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Driving digital transformation of African economies

Evidence and methodology document

May 2024

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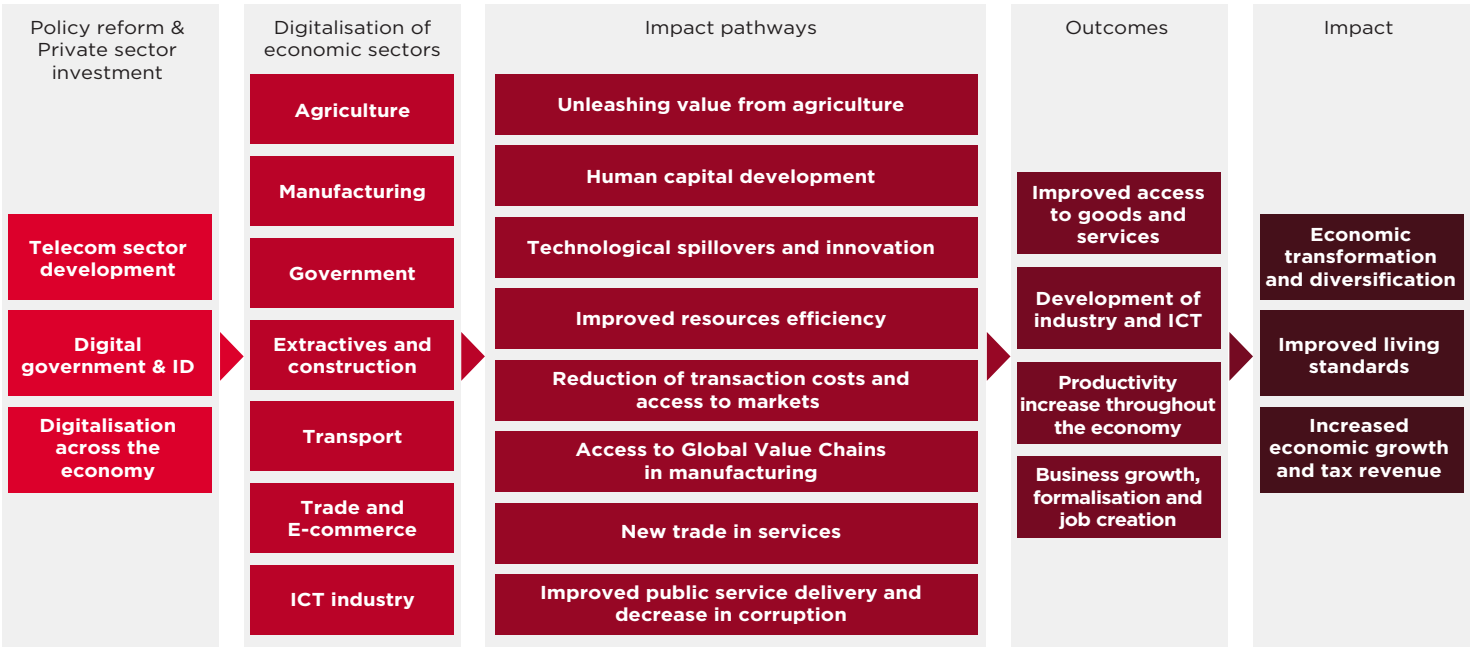
1. Introduction

A. Studies on the digital transformation of African economies

This series of studies examines the role of digital technologies in the economic transformation of selected countries in Africa. The starting point is an analysis of how digital technologies can drive socio-economic development through enhanced productivity, job creation, as well as how they can be used to improve the way in which government functions.

The studies identify opportunities and quantify the economic value of adopting digital technologies across specific sectors of the economy, and how these can be unlocked through policy reform recognising the critical role that the telecoms sector plays in supporting the process of digitalisation.

Figure 1: **Digital pathways to economic transformation**



Source: Authors' analysis.

B. This document

This document sets out the general evidence gathered for the studies, in the form of experiences across African countries and case studies, and the methodology underlying the economic analysis and estimations of the impacts of policy reform and digitalisation on the economy of the selected countries.

The rest of the report is organised as follows:

- Section 2 describes the impacts of digitalisation of the economy and explores how it can positively impact productivity, growth and job creation. For each key sector of the economy, the potential economic impact of digitalisation is described and experience from African countries is collected through case studies.
- Section 3 sets out the methodology used in the country studies to estimate first the impact of specific policy reforms on the telecoms sector and the how these translate into impacts on the economy through digitalisation of key sectors of the economy.
- Section 4 concludes with the Bibliography.

