this by estimating a reduced form equation for internet adoption using SSA cross-country data. This is completed after checking for bivariate relationships to establish simple correlations (not causation). The bivariate correlations involve 37 countries and use the latest (2019) data where available. The multiple regression uses panel data for 40 countries over six years (2014 to 2019). to confirm the expected influence these enablers have on internet adoption (digitalisation) in the region. We believe that this has not been done before.

- We analyse the impact of user, producer and investment taxes on the relevant enablers as transmission channels for assessing the impact of taxes on internet use and hence digitalisation in the region.

Together with findings from other studies, these contributions allow us to make three important conclusions that we discuss in Section 6.

- First we confirm that connectivity enablers (3G network coverage complemented by access to electricity) are robustly significant determinants of internet use (from the supply side) and hence to the extent that discriminatory taxes on right of way and equipment (network and switching) raise the cost of investment in the sector, they stifle progress in digitalisation.

- Second, affordability of digital services (via price and income effects) is a strong and robust determinant of internet use in SSA from the demand side. In this sense, it also underscores the importance of addressing the challenge of the income-based digital divide. Thus, taxes that reduce affordability through increased prices militate against inclusive digitalisation.

- Third, since ownership of mobile handsets has the highest (elasticity) impact on internet use among all the enablers based on our empirical work, the opportunity cost of taxes that raise the price of or the total cost of ownership of mobile phones is very high.

The policy recommendations we make in Section 6 are mainly connected to these conclusions. They emphasise the importance of trade-offs between short-term revenue objectives and the longer-term opportunity costs of higher revenue, enabled by the large positive externality effects of the sector, generating higher social returns than those accruing privately. Overtaxation can be the result of traditional businesses that have been disrupted by digital technology putting pressure on government to address unfair competition – for example, taxi companies in the wake of Uber services.

1.5 Structure of this report

Following this introduction, Section 2 reviews the state of digital transformation in SSA and presents the wide diversity across countries. It also highlights both rural/urban and gender divides.

Section 3 presents the analytical framework for transmission of taxation impacts on digitalisation and, in turn, its effects on the economy. It includes the conceptual model of demand for digital services conditioned by several supply-side factors that serve as a foundation for the reduced form equation used later to estimate the relative importance of internet adoption in SSA using cross-country data. The section also includes a framework of the transmission mechanisms for the effects of taxation on the digital economy.

Section 4 identifies key enablers for digital transformation across SSA and explores the relationships between these enablers and the extent of digitalisation across the region. We use bivariate and multivariate statistical analysis of the determinants of internet adoption and digital transformation in SSA economies using country panel data to confirm their role as transmission channels for digital taxation effects.

In Section 5 we present the sector-specific taxation of the digital economy in SSA, and assess the impact that taxation has on digitalisation in the region. We identify and empirically confirm the transmission channels through which taxation impacts on the pace of digitalisation through: (i) reduced supply of digital services and stunted capacity growth of the digital sector (coverage) as cost of production and investment increase; and (ii) increased cost of digital services and products to users (demand side).

Section 6 concludes with recommendations for fiscal policy that will be supportive of rapid and inclusive digital transformation in SSA.

2. Recent progress in digital transformation across SSA

2.1 Digital transformation progress in SSA

Despite more than two decades of ICT implementation, SSA economies are being left behind in the rapid development of the digital economy, which now accounts for between 4.5% and 15.5% of global gross domestic product (GDP) (UNCTAD, 2019). Those who can have access to internet at home make up 22% of all African households. In contrast, globally, access to home internet averages 57.8%, and use of internet globally stands at an average of 51.2%, whereas only 30% of Africans are using the internet generally (Songwe, 2019).

The recent COVID-19 pandemic has exposed the region's lack of digital preparedness for households and businesses to cope with social distancing. This is due to low broadband penetration. For example, with only one out of every three Africans using the internet, a significant number of children could not continue with education when strict social distancing was enforced, especially among low-income households (Makwakwa, 2020). A Cisco Systems (2020) survey shows that, even in South Africa, despite being the most technically advanced in the region, only 37% of businesses were regarded as well prepared for remote working, having fully rolled out their digital transformation strategies.

At the narrowest end of the digital economy is the direct contribution of the **core sector** producing digital services. In a broader sense, sector-specific contribution to GDP includes value created from all digitalised activities – including the vast range of digital platforms and the content they produce (OECD, 2014; World Bank 2016). Africa's share of the global digital economy in this broad sense is only 1.3% (UNCTAD, 2019).

The digital economy contributes in another way that has proved difficult to measure directly, yet it motivates the focus of this paper. This is the economy-wide digitalisation of processes of production and consumption of goods and services in all sectors, and entails the way digital technologies, services, products, techniques and skills are diffused across economies using digital platforms (OECD, 2016 and 2017 UNCTAD, 2017a). This diffusion is the source of the enhanced efficiency and productivity growth in all sectors.

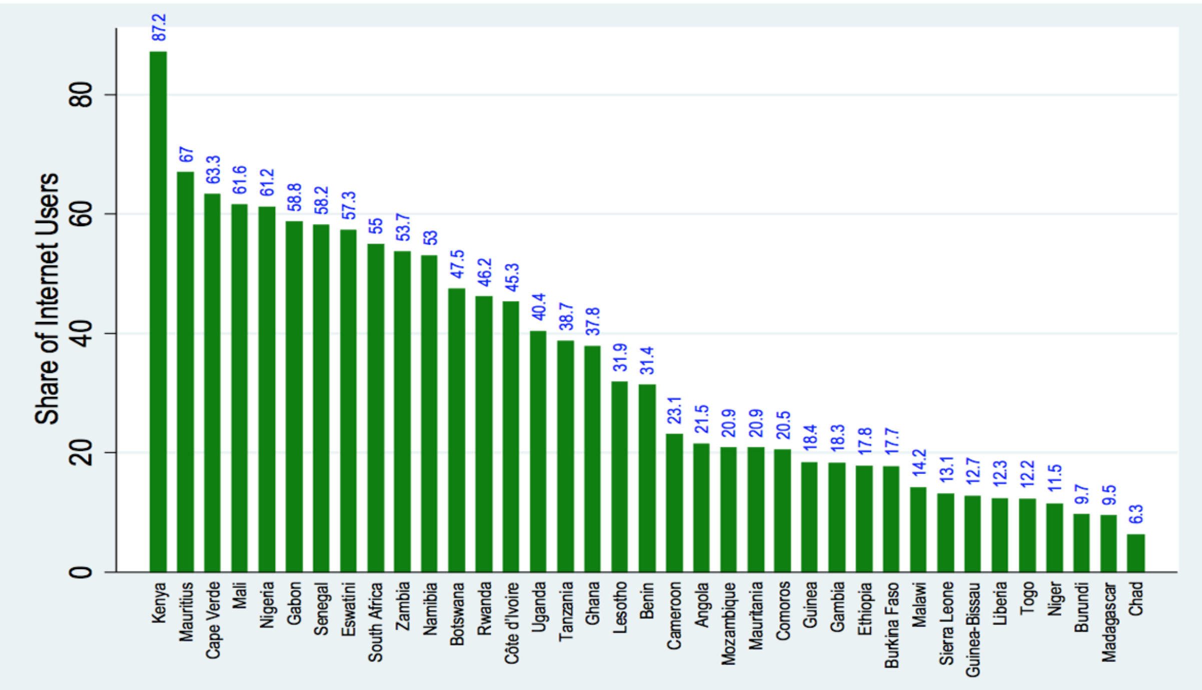
African countries can fully take advantage of the above-mentioned potential benefits if, and only if, they are ready to embrace digitalisation by investing in the required infrastructure, human capital and supportive fiscal and regulatory frameworks. Securing value from the digital economy requires a stronger digital sector, but also broader efforts to enable enterprises in all sectors to take advantage of digital technologies. The impact will depend on the level of development and digital readiness of countries and their stakeholders as well as the policy stance towards digital transformation (UNCTAD, 2019).

2.2 Diversity and rural–urban and gender divides

The internet is the main conduit of diffusion and application of digital services to a wide range of users. The extent of its use (rather than simply access to internet) is what measures progress in digital transformation, and especially its impact on livelihoods in the region. We use the proportion of population using the internet throughout this paper as an indicator of economy-wide diffusion of digital services in production, trade and consumption of goods and services.

Based on the 2019 data for 37 SSA countries, Figure 1 presents the proportion of the population using the internet in each of these countries. The average rate of internet use across the region is 34.5% of the population. This average hides the wide dispersion of internet use across the region. It ranges from the lowest 6.3% for Chad to the maximum of 87.2% for Kenya. The dispersion across countries, as measured by the coefficient of variation (standard deviation over the mean rate of use) stood at a significant 60.8%. The median country, Benin, in this group has an internet users ratio to population of 31.4%. Only seven of these countries (18%) have broadband penetration (use) exceeding the global average of 51%. Beside the fact that non-users are predominantly in lower-income groups, there are other significant divides within countries – rural–urban and gender divides (Pathways for Prosperity Commission, 2018) that we examine in more detail later in this section.

Figure 1: Share of internet users in SSA by country, (%)



Source: ITU (2020)

More recently, however, there has been some acceleration in the rolling out of digital services. In 2018, mobile operators in SSA accelerated the expansion of 3G networks, with coverage increasing to 70% from 63% in 2017. More than 80 million people previously not able to access 3G networks are now covered. With 2G coverage currently standing at 85% in SSA, it is expected that operators will continue to upgrade their sites over the next few years, narrowing the gap between 2G and 3G coverage (GSMA, 2019).

It is noteworthy that this acceleration shows narrowing divergence across countries in the region over a short period of time. This is evident in Table 1. Invariably all the key indicators of digitalisation or their enablers show decreasing dispersion of status across countries. The coefficients of variation of most indicators drop sharply between 2014 – the starting year for our consistent panel data – and 2019. The convergence is significantly sharper in measures of access, rather than measures of use. Differences in network coverage were reduced by more than half over the six-year period, while differences in internet use decreased by less than a quarter.

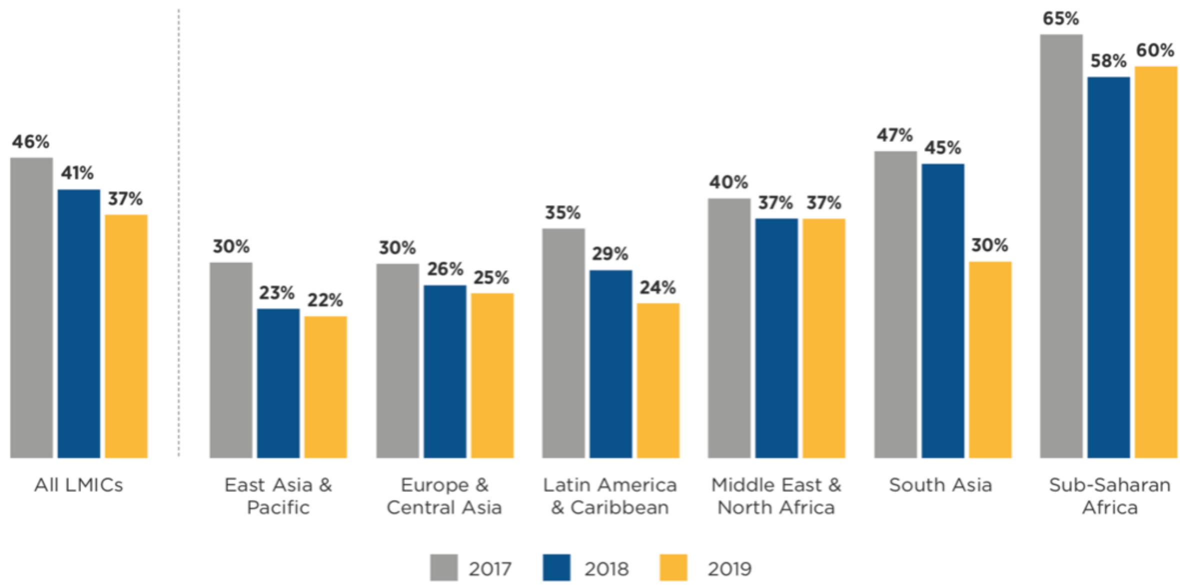
Table 1: Narrowing divergence of digitalisation 2014-2019

Indicator	Coefficient of variation	
	2014	2019
Consumer readiness	27.9	25.1
Access to electricity	73.0	56.7
Mobile ownership	27.6	21.6
Literacy rate	32.7	30.5
Internet coverage	51.0	23.4
Share of internet users	80.7	62.4
Price of 1.5 GB	74.1	58.3
Handset price	67.5	64.2

Notwithstanding this progress, the pace is still relatively low. According to the State of Broadband report 2018, African countries, on average, spend about 1.1% of GDP on investment in digital transformation (including internet infrastructure and networks), while developed countries spend 3.2% of GDP. This implies that developed regions are embracing digitalisation at a faster pace, which may lead to widening of the digital divide with Africa.

Within countries, digital divides are also significant as pace of progress is not uniform between rural and urban areas and between genders. The poorer infrastructure coverage in the rural areas of Africa has resulted in a wide digital gap with urban areas. This gap is on account of deficient network coverage, but also due to poorer signal quality. Figure 2 shows the rural–urban gap in mobile internet use in low- and middle-income countries. It is clear that there has been a gradual decrease of this digital divide across regions. However, a more pronounced rural–urban gap remains in the SSA region compared to the rest of the regions. The gap still stands at 60%, having narrowed from 65% in 2017 to 58% in 2018. South Asia and Latin America have more sharply reduced the gaps.

Figure 2: Rural–urban gap in mobile internet use in low- and middle-income countries by region 2017–2019 (%)



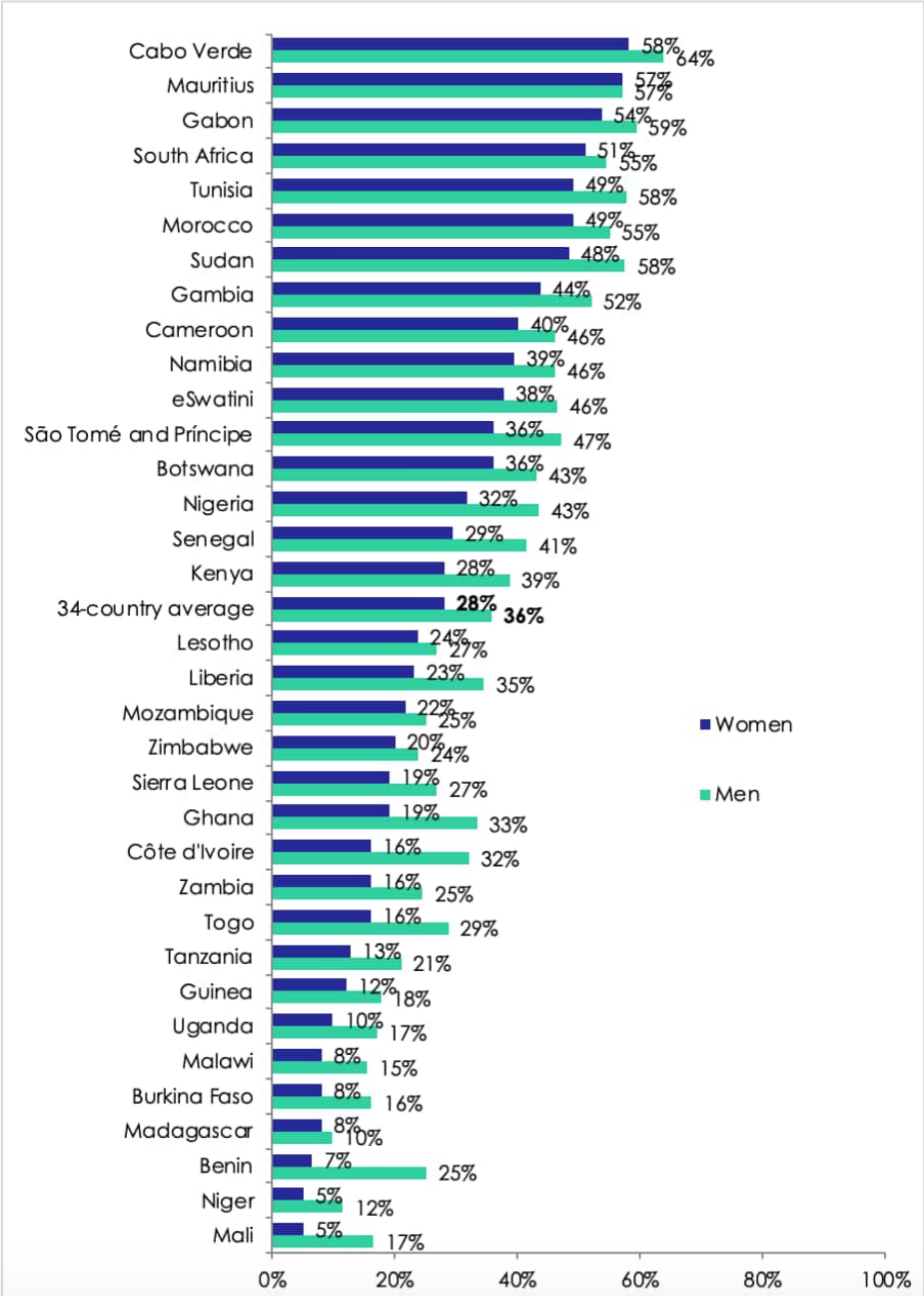
Source: GSMA (2020) Intelligence and Gallup World Poll

The gender divide in internet use also remains significant. Studies show that women in Africa are between 30% to 40% less likely than men to use the internet to participate in public life. The Mobile Gender Gap Report (GSMA, 2019) estimates a gender gap of 48% in mobile internet use for SSA,[1] the second highest gap among regions in the world in 2018, topped by South Asia with a gap of 58%. GSMA (2020) estimates that the gender gap was 38% in 2018 and decreased slightly to 37% in 2019. The corresponding decline for South Asia was from 58% in 2018 to 51% in 2019.