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2. The impacts of digitalisation in Africa

A. Macroeconomic impacts of digitalisation in Africa

Digitalisation of the economy is a key driver for socio-economic growth and government revenue and can offer new opportunities for pathways to growth, job creation and diversification of the economy. The internet economy is projected to reach 5.2% of the GDP in Africa by 2025,[1] and development of the digital ecosystem has been show to add up to 1.9% in GDP per capita in SSA.[2]

The mobile technology sector is key to realise this potential and the associated economic value, given mobile devices are the most common means of internet and financial access in Africa. For example, 10% increase in mobile Internet penetration is estimated to increase GDP per capita by up to 2.5% in Africa.[3] This section illustrates the potential uses and the value of digital and emerging technologies and how these can be adopted and delivered through mobile as the backbone of digitalisation of the economy.

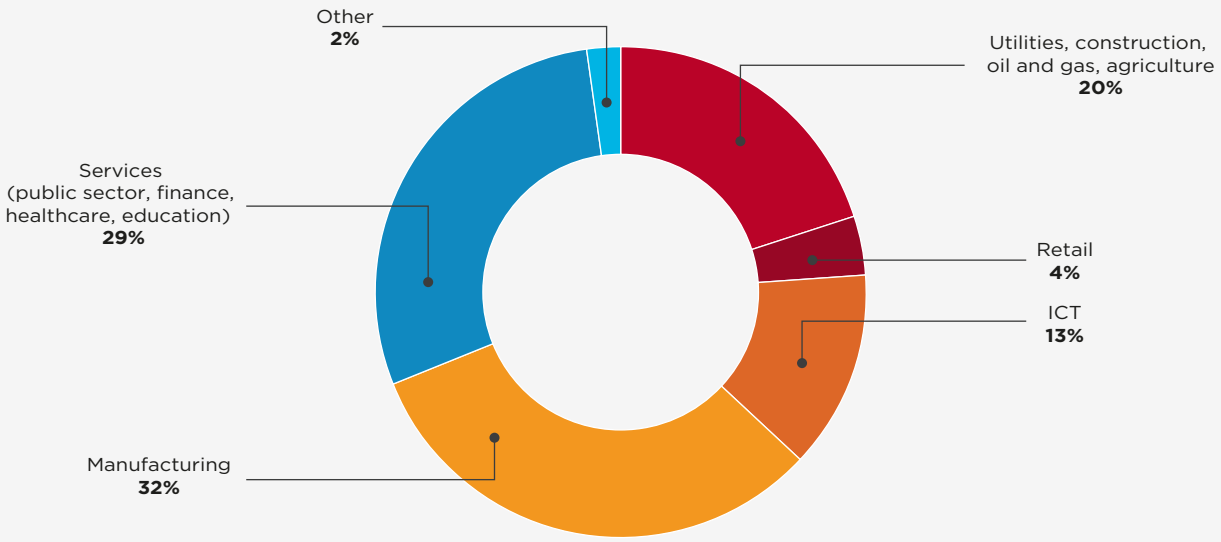
Digitalisation is the process of technological change through adoption of digital technologies across economic activities. Such emerging technologies are enabled by telecommunication and internet access, and range from artificial intelligence to cloud computing, from smart grids and Internet of Things to blockchain. These have the potential to reduce production costs, make exchanges, such as trading goods and services, more efficient, and allow ideas and knowledge to spread, thus promoting further innovation and growth.

The greatest impact is realised through the productivity increase beyond the ICT sector, via adoption in agriculture, manufacturing, retail and other sectors of the economy. Increase in productivity by firms is a key component of the impacts of digitalisation, with higher technology adoption associated with labour productivity increases of up to 2% in Ghana, Kenya, Malawi, and Senegal, and a significantly higher benefit for informal firms.[4] Furthermore, understanding how technological changes 'work through' a sector, allows to identify those innovations that create jobs and enhance productivity not through automation but by creating new tasks and efficiencies per worker.[5]

Adoption of 5G alone is expected to benefit most sectors of the Sub-Saharan Africa economy, bringing almost USD 11 billion to the regional economy, or around 0.37% of GDP in 2030, of which USD 3 billion from low-band 5G.[6] The wide area coverage enabled by low band 5G will be particularly important in driving the digital transformation of the agricultural and manufacturing sectors, with IoT applications such as smart farming solutions, smart factories, smart cities and smart grids. [7]

1 Accenture Africa iGPD forecast.
2 ITU 2019 Economic contribution of broadband, digitization and ICT regulation: Econometric modelling for Africa.
3 ITU.
4 World Bank Jobs and Cirera, Comin, and Cruz 2022.
5 Acemoglu and Johnson, 2023.
6 GSMA, Mobile Economy Africa, 2023.
7 GSMA, Socio-Economic Benefits of 5G: The importance of low-band spectrum, 2023.

Figure 2: **5G contribution to GDP by sector, percentage of total in 2030 in SSA**



Source: GSMA, Socio-Economic Benefits of 5G: The importance of low-band spectrum, 2023.

The studies estimate the macroeconomic impacts of digitalisation in each country for each key sector of the economy, based on academic and policy research and data on the economy of the country. Each impact is articulated through the digital pathways to economic transformation and mapped onto policy objectives and outcomes such as productivity growth and job creation.