The gender gap in the region varies substantially across 34 countries surveyed by online data analyst, Afrobarometer. Figure 3 shows the regional diversity of the gaps between men and women by country. While the gap for the average country is 8 percentage points, it ranges from no gap in Mauritius to 18 percentage points gap in Benin. What is probably more striking is that the gender gap in internet use (in contrast to access) in Africa may actually be rising as the number of male internet users are increasing faster than the number of female internet users. Comparing gender gaps in 31 countries between *round* 5 (2011–13) and *round* 7 (2016–18) of Afrobarometer surveys, the gap increased by a significant 3 percentage points or more in 14 out of the 31 countries, growing most in Benin by 16 points and narrowed only in two countries: Zimbabwe (-3% points) and Tunisia (-6% points) (Afrobarometer, 2020).

[1] The gender gap is measured as the difference between the proportions of internet use by men and women, divided by men's usage. A user is defined as having used internet at least once in three months. Users don't have to own a phone but often have to own a SIM card.

Figure 3: Regular internet use by gender – 34 countries in Africa 2016–18



Source: Afrobarometer (2020)

2.3 Impact of digitalisation on economy and livelihoods

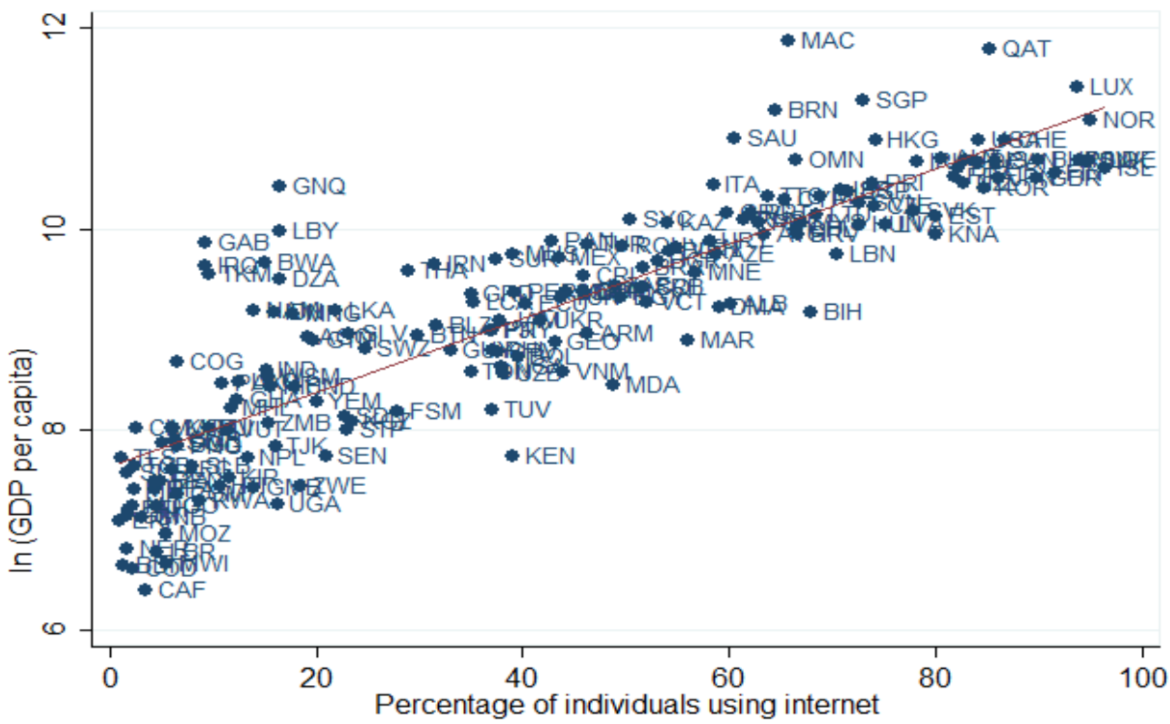
Digitalisation transmits economy-wide outcomes, largely through network effects, which intensify information flow and interaction among connected individuals, businesses and public service providers. This drives scale economies, economic growth and employment, especially at the margin. Digital platforms have become *inter alia* the new conveyor platforms for delivery of a wide variety of services, a marketplace for virtual meeting of buyers and sellers of goods and services, classrooms without walls, and a meeting place for job seekers and employers (UNCTAD, 2019).

The expansion of the digital economy in the region may prove to be one of the key pathways out of poverty as it helps a large segment of the economy become more dynamic. While in advanced economies the ‘gig economy’ may be considered inferior to those jobs being lost in manufacturing, for SSA economies, these jobs are an upgrade in quality from those in the informal sector.

Key application platforms, such as e-commerce and e-government, can leverage this interconnection to support larger volumes of activity more cost-effectively and with reduced inconvenience. The network effects also help to drive the cost of digital services down as the burden of fixed costs is spread over a rapidly expanding number of users (UNCTAD, 2019). Digital transformation provides an important avenue for the African countries to foster economy-wide productivity growth, enhance efficiency across all sectors, and foster inclusion as countries make progress towards achieving the United Nations Sustainable Development Goals (SDGs) (Ndung’u, 2017 AfDB, ADB, EBRD and IADB, 2018). Economy-wide spillover effects from digitalisation can be seen in increased financial inclusion, smart agriculture, online health and education services, e-commerce, e-government, and so on. (Pathways for Prosperity Commission, 2018; Unver, 2014).

There is growing evidence at macro and micro levels to support this positive externality effect of the digital/ICT sector. At macro level, as shown in Figure 4, Marta Guerero (2015) use data from ITU and the World Bank to show a strong positive correlation between the percentage of internet users in a country and GDP per capita at purchasing power parity (PPP). This is not causality, and the association can also go in the opposite direction, when GDP PPP is considered an enabler of internet use (which we confirm below).

Figure 4: Percentage of internet users and GDP PPP per capita, current international US dollars (2013)



Source: Guerero (2015)

International Telecommunication Union (ITU 2018), estimates that the expansion of mobile broadband penetration by 10% in Africa would increase GDP per capita by 2.5%. McKinsey Global Institute (2017) estimates that widespread use of digital finance could boost annual GDP growth in emerging economies by approximately 1 percentage point a year, in contrast to the 'business as usual' scenario (MGI, 2017). OECD (2013) estimated that a 10% increase in broadband penetration would enhance GDP growth in EU countries by 1.1% (OECD, https://www.oecd.org/inclusive-growth/#introduction) and Scott (2012) estimated a 1.35% growth impact for low-income countries from a similar increase in broadband penetration.

There is also growing evidence that broadband penetration fosters inclusion. It does so by offering workers new employment opportunities that extend to previously disconnected households and by connecting low productivity segments of the economy to firms with higher efficiency, thus moving them up the productivity ladder (Pathways for Prosperity (2018 p.48). Hjort et al. (2019) find that fast internet decreases employment inequality and engenders employment growth for skilled and unskilled workers. This means that mobile broadband can directly target inclusive economic growth by creating opportunities for all (World Bank /Research ICT Solutions, 2018).

At a micro level, several studies show how digitalisation is helping change the way we work, and with higher efficiency. For example, according to *Remote Working in South Africa 2020*, a study conducted among 400 enterprises by World Wide Worx for Cisco Systems, the shift to remote working has led to improved productivity by a massive 70% among those companies that had already fully rolled out digital transformation strategies (Cisco 2020, Ndulu et al. 2020).

There is further evidence to show that digitalisation supports formalisation of the informal economy – a source of livelihood for the majority of Africans (Onyima and Ojiagu, 2017). It does so by enhancing its connectedness to the formal economy and substantially reducing its cost and risks of doing business (Pathways for Prosperity Commission, 2018). More recently, digital platforms have enhanced opportunities for women to work in the gig economy and the informal sector by providing the flexibility that women need in terms of working hours and work environment (Furman and Seamans, 2018; OECD, 2019). Digital platforms can therefore facilitate the transition to the formal sector and act as a prime example of inclusive structural transformation. It can be the first step towards transforming what it means to work in the informal sector by introducing structures such as standardised service, and reducing the uncertainty, ambiguity and friction in informal work (Islam, I and Lapeyre, F, 2020).

3. Digital taxation and digital transformation – an analytical framework

Here we present our analytical framework in two parts. The first part is a conceptual framework behind the reduced form equation to be used to estimate the influence of determinants on internet adoption in the region. The second part discusses the transmission mechanisms for assessing the impacts of taxation on internet adoption.

At the turn of the 21st century, and the beginning of an intensive internet diffusion period, two main approaches were pursued in assessing the influence of fiscal regimes on internet adoption. One approach focused on the users' end of the internet value chain and emphasised taxation effects via the demand side of internet adoption (Goolsbee, 2000b; Ellison and Ellison, 2003; Gao et al. 2004, 2014). They mainly used a microeconomic approach and experimental surveys to estimate demand and then used simulations to assess the effect of taxation on demand for internet services via estimated price elasticities.

The second approach adopted the whole of value chain method of assessing the effects of taxation on internet use/adoption. They deployed reduced form equations to explain the determinants of internet adoption (Kiiski & Pohjola, 2002; Stoneman, 1983; Estache et al., 2002; and Caselli and Coleman, 2001) and emphasised the effects of taxation from both sides, but mainly the supply-side shifters of internet adoption (Katz et al. 2010; 2015). The methodology was macro-oriented and exploited cross-country data to explain the effects based on country differences.

In this paper we have adopted the whole of value chain approach to better track taxation at the relevant point of the value chain and cover both supply and demand side channels. Taxation happens at investment, production and consumption stages. A focus at the endpoint of the value chain alone ignores the fact that firms are not able to pass on all tax costs to the consumer. Instead it affects the investor and producer incentives for expansion and upgrade of quality.

3.1 Determinants of internet adoption in SSA: a conceptual framework

The conceptual framework, we use here is an adaptation of the model created by Gao et al. (2004). It considers an aggregation of consumers/internet users, each contemplating whether or not to use wireless digital services/internet but actually make choices to use the internet, conditional on several supply- and demand-side shifters. This choice is at the earliest stage of the decision tree – that is, whether to use the internet or not – abstracting from second order choices of types of internet services. It is assumed that the consumer has a separable utility function for wireless services and other goods:

$$U(x,q)=C(x)+W(q)=C(I-pq)+W(q) \qquad (1)$$

In equation (1), x is the consumption of the outside good (or, identically, income minus spending on digital service); q is the consumption of the wireless digital service; I is the decision period compatible income; and p is the per-unit-of-time price of a wireless service connection. The budget constraint is embedded in the utility function.

The consumer maximises this utility function conditional on/subject to four other supply side constraints:

(i) That the consumer has access to broadband network (at least 3G network coverage)
(ii) That the consumer has access to a feature or smartphone
(iii) That the consumer is digitally ready (capable of using internet – skill-wise, and so on)
(iv) That the consumer has access to electricity (whether on or off grid).

The above model combines both demand- and supply-side determinants of internet use. The reduced form equation from the model is a quantity equation, tracing actual internet use represented at points of intersection between demand and supply. We are aware of the potential identification problems in using an approach that includes both supply- and demand-side factors in the reduced equation, and therefore do not use prices in the quantity equation we estimate. Alternatively, we could, as others have done, use an instrument for price to deal with this challenge.

In applying this model empirically, we will use a reduced form equation for determinants of internet adoption. We will also use cross-country panel data to estimate the relative influence of these determinants in explaining what accounts for diversity of internet adoption across SSA countries (see Estache et al., 2002; Caselli and Coleman 2001.The actual data points of internet adoption will be at the intersection of the aggregated supply and demand curves for internet, and influenced by a host of supply- and demand-side shifters. The key determinants on the supply side include access conditions (network coverage, access to electricity and mobile phone ownership); while on the demand/users' side, the influential factors include internet affordability (in turn dependent on price and income) as well as consumer/user readiness, which measures capability of using the internet gainfully.

In this study, we can use the estimated elasticities from the estimated reduced equation to indirectly confirm and track the impact of digital taxation on uptake or use of internet services in the region via two transmission channels on the cost side:

(i) Impact of taxation in raising the cost of investment in broadband and communication networks, data spectrum and digital platforms, affecting access to network and cost of internet services (eg import duties and other indirect taxes, and investment incentives/disincentives)
(ii) Cost of devices (including smartphone) as a conveyance platform of digital services (eg import duty and value-added tax (VAT)/sales tax).

Separately, estimated demand elasticities from other research, and partially from our own, will be used to assess the impact of direct user taxation on affordability of digital services and, in turn, on internet adoption. This covers the main impact of the price of internet services. The impact of income on internet adoption, a demand shifter, would already be accounted for through the reduced equation. Exclusion of price of internet services from the reduced equation is to avoid the identification problem in the empirical work. Here we include a synopsis of the estimated demand elasticities.

It is worth noting here the results from other studies, which estimate the underlying demand-side relationships excluded from our reduced form equation. Gao et al. (2004) estimated the demand function for mobile internet services in Finland at the early stage of adoption. They did so non-parametrically and computed price elasticities. The elasticities depend somewhat on the demand specification. They obtained high average per-minute price elasticity of connection length, ranging from -1.87 (log-linear demand) to -2.28 (linear demand). They assert that these results support two conclusions:

1. Consumers had demand for wireless services, but it remained latent (dormant).
2. The early demand for the wireless internet was highly elastic.

The study concluded that early take-up was slower than expected, even though consumption needs were plenty. The conditional usage probability was small, suggesting that pricing may have suppressed demand (p.22). They conclude that pricing and taxation of wireless services largely suppressed demand. The paper also noted that these findings were consistent with others that found high elasticities for the early broadband demand (Varian, 2000 and Goolsbee, 2000a). Goolsbee (2000a) finds that the demand elasticity for broadband internet access ranged from -2.2 to -3.7 in the US around 1999, (an early period of internet adoption). Varian (2000) portrays a similar picture. Using data from the Berkeley INDEX experiments, Varian finds that the own-price elasticities for bandwidth were between -2 and -3. Finally, Ellison G. and Ellison S.F. (2001, 2003) study the effects of internet price search on demand elasticity, and document internet price elasticities that are very high, sometimes of magnitude -50. Rappoport et al. (2003) use US country-wide survey data to confirm that determinants of demand are consistent with those for internet and broadband access. Studying the demand for internet in Brazil, Leandro and Gomes (2019) reach similar conclusions.

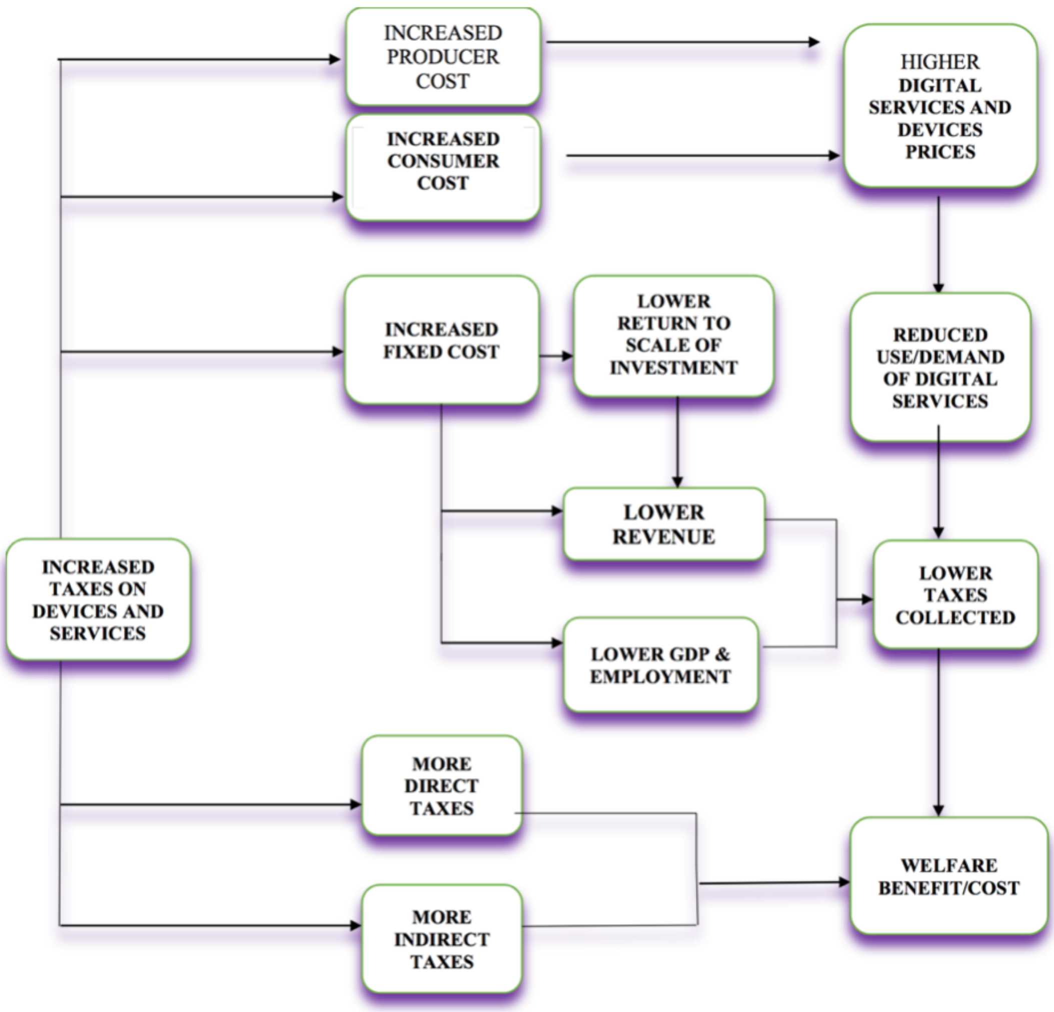
3.2 Transmission mechanisms for assessing the impact of taxation on internet adoption

The second component of our analytical framework models the transmission mechanisms of the effects of taxing digital products and services on digitalisation/digital transformation measured quantitatively throughout the rest of this paper by the extent of internet use in a country. This second component adopts and adapts a transmission framework (model) developed in Katz et al., (2010). Katz's work (updated in 2015) provides the most comprehensive discussion of relationship between taxation policy and internet use we could find, and uses the most comprehensive data set provided by ITU – the global authority linking all formal regulators of the industry and providers of official statistics.

Figure 5 presents the transmission of the effects of levying taxes on the uptake of digital products and services. Digital taxes raise costs in the provision of digital services and, together with direct tax charges to consumers (eg VAT), raise the costs of these products for users. Given the elastic demand for these services, the result is reduction in use of digital services and reduction in all the positive externalities – from application of digital services to enhanced productivity and efficiency in the economy.

The resultant decline in GDP (a tax base) or its growth leads to decline in revenues or its potential. More specifically as Figure 2 indicates, there are three main channels through which increased digital/ICT sector-specific taxes can cause detrimental effects on the economy: fixed-cost channel via increased cost of investment; increased production costs of digital services via production taxes (eg excise taxes); and indirect consumer taxes (eg VAT at point of sale) which amplify the effect of the other two channels.

Figure 5: Developmental/innovation perspective of digital taxation



Source: adapted from Katz and Berry (2014)

3.2.1 Fixed cost channel (via investment)

(i) Increased tax on digital infrastructures (eg import duty, sales and property tax on equipment such as servers) reduces broadband penetration/investment through disincentive to invest in infrastructures. Consequently, it reduces investment in site installations, civil works and employment linked to capacity for delivery of digital services. Furthermore, since taxes raise the required pre-tax rate of return on capital invested, they can act as disincentives to modernisation of digital infrastructure, and prompt carriers to continue with costly operations using obsolete equipment (Katz 2015).

(ii) At the same time, increased tax on digital equipment and servers reduces platform investment. Consequently, it reduces broadband penetration resulting in lower revenue from investment in digital platforms (revenues of digital services operators), tax collected and welfare.

3.2.2 Production cost channel

Increased production taxes on digital products and services (eg excise tax) can be partially passed on to the consumers depending on demand elasticities. Most likely the bulk of this tax goes to reducing profits accruing to the supplying firm, and consequently investable funds for expansion of the service.

3.2.3 Consumption/user channel

This channel includes taxes with a more direct impact on consumers/users – mainly indirect taxes, such as sales tax and VAT on digital services and products as well as on consumer durable devices. It also includes sector-specific taxes and fees on digital products and services as we elaborate on in Section 5. The pass-through to consumers is normally a higher proportion of tax levied and impacts more directly on demand via price increase. In turn, this reduces affordability and the demand for digital services. Taxes on mobile handsets are also directly borne by the user with similar consequences.

Although imposing taxes on digital services may have a positive revenue-enhancing effect in the short term (as illustrated in the bottom part of Figure 5), that needs to be balanced with potential revenue loss in the future from the effects identified here – plus the loss in productivity growth and efficiency gains from the economy-wide diffusion of digital technology. The latter represents the opportunity cost of the short-term gain in revenue from sector-specific digital taxation.

4. Key enablers of digitalisation and their relative impacts on digital transformation in SSA

4.1 Key enablers of digitalisation

Digital transformation requires two key sets of effective enablers:

1. **Connectivity enablers** – including 3G or higher network coverage, ownership of digital devices (smart handsets, digital platforms as conveyors of solutions, and access to electricity to enable uninterrupted network coverage and device use), which determine the extent of and reliability of access to digital services

2. **User enablers** – including affordability of digital services (a result of a combination of prices and incomes); consumer readiness, mainly in terms of digital skills; availability of accessible and useful content to enable users to function more efficiently in their tasks; and a regulatory, business environment and fiscal regime friendly to investment in the provision of and diffusion of digital services to various tasks and uses (Katz and Berry, 2014).

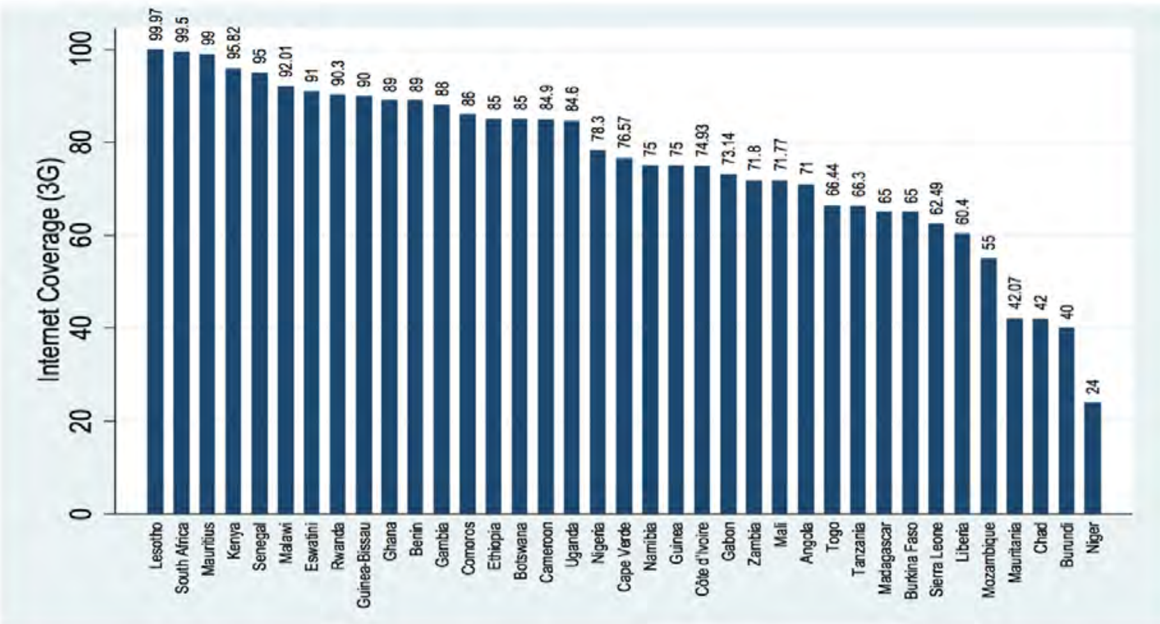
While ensuring wide and quality **access** is a necessary condition for digital transformation, it is not sufficient. People also need to be assured that digital services are affordable and that they are competent in its **use and diffusion**. Significant emphasis, both in the literature and policy, has been placed on access and most global campaigns (until recently) have focused on this necessary condition with significant achievement. Thus, while country average digital network coverage in SSA stands at around 75%, the proportion using internet stands at 34.5% – a very wide gap. It is the diffusion of internet services among the sectors using digital services that ensures digital transformation of the economy, and also the positive impact on livelihoods.

Below we review the status by country and influence of **six** potential key enablers on internet use across 37 SSA countries (see also Annex Table A2). **Three** of these are grouped under **access/connectivity** (3G or higher network coverage; ownership of mobile phone; and access to electricity). The remaining three are **user enablers**, which include **affordability** of internet services and **consumer digital capability** to use internet services – measured as consumer readiness or digital literacy. We have not yet been able to find consistent data on *accessibility of content* – in terms of language and simplicity to allow inclusion in the empirical analysis. The relative importance of these enablers in influencing the extent of use of internet will be analysed in section 4.2 using multiple regression models.

4.1.1 Access/connectivity

Together, three features of connectivity (network coverage, mobile handset ownership, and access to electricity) are deemed to have significant influence in the extent of use of internet services in SSA countries. Figure 6 shows the share of population covered by 3G broadband network in SSA by country in descending order. Figures 7 and 8 present similar information for mobile phone ownership and access to electricity. A cross-cutting feature is the very wide variation across the region.

Figure 6: 3G mobile network coverage

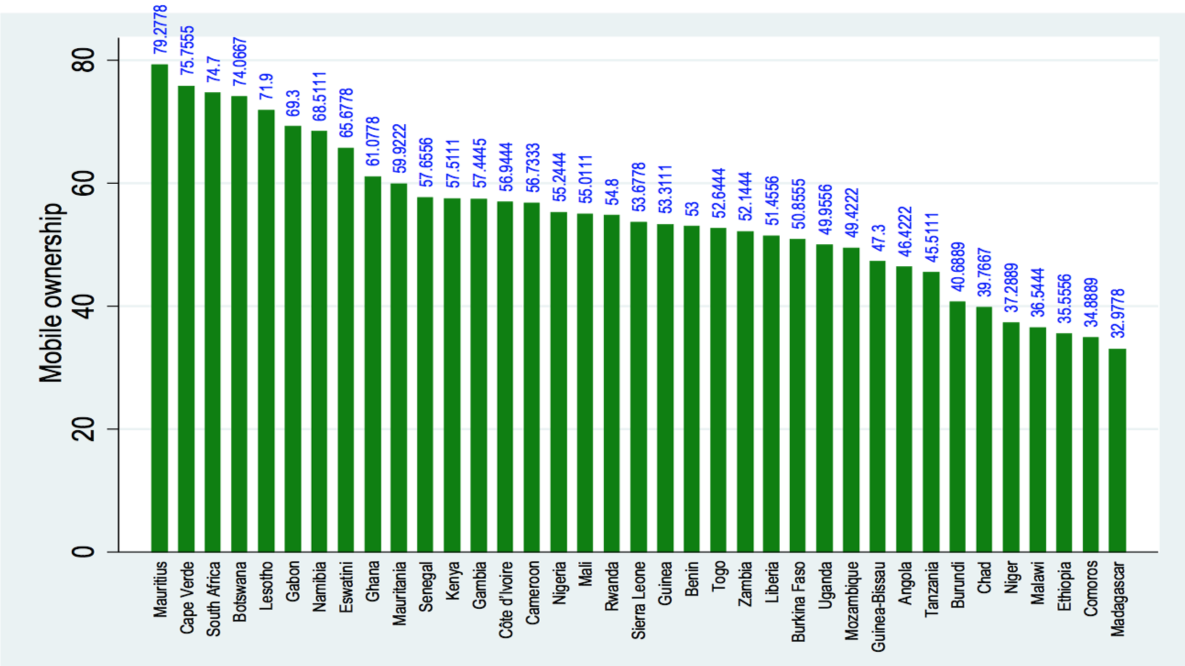


Source: GSMA-MCI (2020)

Figure 6 presents the 3G coverage across 37 countries in the region. In 2019 the average proportion of the population covered by 3G network across the 37 countries for which we have complete and consistent data was 75.5%. Although the range in value is quite wide – from 24% for Niger to 99.97% for Lesotho – only five out of the 37 countries have coverage of less than 60%. Most countries appear to be catching up quickly to the rest of the world in this respect. The dispersion across the region is therefore not very wide, with a coefficient of variation of 23.7%. About 51% of the countries have coverage above the average of 75.5% of 3G internet coverage.

However, to make use of this 3G connectivity for internet, there are two other connectivity conditions to be met: to have a smart mobile phone or (for limited use) internet-enabled feature phone; and connectivity to electricity – a key enabler for use. Based on the same data, Figure 7 shows that an average of 54.5% of the adult population across the 37 countries own a mobile phone. Populous countries such as Nigeria, Kenya, and South Africa are at or above this sample average, and could influence the population-weighted average. The range of mobile phone ownership is from 33% for Madagascar to 79.3% for Mauritius. The median country is Sierra Leone with 53.7% of mobile phone ownership. Dispersion across countries is low, with a coefficient of variation of 22%. About 68% of the countries have mobile phone ownership levels above 50%.

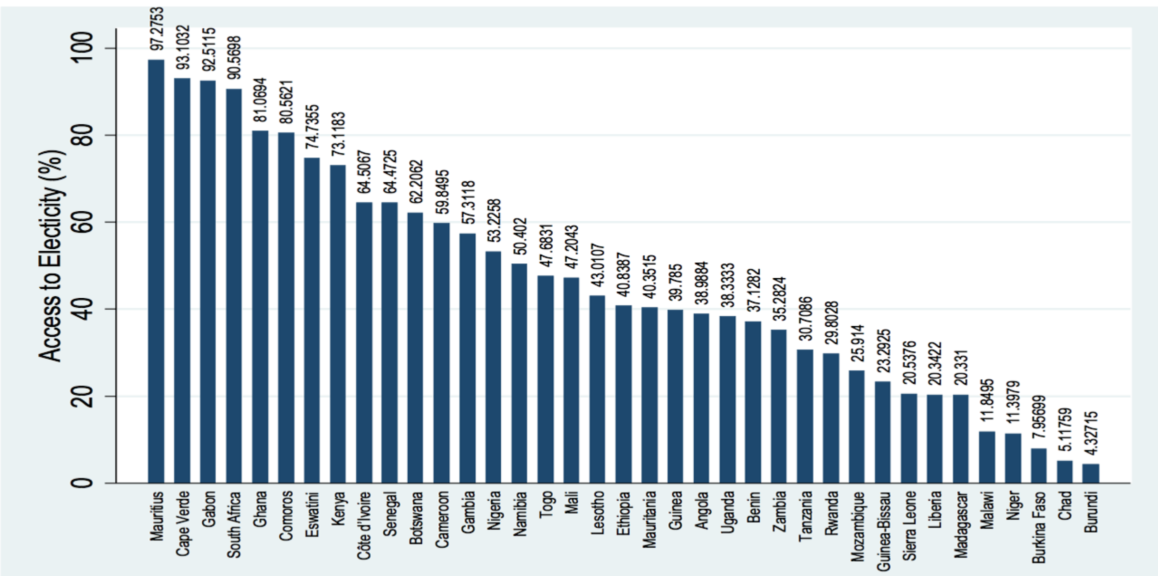
Figure 7: Proportion of mobile ownership in SSA countries



Source: GSMA-MCI (2020)

As to connectivity to electricity, the average level of access to electricity is 46.4% of the population. Figure 8 shows a very wide dispersion across these countries. The range of electricity connectivity is very wide – from 4.3% of population in Burundi to 97% coverage in Mauritius. The median country is Mauritania with access ratio of 40.3%. The coefficient of variation across the countries is a high 56.4%. The distribution is skewed towards the lower end of access, with 22 out of the 37 countries (nearly 60%) having access levels below 50%, and half of those 22 countries with access levels below 30%.

Figure 8: Proportion with access to electricity in SSA countries



Source: GSMA-MCI (2020)

4.1.2 User enablers

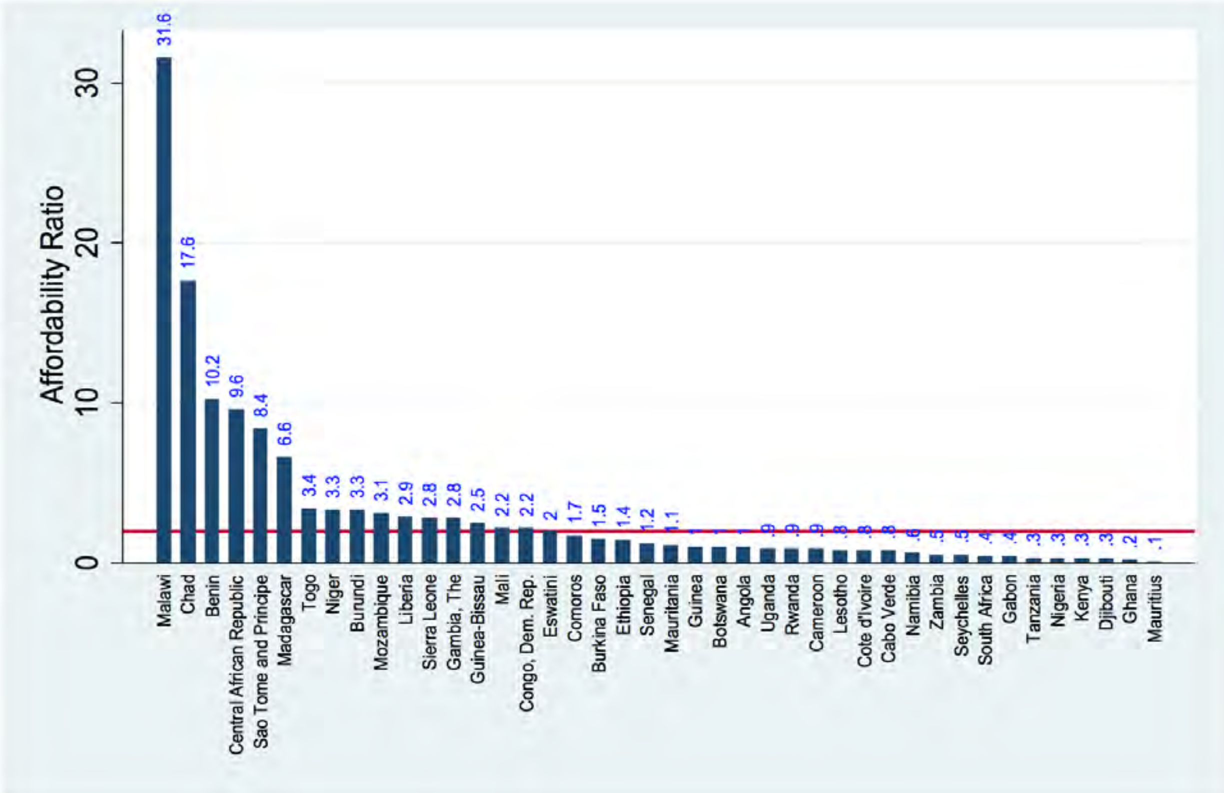
Once internet connectivity (access) is established, three other key factors significantly influence an inclusive uptake/use of digital services: (i) affordability of digital services and mobile devices (smart or feature phone), measured as the share of their cost in a monthly average income; (ii) consumer readiness which is largely determined by level of educational attainment and digital literacy; and (iii) accessibility of content in terms of complexity and language as well as being fit-for-purpose. Since we do not have systematic data on this enabler, we do not use it in the subsequent analysis.

4.1.3 Affordability

Affordability is defined by income and price of digital products. Sarkar et al., (2015) confirm that gross national income is a significant predictor for broadband, fixed landline phones, and level of internet use. Also, mobile tariffs are found to be negatively associated with mobile phone subscription. Combined, this is consistent with contentions in existing literature that higher tariffs act as a barrier for ICT penetration for low-ICT-intensity nations (Ndulu et al., 2020). According to its *Affordability Report 2020*, more than 1 billion people living in the 57 countries across the world that do not provide access to a 1GB data plan that meets the international standard for affordable internet. Almost 2.5 billion people live in countries where the most affordable smartphone costs more than a quarter of the average monthly income. Closing the digital divide, demands affordable broadband and devices for the billions who do not yet have access.

Figure 9 presents affordability across 42 SSA countries in descending order of cost of 1GB data as a proportion of monthly average gross national income (GNI) per capita in 2019, both measured in PPP US$ for comparability. On average across the countries, 1 GB of data took up 2.9% of the average monthly income, with a very wide dispersion across countries. It appears that changes have occurred since 2017, as 26 of the 42 countries for which 2019 data is available meet the 2% threshold of affordability. However, the variation across countries is huge. The coefficient of variation is a staggering 189.69%. The most affordable was Mauritius, where it costs a miniscule proportion (0.11%) of the monthly income to buy 1GB data; while the highest cost is in Malawi, where 1GB takes up nearly 30.5% of average monthly income. In the multivariate analysis we undertake in section 4.3, we separate the price and the income effects of affordability. This will allow us to confirm the use of this transmission channel to assess the impact of digital taxation, which is partly mediated via price elasticity, separate from the income elasticity of demand.

Figure 9: Affordability ratio, 1GB



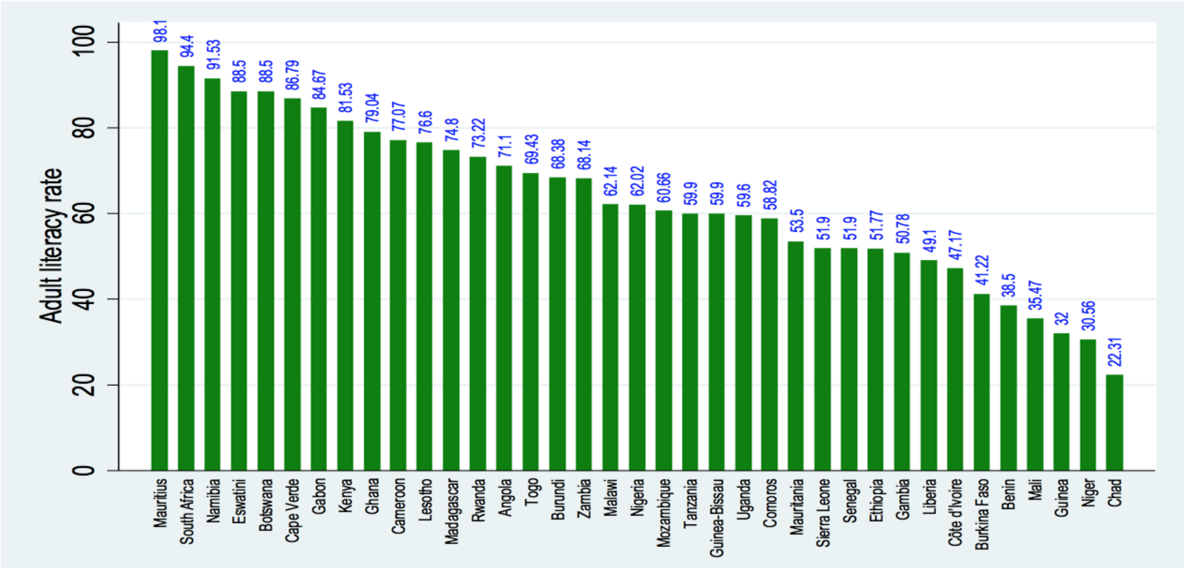
Source: GSMA (2020) and WDI (2020)

4.1.4 Consumer digital capabilities and readiness

Digital literacy affects consumer readiness for uptake of digital services. It is evident from past research that a lack of skills is one of the most commonly cited reason for non-use of the internet (Schmidt and Stork, 2008) and differences in the endowment or acquisition of these skills often results in digital divide (Ndulu et al., 2020).

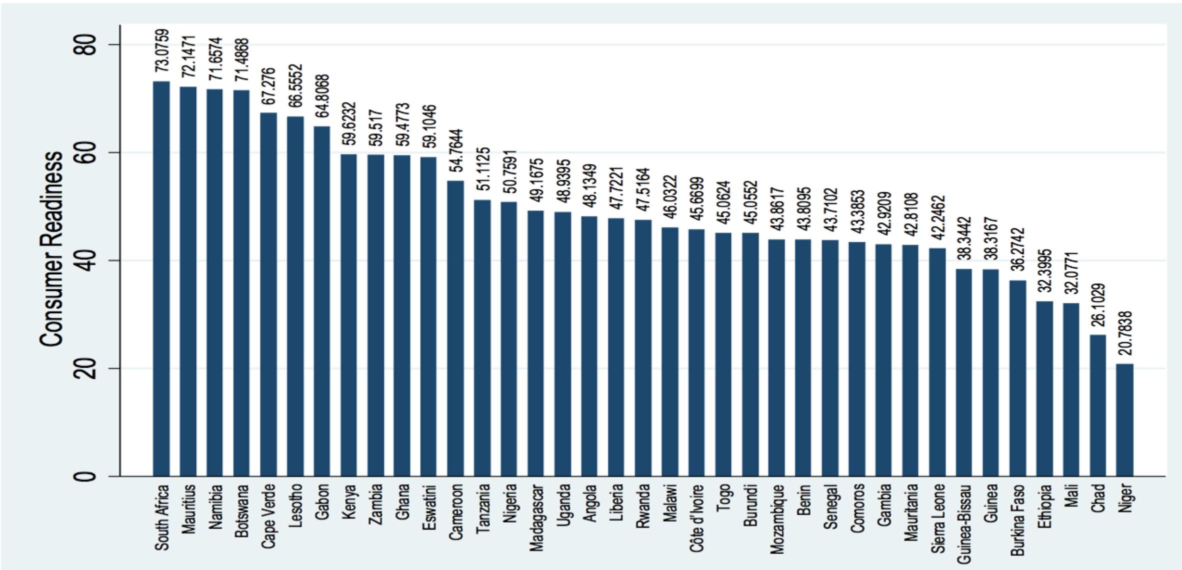
Data for an alternative measure of digital capabilities exists. The consumer readiness ratio measures the proportion of population with digital skills adjusted for gender equality and ownership of mobile phones. Figure 10 presents literacy rates across the 37 SSA countries with an average adult literacy rate of 63.5% and a range from the lowest rate of 22.3% of adult population in Chad to a maximum of 98% literacy for Mauritius. The coefficient of variation stood at approximately 30%. Similarly, for consumer readiness figure 11 shows that the average score stands at 49.5 or about half of the adult population with a range from 20.7 for Niger to 73% for South Africa. The dispersion around the mean, measured by a coefficient of variation, is 25%.

Figure 10: Literacy rate



Source: WDI (2020)

Figure 11: Consumer readiness



Source: GSMA-MCI (2020)

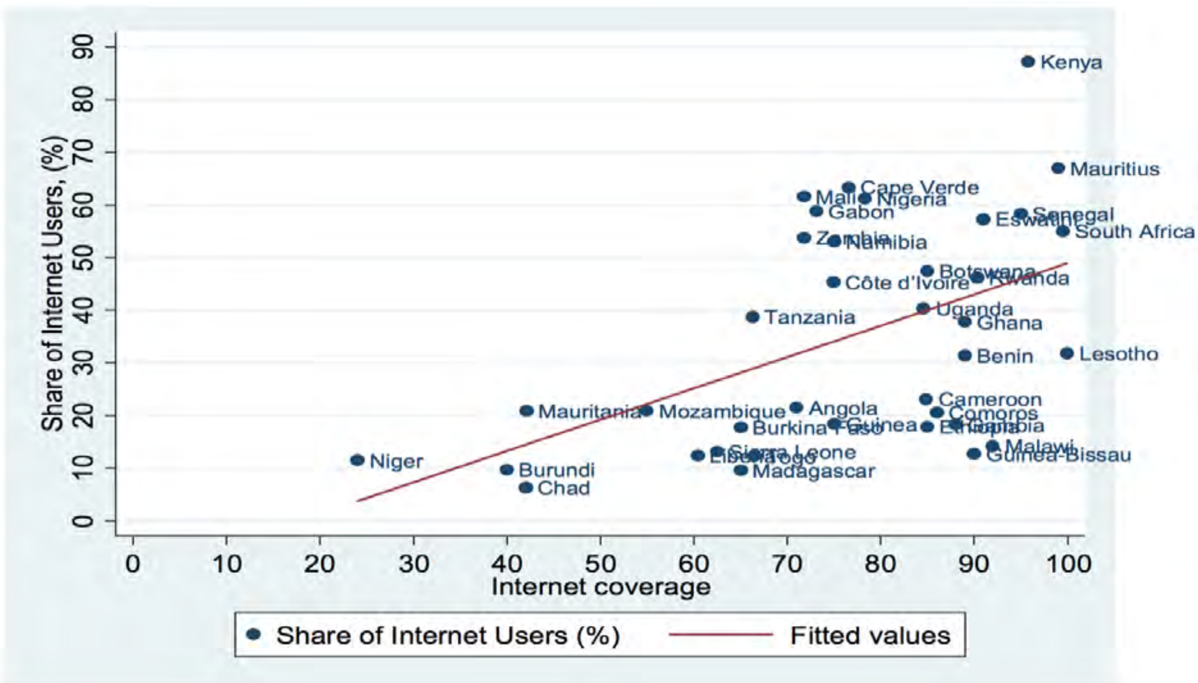
4.2 Relationships between enablers and use of internet service – a bivariate analysis

As discussed in Section 3, to assess the impact that fiscal action has on a country's digital transformation, it is imperative that we identify and establish the effectiveness of the transmission channels for digital taxation that influence digitalisation. Having identified the key enablers of digitalisation above, we now need to assess the ways these are influenced by the digital taxation regime. We use cross-plots and univariate regressions to explore the type of influence each enabler has on broadband penetration or internet use. We distinguish between **connectivity enablers** and **user enablers** in the assessment.

4.2.1 Relationships between connectivity enablers and internet use

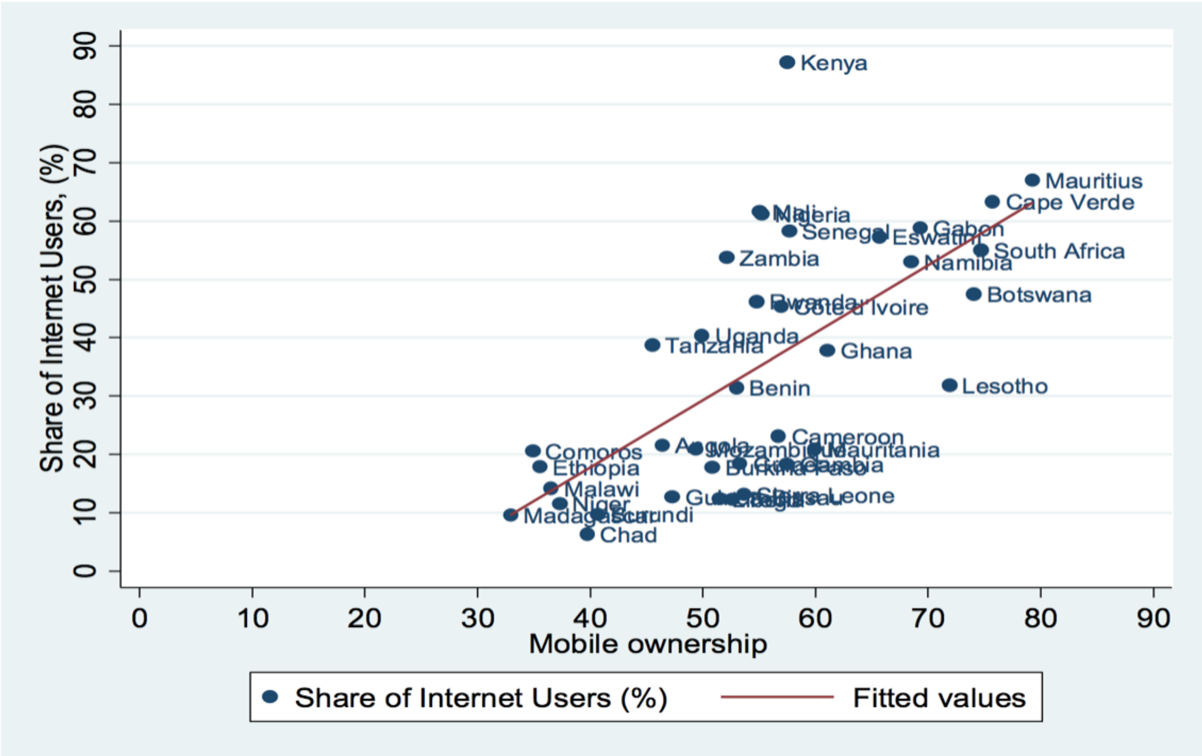
Figures 12 to 14 present the relationships between internet use and all the three connectivity enablers individually: (i) 3G network coverage; (ii) smartphone ownership; and (iii) access to electricity. As expected, all correlations are strong, confirming a positive relationship between access/connectivity enablers with internet penetration. The correlation coefficient for each pair is shown in the brackets following the figure title (as **r**). There are significantly high correlations, ranging from 0.51 for 3G network coverage, to 0.66 for phone ownership and to 0.7 for electricity connectivity.

Figure 12: Internet users and 3G internet coverage – 2019 (r=0.51)



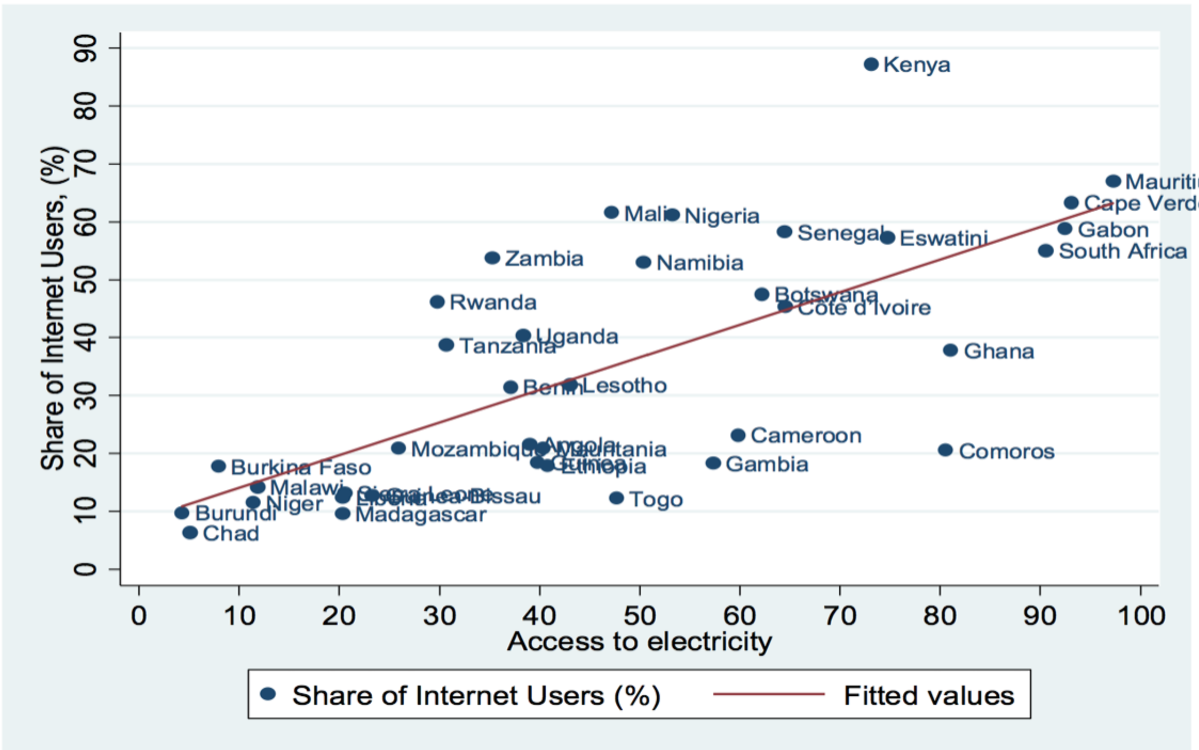
Source: ITU (2019) and WDI (2020)

Figure 13: Internet users and smartphone ownership – 2019 (r=0.66)



Source: WDI (2020)

Figure 14: Internet users and access to electricity – 2019 (r=0.70)

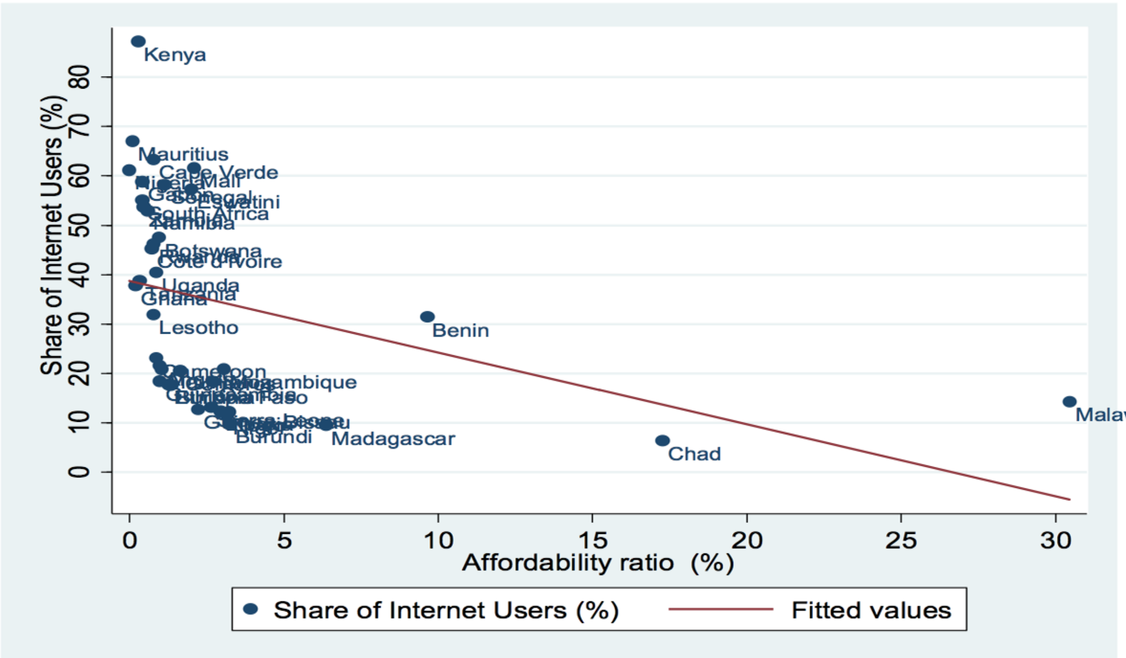


Source: ITU (2019) and GSMA-MCI (2020)

4.2.2 Relationships between user enablers and internet use

Figure 15 presents the cross-plot between affordability and internet use with a fitted linear relation. The cross-plot confirms a negative relationship with internet use. The correlation coefficient between affordability and internet use is -0.38. Given the curvature of the cross-plots, a non-linear fitted regression line would track a stronger correlation than the linear relationship and point to a downward sloping demand curve for internet services.

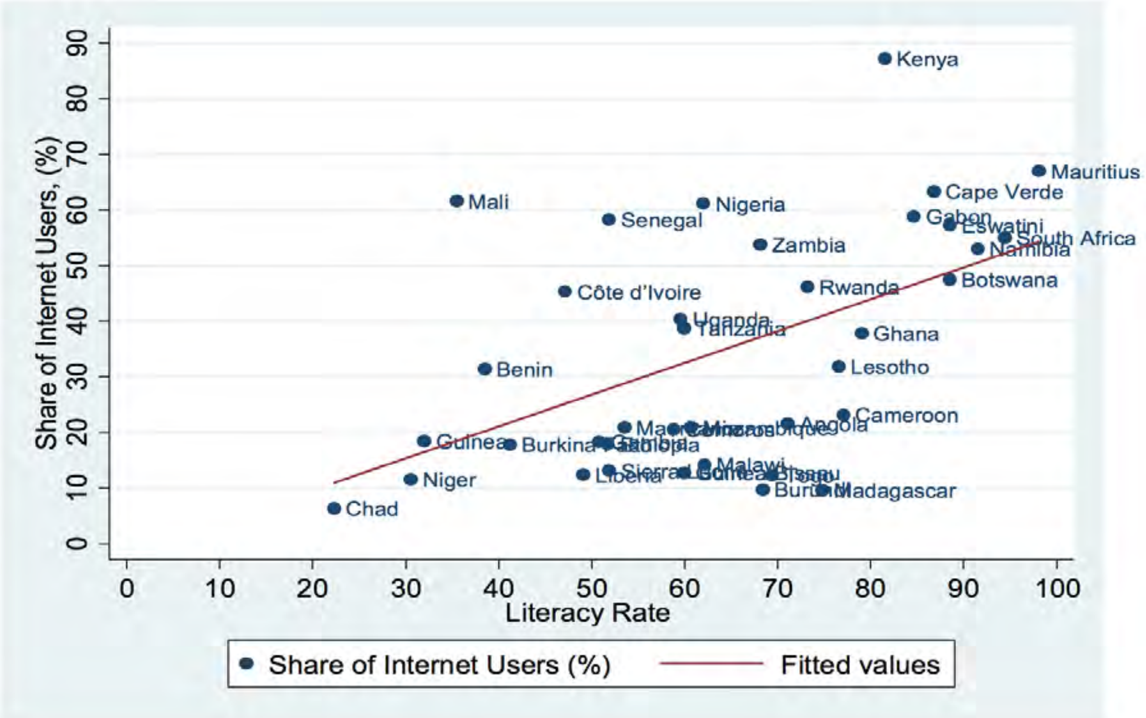
Figure 15: Internet users and affordability ratio – 2019 (r= -0.38)



Source: ITU (2019) and GSMA-MCI (2020)

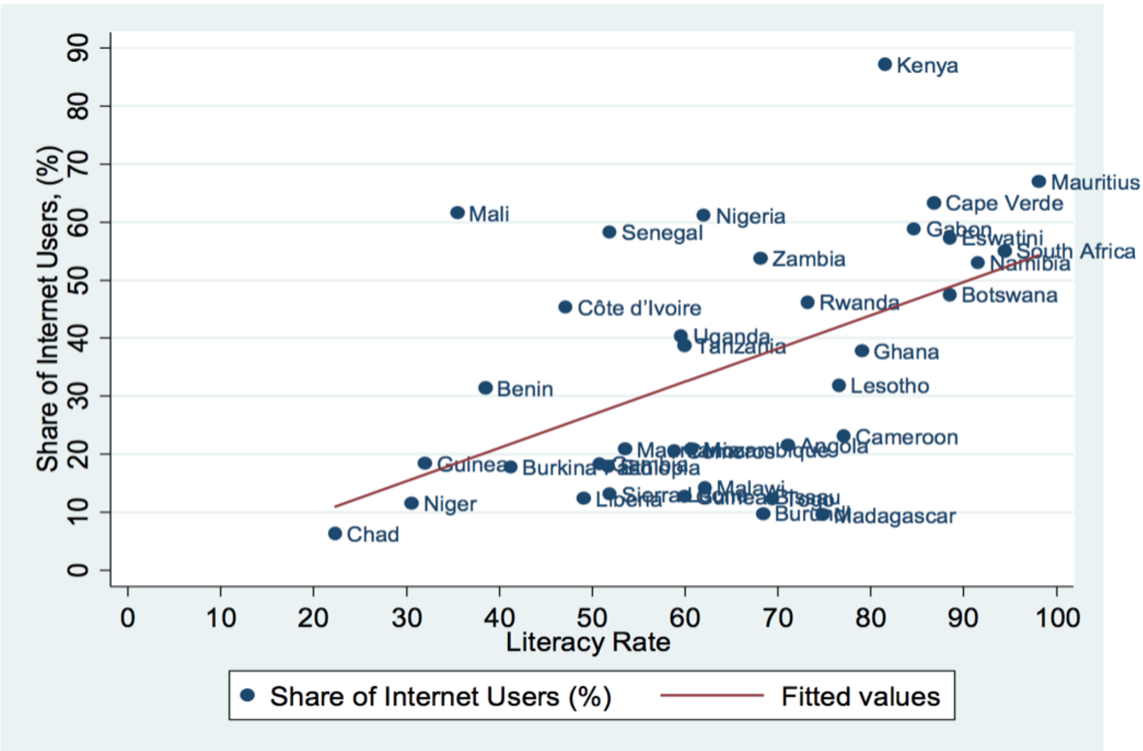
Figures 16 and 17 present the bivariate relationships between internet use and consumer capabilities enablers – consumer readiness and literacy rates respectively. Using cross-plots and bivariate regression we can confirm that both these variables have strong positive relationships with internet use. The correlation coefficient between literacy rate and internet use is 0.52; between consumer readiness and internet use, it is a stronger 0.62.

Figure 16: Internet users and consumer readiness – 2019 (r=0.62)



Source: ITU (2019) and GSMA-MCI (2020)

Figure 17: Internet users and literacy rate – 2019 (r=0.52)



Source: ITU (2019) and WDI (2020) and GSMA (2020)

4.3 Estimating the determinants of internet adoption in SSA – a multivariate analysis

Next, we use multivariate regressions to confirm the significance that each enabler has on broadband penetration or internet use. Given that result, we then discuss the influence of sector-specific taxes on each enabler, and the impact of taxes on digitalisation. This involves estimating the adoption or use of digital services using country-level panel data.

4.3.1 Empirical model for estimating the determinants of internet adoption using country panel data

Informed by the conceptual model in Section 2, equation (1) below presents the model to be used for estimation. The dependent variable on the left-hand side (IU) represents the number of internet users per capita measured as the proportion of the population using the internet actively out of the total adult population. On the right-hand side are: the determinants comprising the enablers reviewed earlier, including affordability of internet services (defined by prices of data/handsets and income per capita); connectivity enablers; consumer readiness and access to electricity. The expected signs of relationship for each enabler was discussed in Section 4.2. In some of the specifications we add a lagged value of internet use/adoption to test for networking effects and habitual inertia to change once a consumer is using the internet platform. This is in line with the reduced form of a Gompertz model of technology diffusion with a constant speed of adjustment. As Andres et al. (2007) assert:

> In such a model, the change in the number of users (from the current period to the next one) is expressed as a fraction (the speed of adjustment) of the gap between the number of users in equilibrium and the number of current users. Hence, the number of new users who adopt a certain good or service in a given period depends on both the number of existing and potential users, which is itself determined by demand-side variables (income, costs, etc.), and other factors affecting the demand or supply conditions or the technological infrastructure in each country (see Estache et al., 2002; Kiiski and Pohjola, 2002; Stoneman, 1983; ITU 2020 p.331).

The relationship is specified in equation (2).

$$\ln IU = + \beta_1 \ln LT + {}_2 \ln GNI + \beta_3 \ln IC + \beta_4 \ln MO + \beta_5 \ln AE + \beta_6 \ln IU_{(t-1)} + \qquad (2)$$

Whereas:

Log IU = Proportion of internet users in total population (DEPENDENT)
Log LT: log literacy rate as a measure of basic skills
Log GNI: log GNI per capita, PPP as measure of income

Log IC: log of internet coverage as a measure of the percentage of population covered by 3G network

Log MO: log mobile ownership as a measure of the percentage of the population owning a mobile phone

Log AE: log access to electricity as a measure of the percentage of the population with access to electricity.

Note: In some estimations, consumer readiness – a measure of the capacity to access the internet, including literacy rate, gender equality and mobile ownership – is used instead of the literacy rate. We estimate several variants of this model as discussed in Table 4.

4.3.2 Data sources and descriptions

The panel data contains information on a set of 40 SSA countries (see Annex) for the period 2014–2019. The study uses secondary data gathered from various sources. The data on internet use (measured by the percentage of the population using the internet) were obtained from ITU (various years). The data on GNI per capita, PPP in US dollars and adult literacy rate (as a measure of skills) were obtained from World Bank's World Development Indicators.

The data on the average price of 1GB (US$) were taken from ITU (2019) Global Broadband Pricing Study, while the data for an average price on 1.5GB were ITU's ICT Prices (price trends). Data on internet coverage (measured by the percentage of the population covered by 3G networks), the percentage of the population with access to electricity (as a measure of enabling infrastructure), consumer readiness (as a measure of the capacity to access the internet), handset prices (as a measure of a cost of the cheapest internet-enabled device) and taxation were obtained from the GSMA Mobile Connectivity Index scores.

The problems of consistent, quality and transparent data across SSA are well known and have been discussed most recently in Frankfurter et al. (2020). Despite some weaknesses pointed out on consistency across countries, ITU perhaps provides the best and most consistent reliable source of supply-side data on internet and other digital services. It obtains most of it from national regulatory authorities but combines that with respectable demand-side sources of data, including from National Statistical Offices, Afrobarometer surveys, PEW, Research Institute for Advanced Studies (RIAS), TELECO and United Nations International Children's Education Fund. The other credible supply-side data source, (particularly on mobile data and taxation/investment data from its members), is the mobile operator GSMA. The World Development Indicators (WDI), which also uses data from ITU and GSMA for internet and related information, is a credible source on development data, including income.

4.3.3 Summary statistics and tests

The mean, standard deviation, minimum and maximum of the variables used in the analysis are presented in Table 2. The results in Table 1 show that the mean for internet use for SSA is 23.4% – with the highest rate of 87.2% and the lowest rate of 1.2%. Also, a high value for the standard deviation (17.4%) indicates a substantial unevenness in internet use among the population of SSA countries. The internet coverage rates are substantial or high (mean of 60.2%) and have a standard deviation of 23.4%. GNP per capita, PPP (INCOME) also reflect significant variation in income levels – from a high of US$26,410 to a low of US$770.

Table 2: Summary statistics

	Number of observations	Mean	Standard deviation	Minimum	Maximum
Consumer readiness	240	48.2083	12.7501	17.1476	74.599
Access to electricity	240	41.4502	26.2148	0.75269	97.2753
Mobile ownership (%)	240	50.5331	12.3576	21.4667	79.2778
Adult literacy rate	240	63.8843	20.2027	19	94.3679
Internet coverage (%)	240	60.1686	23.3804	10	99.97
GNI per capita, PPP (US$)	240	4416.46	4665.87	770	26410
Internet use (%)	240	23.3996	17.4074	1.24868	87.2
Affordability ratio (%)	240	7.74317	9.54565	0.32942	57.0968

After the data have been transformed into natural logarithms, the correlations between independent variables were performed. The results are presented in Table 3. The correlation test shows the existence of possible multicollinearity in our estimation since there are high correlations among some pairs of variables such as log CR and log LT; log CR and log MO; log MO and log GNI.

Consumer readiness includes CR includes literacy rate (LT) as one of its components, as well as mobile ownership, hence the high correlation between the two pairs. We include these two variables as alternatives in the estimated equations. The level of per capita income influences affordability, and hence ownership, of mobile phones, again explaining the high correlation with mobile ownership. Our equations are calculated with and without both. The measurement of CR also includes mobile phone ownership, and hence the high correlation.

Table 3: Correlation matrix

	Log CR	Log LT	Log GNI	Log IC	Log AE	Log MO
Log CR	1					
Log LT	0.8698	1				
Log GNI	0.7127	0.5171	1			
Log IC	0.5388	0.4377	0.3769	1		
Log AE	0.611	0.5079	0.6876	0.5511	1	
Log MO	0.6546	0.3675	0.7358	0.439	0.6392	1

Before estimating the multivariate relationship, we conducted a test to determine whether using a fixed or random effects model would be more appropriate for our analysis. We used the Hausman Test where the null hypothesis is that the preferred model is random effects vs. the alternative to the fixed effects. We rejected the null hypothesis (Prob>chi2 = 0.0008) and concluded that the fixed effect model is preferred over the random effect model. Therefore, to examine the determinants of internet use in SSA, the study uses a specific panel data country fixed effects model. Finally, by inspecting the matrix of correlations between the independent variables, we cannot infer the existence of major collinearity problems.

The estimated model is sufficiently robust in the sense that small variations in the sample size, (or in the time period under analysis), do not provoke changes in the value and significance of the parameters of the model. We have also tested for heteroskedasticity under a null hypothesis of constant variance. The modified Wald Test for group-wise heteroskedasticity in a fixed effect regression model showed a chi2 (37) = 30537.54 (Prob>chi2 = 0.0000) and therefore we rejected a null hypothesis confirming the presence of a heteroskedasticity problem. To deal with heteroskedasticity, we used robust standard errors adjusted for 37 clusters. The R-squared, which explains how well the regression line approximates real data points (explaining total variability of the dependent variable – the rate of growth of internet use) are given under each estimated model.

4.3.4 Model estimation and findings

Table 4 presents the estimated reduced form equations for determinants of internet use (internet users per capita) in SSA using panel data with 240 observations (covering 40 SSA countries for six years). The estimated equations confirm the significant influence that enablers have on internet use in SSA. The variables jointly and significantly explain the variation of internet use across the countries. The p value of the F tests in all specifications allow us to conclude that we can reject the null hypothesis and confirm that our specified models provide a better fit than the intercept-only model.

In the section below, we first report the results for the estimated fixed effect models. Model 1 excludes consumer readiness (instead, it uses literacy for consumer capability) as CR explicitly includes mobile phone ownership as part of its defining components. Model 2 excludes MO and includes consumer readiness, which includes LT as part of its defining components. The estimated coefficients for connectivity variables in models 1 and 2 (internet network coverage, mobile phone ownership, and access to electricity) are significant at a minimum of 5% and with: estimated elasticities of 0.44 – 0.51for network coverage; 2.12 for mobile phone ownership; and 0.219 for access to electricity (Model 2). On the user's side, per capita income (GNI) and consumer capability are statistically significant at 1%; have high elasticities with that for per capita income, ranging between 0.963 – 1.099; and a high 2.2 for consumer readiness.

In models 3 and 4 we add a lagged dependent variable to capture the network effects and the possibility of habitual response to internet use once consumers are on board with the service. Network coverage, per capita income and handset ownership remain robustly significant at a minimum of 5%. The adjustment coefficients are small, signifying low network effect and/or slow adjustment to the desired levels due to the various constraints analysed. We also estimate dynamic specifications in models 4 and 5 using generalised methods of moments (GMM) and include a lagged dependent variable. The three enablers, network coverage and mobile phone ownership on the connectivity side, and GNI on the affordability side, remain significant at a minimum of 5%.

Table 4: Fixed effect model results – determinants of internet use in SSA (log proportion of internet users)

	Fixed effect model without lag		**Fixed effect model with lag**		**GMM estimation**	
Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Log LT	0.441		0.316		-0.075	
	(0.445)		(0.523)		(0.149)	
Log GNI	0.963***	1.099***	0.721	0.928**	0.107	0.223**
	(0.316)	(0.318)	(0.470)	(0.453)	(0.079)	(0.095)
Log MO	2.124***		1.873**		0.655***	
	(0.391)		(0.729)		(0.237)	
Log IC	0.443***	0.510***	0.506***	0.572***	0.329***	0.356***
	(0.118)	(0.126)	(0.173)	(0.171)	(0.091)	(0.105)
Log AE	0.042	0.219*	-0.052	0.096	0.044	0.088
	(0.042)	(0.115)	(0.174)	(0.150)	(0.055)	(0.063)
Log CR		2.230***		0.922		-0.120
		(0.813)		(0.617)		(0.274)
Log lag IU			0.044	0.085	0.449***	0.465***
			(0.083)	(0.086)	(0.124)	(0.126)
Constant	-16.853***	-17.311***	-13.460***	-10.945***	-2.927***	-1.435*
	(3.006)	(3.415)	(3.678)	(3.788)	(1.010)	(0.845)
Observations	240	240	200	200	200	200
R-squared	0.69	0.63	0.67	0.64		
Number of id	40	40	40	40	40	40
Robust standard errors in parentheses ***p<0.01 **p<0.05 *p<0.1						

Based on the results above, we are reasonably convinced that connectivity enablers (3G network coverage, access to electricity, and ownership of a mobile phone) are robust and significant determinants of internet use. As expected, per capita income is a key determinant of internet use, dominating the price effect in the affordability variable. At approximately 1.0, the estimated income elasticity for internet use points to a conclusion that internet use as a service fits the category of a normal good, with use increasing as per capita income increases. Using a simple model and global cross-country data from 2000, Goel R., Hsieh, E. Nelson M. and Ram (2006) found income elasticities of unity or higher, indicating that internet services (at that time) were not deemed a necessity. However, it is important to be mindful that, where income distribution is highly unequal, as is the case with South Africa, the rate of use may be lower relative to the country's expected position, given the level of its per capita income. Consumer readiness/capability to use the internet gainfully is also significant and supports the call for upskilling consumers so they can benefit from digitalisation.

5. Taxation of digital assets and services – impact on internet use in SSA

Much of the recent attention on taxation of the digital economy has focused on challenges related to: i) the shrinking tax base (due to increased intangibility with economy-wide digitalisation); and ii) tax evasion/avoidance due to globalisation of the value chain of digital services (Olbert and Spengel, 2019; Hadzieva, 2019; ATAF, 2019 a,b,c and d; Clavey et al. 2019; Kitsios, E., Jalles, J., & Verdier, G. 2019; Rukundo, 2020). While both these issues are quite important from the revenue perspective, in this paper we focus on the developmental dimension of digital taxation. More specifically we look at the challenge that taxation of digital services presents to penetration, adoption and use of digital services in the early stages of digital transformation of the economy.

5.1 Discriminatory taxes on the digital supply chain

A wide array of taxes affect the entire digital supply chain across SSA. Upstream examples include right-of-way charges, import duties on equipment and smartphones, and VAT on imports of both, which increase the cost of rolling out infrastructure for connectivity. Downstream examples of taxes include those on data, the popular Over-the-top services (OTTs) such as Voice Over Internet Protocol (VoIP), social media sites, and instant messaging, which directly increase user costs (World Bank, 2019). There are many other examples, including additional levies on mobile money transactions (excise and VAT) as well as social media products (Rukundo, 2020).

These taxes discriminate against the digital sector in three ways:

1. Many countries in SSA charge import duties on digital infrastructure assets – transmission, switching and networking equipment – while, in a typical escalated import duty structure, capital goods are zero rated.

2. Although most products (including internet services) are treated as consumer products, in the majority of cases, they are producer services.

3. There has been a notion in some countries that digital services are a luxury, and these attract punitive rates. Rwanda's President Kagame dispelled this misconception: "In 10 short years, what was once an object of luxury and privilege, the mobile phone, has become a basic necessity in Africa." (GSMA, 2008). Lessons from the recent experience with the COVID-19 pandemic further helped to debunk the misconception about digital services being a luxury item, as those without internet access were the hardest hit in the period of social distancing to contain the spread of infection.

Because digitisation has helped to monitor the ICT and financial sectors' rapid rates of growth, this has often tempted many governments to treat these sectors as 'cash cows'.

5.2 The impact of fiscal action on digital transformation

To assess the impact that fiscal action has on a country's digital transformation, it is imperative that we identify the transmission channels through which digital taxation influences the pace and depth of digitalisation. Section 4 confirmed empirically that all six connectivity and user enablers are significantly potent transmitters. Discriminatory sector-specific taxation on equipment and other capital formation transactions can stifle digitalisation progress by discouraging the rollout of network coverage and digital platforms. Whether they are levied on users directly or indirectly, discriminatory taxes stifle economy-wide diffusion of digital services, and make economies suffer high opportunity costs from loss of potential gains in productivity and efficiency in all using sectors and welfare losses in case of final consumption.

Should governments take into account the basic principle that, to encourage greater uptake of services to promote economy-wide productivity, growth and efficiency, activities that generate positive externalities should be rewarded rather than be taxed? In light of the fact that digital transformation also increases intangibility and erodes the tax base for the badly needed revenue to finance development, what is the appropriate level and structure of taxation that is consistent with balancing this tension – that is, the objective of digital transformation for developing economies versus enhancing revenue-generation for development.

In the next section, we review the status of digital taxation in the region to establish the extent of overtaxation of digital assets and services. We then look at the impact that such overtaxation has on digitalisation, given the confirmation of effective transmitters in the previous section. As well as drawing from the significant pool of existing research, our assessment also deploys evidence from the bivariate and multivariate statistical analysis in this paper.

5.3 Overtaxation of digital assets and services in Africa

We use 'overtaxation' to measure discrimination against the sector in tax policy. Overtaxation is the excess of general taxation the sector suffers via sector-specific taxes and fees. It typically involves the digital sector contributing more than its fair share, for example, in GDP.

In a study of 30 African countries for GSMA (2008) Frontier Economics carried out a comprehensive analysis of the impact that taxing mobile services had on growth in the decade since the introduction of mobile telephony in SSA. The study covered taxes levied throughout the telecoms/internet value chain, on: the equipment used for transmission, switching and core networking; software; handsets; and the range of outputs, including airtime and subscriptions. The equipment and software make up the bulk of infrastructure and operating assets – into which most investment is directed. Taxes on these items raise the cost of investment, while taxes on handsets, airtime and subscriptions are borne mainly by consumers. The consumer indirectly bears the infrastructure and operating taxes – shared with the operator's profits – depending on demand elasticity for services.

Table 5 presents the status of taxation in 2006 across the responsive sample of the 30 countries included in the study. The average share of taxes in the total revenue of mobile operators was about a third (32.5%), with a range of 16% for Democratic Republic of the Congo (DRC) at the lowest end, to 53% for Zambia at the top. The five countries with the highest ratios were Zambia (53%), Madagascar (45%), Tanzania (40%), Gabon (40%) and Cameroon (39%). The composition of taxes can be seen in the table for the 15 countries that provided data.

Table 5: Share of taxes in mobile revenue and tax rates in the mobile value chain – selected countries (2006)

Country	Total taxes as a share of total revenue by mobile operators (%)	Average import duty on equipment (transmission, switching and core network) %	Import duty on software %	Handsets			Output taxes (airtime and subscriptions VAT + other airtime + other subscriptions) %
				Import Duty (%)	VAT (%)	Others (%)	
Zambia	53	13.3	0.0	5.0	17.5	0	17.5
Madagascar	45	10.0	20	10	18	3	18
Gabon	40	23.3	0.0	10	18	0	18
Cameroon	39	22.3	22.5	31.5	0	0	19.3
Burkina Faso	37		0.0	14	18	1	18
Kenya	35	10.0	25.0	0	16	2.25	16
Tanzania	40	20.0	20.0	0	20	0	20
Nigeria	35	12.0	0.0	10	5	7.5	5
Uganda	34	7.0	0.0	0	18	0	18
Malawi	34	20.0	0.0	30	17.5	0	17.5
Chad	31	18.4	39.6	30	0	0	0
Republic of the Congo	27	20.0	20.0	41	21.6	0	21.6
Rwanda	25						
Niger	25						
South Africa	22	0.0	0.0	8.1	14	0	14
Ghana	21	10.0	10.0	10	15	5.5	15
Senegal	21						
Mali	19						
Swaziland	19						
DRC	16	0	0.0	20	13	0	18

Source: Adapted from Frontier Economics for GSMA (2008)

A GSMA (2017) report on taxing mobile connectivity in SSA collected and analysed comprehensive data on taxation of the mobile sector across 12 countries for which complete information was collected in 2015. In addition to general taxes such as VAT and corporate tax, mobile consumers and operators in SSA are subject to a number of sector-specific taxes and regulatory fees that either apply exclusively to the mobile industry or are applied at higher rates than other sectors (GSMA, 2017, p.9).

Mobile-sector-specific taxes in SSA based on 2015 data contributes between 2.5% of total government revenue in South Africa to 22% in Guinea. This contribution is 2.7 times more than the industry's share of GDP (GSMA, 2017, p.12) a clear indication of discriminatory tax policies against digitalisation. The report disaggregated total tax and fees as a proportion of mobile sector revenues into general taxation component and sector-specific taxes. We use the data to compute overtaxation as the excess of specific taxes and fees over general taxes for each country in the sample. Table 6 presents overtaxation across the 12 countries. There is significant overtaxation in this sense across the countries, with an average of 63%, but ranging widely – from 5% in South Africa to 124% in DRC. Two-thirds of the countries in the sample have overtaxation rates exceeding 60%.

Table 6: Overtaxation of mobile connectivity in a sample of 12 countries in SSA (2015)

Country	Total taxes and fees in mobile sector revenues %	General taxation %	Sector-specific taxes and fees %	Excess over general taxation %
Guinea	61	32	29	90
Chad	48	30	18	60
DRC	47	21	26	124
Niger	43	25	18	72
Tanzania	39	23	16	70
Ghana	30	16	14	88
Madagascar	30	25	5	20
Cameroon	28	22	6	27
Sierra Leone	29	24	5	21
Senegal	22	12	10	83
Rwanda	21	11	10	91
South Africa	20	19	1	5

Source: GSMA (2017)

Table A1 in the Annex illustrates some of the changes in five specific country cases we have studied more closely, including some more recent developments. Several of the conclusions reached by the studies reviewed above are confirmed at this more detailed level of analysis:

• The basic taxation approach invariably entails both discriminatory practice of overcharging the ICT and digital sectors, carrying a tax burden above general taxation across the supply chain and specific taxes applied across infrastructure and services.

• Invariably the key objective for taxing this sector is revenue maximisation. Inclusion does not explicitly feature in the fiscal objectives, except for one country.

• Given that, across all these countries, equipment is charged import duty notwithstanding the fact that they are capital goods imports – generally they would have been subject to zero taxation – confirms discrimination against investment in this sector.

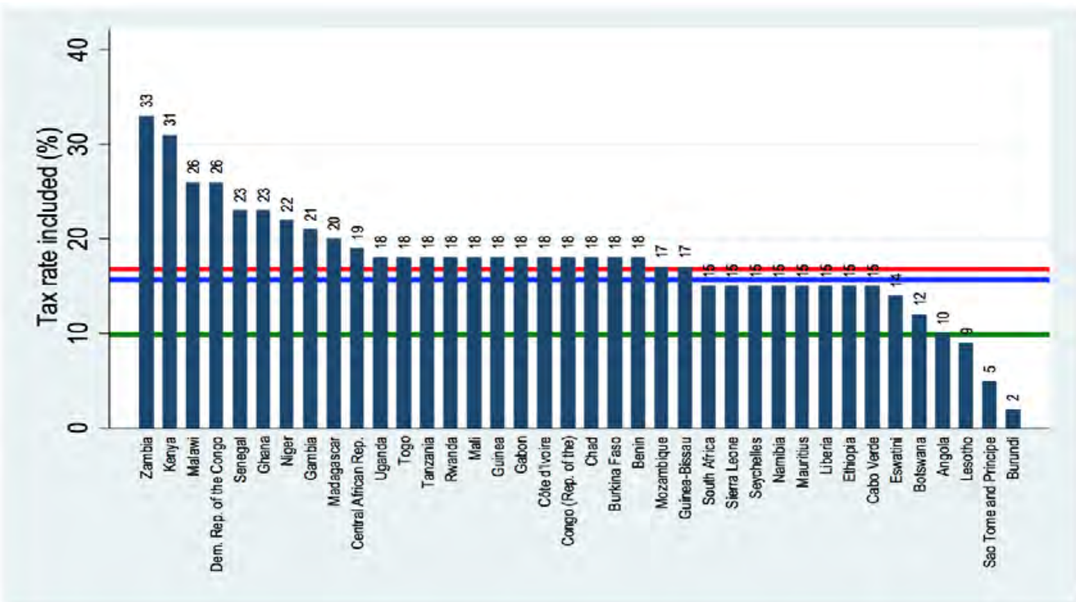
• On a more positive note, the sector more broadly benefits from competition given that there are multiple operators delivering services, and the fact that spectrum is auctioned.

• It is notable that all countries are currently enacting new tax laws to plug the revenue haemorrhage emanating from the fact that a number of key multinationals are providing cross-border services in these countries without a tax presence, effectively transferring tax revenue abroad. This new source could fill the gap caused by the revenue losses from rising intangibility of the tax base with digitalisation, and hopefully reduce the pressure for discriminatory sector-specific taxation.

5.4 Sector-specific taxation and impact on uptake of digital services

High sector-specific taxes make up a significant component of the cost to users for digital services. These taxes pose a huge burden on internet access and use. Two examples illustrate the point: Figure 18 presents the share of taxes in the prices of mobile handsets across 37 African countries in 2019. The average rate across the SSA countries stands at 16.8 above regional averages for Latin America/Caribbean region (15.7%) and Asia-Pacific (9.9%). There is, however, a very wide variation across the SSA 37 countries – from Burundi with the lowest tax share of 2% to Zambia with 33% of the price of the handset.

Figure 18: Tax rate included in mobile handset prices (%)



Source: ITU (2020)

Averages for ---- SSA (16.8%); ---- Latin America and Caribbean (15.7%); --- Asia and Pacific (9.9%)

GSMA (2017) *inter alia* reviewed the comparative taxes levied on mobile phone use (calls, SMS and data) across a study of 30 SSA countries, using data from 2016. Usage costs are the largest proportion in the total cost of owning a mobile phone, and therefore taxes on this component are a burden to users. In 2016, the top five countries (out of the 29 with available consistent data) with the highest combined usage tax rates across SSA were Gabon (36%), Tanzania (35%), Zambia (33%), Madagascar (30%) and Uganda (30%) (GSMA, 2017, see Figure 9). The average for the region was 21%.

These top five countries also have the highest sector-specific taxes on top of general taxation – VAT in this case. In the same study, three of these countries (Zambia, Madagascar and Tanzania) reappear among the top five countries with the highest tax as a proportion of total cost of mobile phone ownership. Again, sector-specific taxes dominate their ranking.

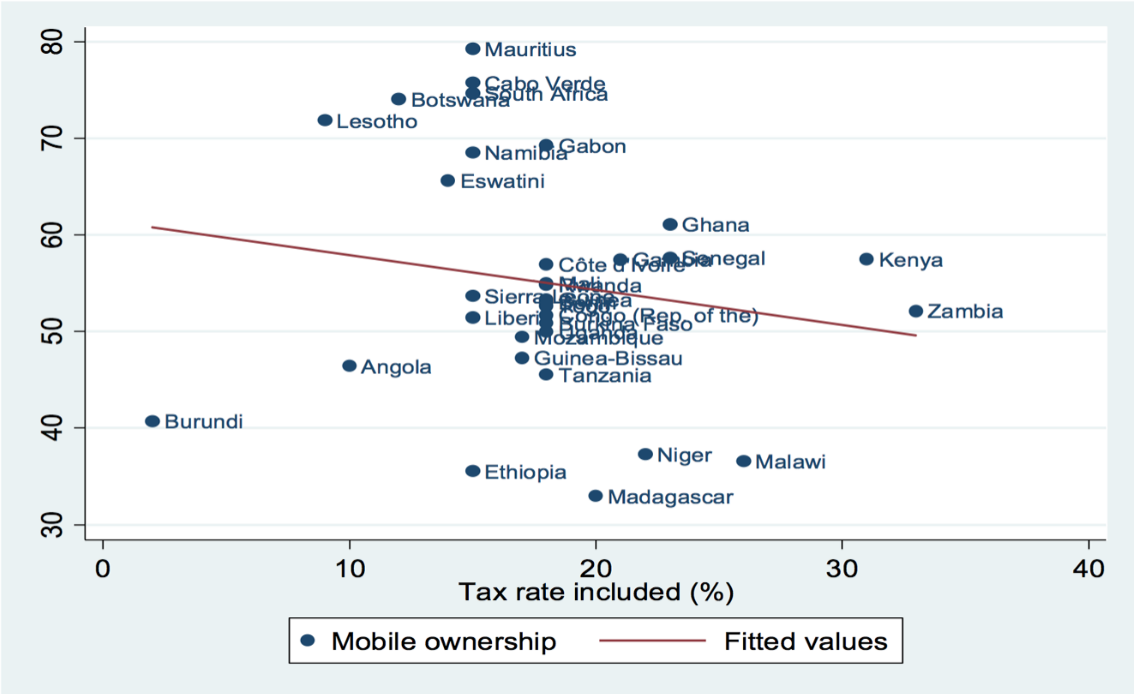
5.5 Assessing the indirect impact of taxation on digital transformation

There is significant evidence that broadband penetration is impacted negatively by these taxes. We use a more indirect approach to confirm this impact. As argued earlier, these effects are mediated through the influence of the enablers on digitalisation, measured here as uptake and use of the internet. In Section 3 we confirmed that: all access or connectivity variables will positively influence the extent of adoption and use of internet; the price of a mobile handset and data will negatively influence the extent of use of internet; and income per capita (GNI per capita) would positively influence the uptake of internet, and so would consumer capabilities.

To the extent that sector-specific taxes either stifle rollout of connectivity infrastructure or reduce affordability of data and handsets, the taxes would militate against digitalisation as measured by internet use. We provide some evidence here of the indirect transmission of these tax effects on digital transformation. For example, policies that enhance affordability of digital services, including those that impact on the price of data, can encourage uptake or use of internet. To illustrate, we include bivariate analysis of the relationships between taxation rates, use of digital services and ownership of handsets.

Figure 19 cross-plots the proportion of taxes in the price of a mobile phone with the proportion of the population that own a mobile phone. The expectation is that higher tax rates raise prices, reducing affordability and decreasing demand for mobile phones. The fitted regression line confirms that higher taxes tend to reduce affordability of mobile phones and decrease ownership, (a precondition for use, as confirmed in Section 3 above) with a very high coefficient of impact – a -10% decrease in ownership of mobile phones reduces internet use by more than 20%.

Figure 19: Tax rate included and mobile ownership (r-0.17)



Source: ITU and GSMA-MCI (2020)

We also estimated a bivariate regression between the price of a package containing 1.5GB data and internet use in logs, which should also closely track data use (see Table 7). This covers a panel of 40 countries for which we have consistent data over a period of two years. We found a statistically significant negative relationship between the price of internet services and internet use, with a coefficient of -0.31 (t statistic= 4.56, p=0). Since consumer taxes are applied directly at end point, taxes on usage would directly have the same impact via a price increase. A 10% reduction in consumer/usage taxes would thus be associated with a 3.1% increase in the proportion of people using the internet.

Table 7: Price of 1.5 GB data package and internet use in SSA
Log internet use and log price of internet services

logIU	Coef.	Robust Std. Err.	T	P>t	[95% Conf.	Interval]
logPGB	-0.3108	0.068116	-4.56	0	-0.44858	-0.17302
_cons	3.615356	0.167626	21.57	0	3.2763	3.954412

Next, using a panel of 40 countries over six years, and a country fixed effect model, we estimate a bivariate regression between network coverage and the proportion of taxes included in the total cost of mobile phone ownership (device, usage, activation costs). Table 8 shows a statistically significant negative relationship with a coefficient of - 0.17.

Table 8: Network coverage with proportion of taxes included in the total cost of mobile ownership (TCMO) – fixed effect model

logNetwork	Coef.	Std. Err.	T	P>t	[95% Conf.	Interval]
logPGB	-0.3108	0.068116	-4.56	0	-0.44858	-0.17302
_cons	3.615356	0.167626	21.57	0	3.2763	3.954412

The tax impact on internet use is indirect via its influence on network coverage, which in turn influences internet use. The impact could be derived indirectly by multiplying the coefficient obtained here (-0.17) with the coefficient of network coverage on internet use/adoption (0.5 on average across fixed effect models) to arrive at 0.085. A 10% reduction in tax rate charged to TCMO would lead to an 8.5% increase in internet adoption.

5.6 Evidence from other studies

5.6.1 Boosting demand for internet: Finland and the EU

Gao et al. (2004) performed a number of counterfactual experiments in the study of wireless broadband penetration in the early phase of internet adoption in Finland. One of the experiments demonstrated that abolishing the existing VAT would have greatly boosted demand for wireless internet services in Finland at that early stage of adoption and use. These results were consistent with those found by Goolsbee (2000b) and Ellison and Ellison (2003), which found high tax elasticities of demand for the emerging internet commerce. In another paper, Gao et al. (2014) also undertook a simulation to find out what would have happened had the EU, at the early stages of adoption, placed a moratorium on taxing new wireless services and restricted its member states' ability to raise revenue from them, just as the US Federal Government did with the 1998 Internet Tax Freedom Act *vis a vis* its states. They found that, had the EU enforced such a moratorium, the expected number of connections would have increased, on average, by 41% per year, with linear demand. For log-linear demand, these numbers would have been higher, at 158%. The demand-enhancing effect of a tax break would have been significant.

5.6.2 Taxation and mobile broadband in emerging countries

Katz et al. (2010) examined the impact of taxation on mobile broadband sector development in five emerging countries (Brazil, Mexico, Bangladesh, South Africa and Malaysia). The results showed that taxes had a negative impact on the diffusion of wireless broadband with a consequent detrimental effect on economic development. Taxes on mobile services hamper the diffusion of technology – with the largest impact in Brazil and lowest in Malaysia. For example, a reduction in taxation would increase wireless penetration between 4.6 and 24 percentage points in Malaysia. The study indicated further that a reduction in mobile broadband taxes will translate into higher service adoption, which will ultimately generate additional GDP – that is, US$1.4 to US$12.6 in emerging countries. Moreover, the forgone revenue will be partially or totally compensated by taxes collected from a larger tax base due to a larger GDP.

5.6.3 Lower taxes attract investment

GSMA (2017) confirms that SSA countries where operator taxes as a proportion of sector revenue are lower are also more attractive for investment, as measured by the Africa Investment Index (AII) developed by Quantum Global Research Lab (see Figure 19 in GSMA 2017). The AII measures countries and markets that are most attractive for investment in the short-to-medium term across growth, liquidity, risk, business environment, demographic and social capital factors. The same GSMA study, using country cases, also assessed the economy-wide effects of reforming sector-specific taxes and fees. The research concludes that tax reductions can increase the tax base and allow at least tax neutrality in the medium term, and achieve higher tax and fee revenues in the long run, more than compensating for short-run losses (see Figure 22 in GSMA 2017).

5.6.4 Mobile-based financial services: Kenya

Ndung'u (2019) showed that taxation of mobile phone airtime and financial transactions may not expand the tax base significantly; but, rather, it may reverse the gains on retail electronic payments and financial inclusion. A higher tax rate on low-level retail electronic transactions may discourage the use of mobile phone transactions, especially for low-income earners who are sensitive to transaction costs, incentivising them to revert to cash transactions, resulting in less tax revenue (Ndung'u, 2019). However, the study showed that the contribution of mobile-money-related taxes is less than 1% of total tax revenue, a negligible contribution to Kenya's total tax income, at high economic opportunity costs to Kenya.

5.6.5 VAT on equipment and services

For a GSMA study (2019) Frontier Economics carried out a simulation of the impact of lowering and removing non-VAT mobile-specific taxes on subscriptions, usage and total tax revenue generated by the industry (excluding those generated through diffusion of these services into all other sectors). If non-VAT taxes were removed, governments in the majority of countries would receive incrementally higher tax returns as industry growth boosts total VAT receipts along with corporate and employment tax receipts. Specific examples are used to drive this point home. If mobile-ownership-specific taxes – that is, all non-VAT taxes relating to handsets, subscription and connections – were removed for the five-year period 2007 to 2012, after short-term revenue losses, by 2012, tax receipts would be higher: Chad by approximately 30%; Ghana by 20%; Cameroon and Nigeria by 15%; Republic of Congo by 11%; Malawi by 8%; and Zambia by 7%. For the 10-year period 2007 to 2017, if Ghana removed all non-VAT taxes in 2007, by 2017 tax revenues would be 38% above the base case, and penetration would be 28% higher. In Cameroon, if non-VAT taxes were removed on handsets only in 2007, by 2017 tax revenues would be 24% above the base case and penetration would be 43% higher.

6. Conclusion and policy recommendations

6.1 Key conclusions

There are three important conclusions from the empirical analysis that are pertinent to our policy recommendations:

1. On the supply side, we have confirmed that connectivity enablers (3G network coverage complemented by access to electricity) are robust and significant determinants of internet use in SSA. Network coverage requires investment in the right of way, switching and transmission and network equipment. To the extent that discriminatory taxes on these raise the cost of investment, and disproportionately so through sector-specific taxes that are added on top of general taxation, they discourage rollout of network coverage, and disproportionately disincentivise investment in this sector relative to others. A key policy recommendation flowing from this conclusion is to eliminate overtaxation of the digital services sector by eliminating sector-specific discriminatory taxes.

2. On the user's side we have statistically confirmed that affordability of digital services (via price and income effects) is a strong and robust determinant of internet use in SSA. Affordability effect is dominated by the per capita income level in a country. Use of internet services generally increases with a country's income per capita, although adverse changes in income inequality may moderate this. Therefore, a predominance of low incomes in the region is a key influence on low internet use. This is the key for countries addressing the income-based digital divide in broadband penetration. To the extent that taxation of digital services is regressive, it will hold back overall progress in increasing internet use in the region. A key policy recommendation is to adopt a progressive taxation approach, even for indirect taxes such as VAT, and consider subsidies for promoting uptake.

3. On the users' side, among the variables included in the multivariate analysis, mobile phone ownership has the largest impact (elasticity of up to 2.1) on internet use in the region. Discriminatory taxation on mobile phones is predominant across countries in the region. Taxes as a proportion of total cost of ownership of a mobile phone in more than half of the 37 countries in the region exceeds 50%. As the ultimate connectivity platform for internet users, mobile phone ownership is an essential condition for use of digital services among most consumers in the region who depend on mobile broadband. Our policy recommendations propose affirmative fiscal action to promote increased ownership of smart or feature mobile phones, and increase potential internet use.

6.2 Policy recommendations

Governments should consider design of fiscal architecture that supports growth in the use of digital services and focuses attention on excluded consumers. The design of an efficient tax structure in the digital space requires avoidance of discriminatory and distortive sector-specific taxation. Governments should consider positive discrimination of low-income users, and rewarding the positive externality of the sector by selectively providing exemptions to facilitate investment in infrastructure and promote adoption by end users (Katz, 2010).

These fiscal measures should complement business models that make smartphones and digital services available at lower costs to ensure that people living in poverty can afford such life-changing services. We propose policy measures that eliminate distortive sector-specific taxes that discriminate against the sector. We also propose a progressive tax regime that discriminates in favour of low-income users by explicitly implementing differential taxation of services across consumer categories, complementing cross-subsidisation in pricing. Though not often practised in the region, public subsidy initiatives in the form of investment incentives and Universal Service Funds could be considered a positive externality from the core digital sector.

These measures will have a better chance of acceptance if the government ensures proper collection of taxes from income generated at source by multinationals operating in the digital space. This will help to fill revenue gaps originating from the intangibility of the tax base more generally as digitalisation of economy increases.

Although it is instructive to learn from the positive impact on uptake of internet that the 1998 Internet Tax Freedom Act had in the early stages of digital transformation in the USA, we are **not** advocating that digital services and products be exempted from taxation. Intangibility and nexus challenges reduce the tax base and revenue, which is important for financing inclusive development and helping deal with disruptions (e.g job destruction) engendered by digitalisation. Digital taxation should: embrace the principles of fairness given the predominance of digital division; focus on efficiency rather than simply ease of collection; and be supportive of innovation – digital transformation – in light of the large positive externalities that digital services provide via their economy-wide diffusion (Pathways for Prosperity, 2018).

6.2.1 Eliminate distortionary and discriminatory sector-specific taxes

Several studies cited in this paper, and our own analysis of data, confirm that discriminatory sector-specific taxation throughout the digital value chain is predominant across the region and is harmful to the uptake of digital services. These taxes undermine revenue collection and stifle the sector's growth and tax base. Excess taxation stunts the specific sector's growth, and also stifles economy-wide diffusion of these services, decreasing productivity growth and efficiency across using sectors. The harm from these taxes is not limited to their cost burden for operators and users. Because of the frequent unpredictable changes in taxes levied, uncertainty over future taxation reduces investment: the risk of future tax rises is priced into investment decisions, and can reduce investment in the medium term. Numerous sector-specific fees also raise compliance costs for mobile operators (GSMA, 2017, p. 3).

We propose a reduction of all sector-specific taxes throughout the value chain – from investment and operations to consumer services. The ultimate aim is to totally eliminate discriminatory taxation or all sector-specific taxes. The typical structure of import duties across East Africa and many other countries is: 0% for capital goods and raw materials; 10% for semi-finished goods; and 25% for final consumer goods or finished commercial goods. With the exception of very few countries in the region, in contrast to general import regulations, imported equipment for investment in the ICT sector attracts import duty (see Table 5 above). Mobile phone handsets and services also attract sector-specific taxes, which are discriminatory and distortionary.

6.2.2 Promote 'freemium' pricing and taxation

A 'freemium' ('free' plus 'premium') pricing strategy allows low-income earners to start as a new entrant, using basic features of a software, platform or service for free, with charges to 'upgrade' to higher priced services such as higher bundles of data. These users benefit from digital services that can improve their livelihoods. Under a freemium model, a business usually gives away a low-capacity data package at no cost to the consumer as a way to establish the foundation for future transactions or upgrades to a paid service. The operator may include some level of cross-subsidisation by higher data users, but as low-income users migrate to higher packages, the paying customer base grows substantially as new entrants move up the ladder.

Governments can offer tax breaks to operators that embrace this scheme to encourage broad adoption of freemium pricing models. And, since the basic package under this strategy is zero-priced, low-income users automatically do not pay taxes such as VAT.

The same principles can be applied to a progressive taxation scheme – we can call it 'freemium taxation'. The basic package can be tax-free to incentivise new entrants, with the same expectations that the new customers upgrade their demand for services beyond the basic provision and grow the tax-paying customer base over time. This becomes more important, particularly where the freemium pricing model has not been adopted by operators and low-income users become tax exempt. Likewise, it could suspend VAT on low-end smartphones (e.g feature phones) to enhance affordability of these for low-income earners. As we saw earlier, the cost of smartphones remains a major obstacle to internet access, notwithstanding the fact that the cost of mobile phones has been decreasing significantly.

These measures also enable dealing with the challenge of low-income digital service users suffering a poverty premium. Low-denomination prepaid bundles typically have what has been termed as a 'poverty premium'. This arises because poor people, who predominantly use these low-denomination bundles end up paying more than proportionate to their incomes than wealthier groups. And higher priced bundles typically enjoy larger discounts in the marketing schemes. In South Africa this particular concern has been raised by the President and is receiving attention (Ndulu, Ngwenya and Setlhalogile, 2020).

6.2.3 Adopt a collaborative approach to subsidising broadband penetration to rural areas

Harnessing digital opportunities will require co-ordinated effort (collaborative framework) across government and also in unison with the private sector and civil society to select and implement a digital pathway that leaves no one behind. In underserved areas, supply costs typically exceed the revenues from demand and, in the absence of affirmative intervention, these areas will continue to stagnate in terms of internet use (Ndulu et al. 2020). The rural–urban divide is one of the key hindrances to raising overall internet penetration in most SSA countries. Fiscal policy can play an important integrative role in addressing this.

Our empirical analysis confirmed that, after provision of network coverage, ownership of mobile phones and affordability of internet services are the key issues for internet adoption. One of the strategies that has been used in a number of countries is to establish a Universal Service Fund to subsidise access to lower-cost smartphones in the rural areas that are newly connected to 3G and 4G networks (World Bank, 2019, p.16) and pay for public Wi-Fi hotspots. For example, Kenya has deployed more than 3,000 hotspots targeted at rural communities close to cities. The country is also setting up a network of giant internet-enabled balloons (high-altitude platform stations) to serve remote underserved areas or unserved areas. These may not be commercially viable, and so there is a need for government subsidy as part of strategy for closing the digital divide (Ndulu, Ngwenya and Setlhalogile, 2020).

We appreciate that there may be challenges in effectively targeting supply-side subsidies, as it may be difficult to prevent diversion of universal funds away from the intended beneficiaries to undesignated uses. A shift towards demand-side subsidies and away from the more preponderant traditional supply-side subsidies may be required. However, with appropriate oversight and prudential use, subsidies should not be ruled out (World Bank, 2019).

It is worth reiterating that, as the majority of the digitally excluded are either poor, located remotely or women, it is vital for successful digital transformation that SSA countries adopt fiscal strategies that primarily deploy an inclusive approach. These countries can't break into a significant threshold of digitalisation and enjoy the network effects from scale if they don't address the 'triple digital divide' – income, rural–urban, and gender – and commit to leaving no one behind. We do appreciate that countries are starting from different initial conditions, particularly those that influence the extent of existing digital divides. But the key principles of the fiscal regimes advocated in this paper are applicable across all countries.

Annex

Table A1: Lessons from country cases

Country	Taxation approach	Is the tax regime favourable to investment?	Recent changes	Consumer responsiveness	Objective of the DST	Number of mobile operators (competitiveness)	Auction of spectrum (competitiveness)
Kenya	**Sector discrimination** (5% on value of mobile services; 12% on transaction value of mobile money). **Revenue maximisation objective**	The tax regime is **favourable** to investment. **No import duty on network equipment**	• 2014/15 reduced excise duty from 15% to 10% • 2018 increased excise duty on money transfers from 10% to 12% • 2018 introduced excise duty on internet data Effective 1 Jan 2021, new DST at the rate of 1.5 % on the gross transaction value (excl. VAT)		The government intention with the new DST is to broaden the tax base through inclusion of business activity in the digital marketplace	4: Safaricom, Airtel, Essar, and Orange	Yes
Tanzania	**Discriminatory vs sector.** (17% excise tax on mobile services; 10% on mobile money transfers) **Revenue maximisation objective.**	The tax regime is **not favourable** to investment. **0-25% import duty** on network equipment	• 2013 monthly 1,000 TSh fee on active SIM cards – currently removed • 2013/14 introduced 10% excise duty on mobile money transfer fees • 2018 introduced VAT on non-resident providers		Regulate online content	8: Airtel, Smart, Smile, Halotel, Tigo, TTCL, Vodacom, and Zantel	Yes
Uganda	**Discriminatory vs sector** (1% excise duty on money transfers). **Revenue maximisation objective**	The tax regime is **not favourable** to investment. **25% import duty** on network equipment WHT – 6%	• 2014/2015 255 excise duty on equipment removed and excise duty on airtime increased from 8% to 10% • 2018 introduced fixed tax on Over the Top (OTT) services (€64 cents daily) for any user/SIM card accessing social media platforms – changed in 2020 to direct tax on internet bundles to contain tax evasion	• Internet users dropped by 30% due to the DST • Some switched to alternatives like SMS and tax avoidance via VPN • Others used Wi-Fi in offices to avoid OTT tax payment	Curb gossip and broaden the country's tax base	8: MTN Uganda, Airtel Uganda, Uganda Telecom, Africell Uganda, Smile Telecom, K2 Telecom, and Lycamobile Uganda	Yes

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Ghana	**Discriminatory vs sector** (6% communication services tax; 2.5% NHI levy). **Revenue maximisation objective**	The tax regime is **not favourable** to investment. **20% import duty** on network equipment	• January 2014, imposed 12.5% VAT on non-resident vendors of digital services • 2018 excise tax stamp became effective • Oct 2019, 6% tax levied on communication services			4: AirtelTigo, Ghana Telecom (Vodafone), Glo Ghana, and Scan-Com Ghana (MTN)	Yes
Zimbabwe	Discriminatory vs sector (10% excise on airtime for voice and data; and 5% general income tax on specific digital services income) **Revenue maximisation objective**	The tax regime is **favourable** to investment. **No import duty**	• On 1 January 2019, enacted 5% as a general income tax on specified digital services income -•January 2020, amended VAT rules to tax **non-resident** suppliers of digital services at 14.5%		To raise additional revenue to finance non-discretionary expenditures	3: Econet Wireless, NetOne Cellular, and Telecel	Yes

Table A2: Variations of enablers by years

Year		Consumer Readiness	Access to electricity	Mobile ownership	Literacy	Internet coverage	GNI per capita, ppp	Share of internet users	Price of 1.5gb	Price of handset
2014	Mean	47.9	39.4	48.0	64.5	47.2	4655.4	16.7	24.2	29.5
	S.D.	12.6	25.7	11.8	20.4	24.2	4568.6	12.2	17.6	15.7
	C.V	26.4	65.3	24.6	31.7	51.2	98.1	73.0	72.8	53.3
2015	Mean	49.1	42.1	50.3	65.6	52.6	4781.5	20.8	21.1	27.2
	S.D	12.4	25.3	11.9	19.8	23.7	4553.2	13.5	18.0	14.0
	C.V	25.3	60.0	23.7	30.2	45.0	95.2	64.7	85.0	51.6
2016	Mean	48.8	44.8	51.7	65.1	58.9	4683.3	22.1	17.5	27.8
	S.D	12.7	24.5	11.4	19.6	22.0	4626.7	14.0	14.5	15.9
	C.V	25.9	54.6	22.1	30.1	37.4	98.8	63.2	83.3	57.0
2017	Mean	49.5	44.9	52.6	66.1	64.4	4700.0	23.8	12.1	29.0
	S.D	12.2	24.7	11.6	19.4	19.1	4748.8	14.7	7.7	16.9
	C.V	24.6	55.1	22.0	29.4	29.7	101.0	61.6	63.7	58.4
2018	Mean	50.4	48.8	53.9	65.6	72.7	4910.0	30.8	10.5	27.2
	S.D	11.9	25.3	11.9	18.9	15.9	4991.6	19.4	6.6	17.3
	C.V	23.6	51.7	22.0	28.8	21.9	101.7	62.9	62.5	63.7
2019	Mean	51.4	49.7	55.4	67.6	79.3	5101.7	36.5	10.0	30.6
	S.D	11.4	24.2	11.5	17.6	13.7	5153.7	20.6	5.8	15.9
	C.V	22.2	48.8	20.7	26.0	17.2	101.0	56.5	57.8	52.0

Countries included in the multivariate analysis:

Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Chad, Comoros, Congo, Cote d'Ivoire, Democratic Republic of the Congo (DRC), Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Tanzania, Togo, Uganda, Zambia and Zimbabwe.

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