The policy objectives, impacts of digitalisation by sector and their relationships are mapped in the table below, as well as the evidence used to quantify them. More details on the methodology and evidence review are contained in section 3.

Table 1: **Mapping digitalisation to policy objectives and estimating the impact**

Sector	Policy objectives	Outcomes of digitalisation	Impact relationship	Evidence rule
Agriculture	Agricultural development and agricultural productivity, access to markets, increase and diversify production	Precision agriculture, targeted information, better access to markets	Access to technology by farmers → productivity, profits	Access to technology and precision agriculture increase crop yields between 10.5% and 20%, and profits up to 23%
Manufacturing	Diversify and develop manufacturing, attract FDI, increase technology exports	Expand manufacturing capabilities, diversify production, increase FDI and exports	Adoption of new technologies by firms → productivity, GDP, exports	Application of industrial IoT and Industry 4.0 increases value add between 15-25%
Transport	Improve trade links, infrastructure for transport and logistics, strengthen competitiveness of ports	Reduce transaction and logistics costs, border delays and tax leaks. Increases productivity and integration in GVCs	Digital platforms and infrastructure → increase productivity, port capacity, GDP	Transport upgrades increase incomes by 10%. Digitising ports reduces logistics costs by 15-25%. Digital customs increases revenue by 54% in 5ys
Trade	Economic diversification, strengthen trade and exports	Improves trade flows, growth of E-commerce and exports of ICT services and digitally delivered services	Digital trade → increased integration in AfCFTA, E-commerce and service exports	Potential to increase E-commerce value to 15% GDP and ICT exports value to 7% GDP
Healthcare	Increase access to healthcare, improve well-being, increase productivity of healthcare sector	Telemedicine, digital health records, digital payments for insurance contributions increase access to health services and producitivy	Digital health → increased access to health services and productivity	Digital health solutions enable doctors to increase visits by 30%
MSMEs	Strengthening competitiveness and formalisation of MSMEs	Improves profits of MSMEs. Facilitates business registration, access to finance, formal contracts	Access to digital by MSMEs → increased incomes and formalisation	Technology adoption is associated with labour productivity of 2-4% for small firms
Government	Strengthen domestic revenue mobilisation, prevent corruption, improve services delivery	Increases tax revenue and provides saving in public expenditure through better targeting, transparency and reduction of corruption	Mobile money, P2G, G2P adoption → increase GDP, tax revenue, reduce leakage	Mobile money adoption increases tax revenue by between 7% and 17%, and 12% on average. Digital ID for social protection decreases leakage by 41-47%

For details and references see evidence review.

B. Agriculture

Agriculture in an important engine for growth and jobs in Africa. Recent progress allows more effective advice to be delivered to farmers through 'precision' agriculture utilising big data, GPS, drones, and high-speed communication, with considerable impact.[8] For example, Aerobotics in South Africa provides data analytics and machine learning to process aerial imagery from drones and satellites, providing real-time insights on crop performance, pests, plant health, irrigation levels and can improve the crop yields by 20% over 5 years.[9] Similar applications based on delivering tailored expert knowledge to farmers have been developed in Ghana, Nigeria, Kenya.[10]

Even simpler digital technologies (DTs) can improve efficiency in agricultural supply chains though better information and training. SMS messages to smallholder sugarcane farmers about when to perform specific agricultural tasks was found to increase yields by 11.5%.[11] Local-language videos on tablet or smartphone providing personalized advice to farmers were found to increase crop yields and profits in Ethiopia, Nigeria and Uganda.[12] Information combined with access to fertilizer increased yields by 20% and profits by 23%.[13]

Moreover, **technology can connect farmers to markets much more effectively** through new models of aggregation, logistics and supply-chain management.[14] For example, Ethiopian Commodity Exchange can now better differentiate the quality of coffee; its tracing technology even allows a smallholder farmer to directly connect to global buyers.[15] In Kerala, mobile phones allowed fishermen to determine the most profitable port to sell their fish; by equalising access to information, price variance in the market declined, boats' profits rose by 8%, and consumer prices fell by 4%.[16] In Niger, mobile phones reduced grain price variance for producers and consumers.[17]

8 Cole and Fernando (2016) and Casaburi et al. (2013).
9 South Africa Department of Science and Innovation (2022).
10 Ekekwe (2017) and Chatterjee (2018).
11 Casaburi et al. 2019.
12 Campenhout, Spielman, and Lecoutere (2021) and Hörner et al. (2019).
13 Arouna et al. 2021
14 Deichmann, et al. (2016).
15 Hernandez et al. (2017).
16 Jensen (2007).
17 Aker (2010).

Case study: **MTN Rwanda digital procurement and payment solutions**

MTN Rwanda has deployed a digital solution that allows agribusinesses to digitise procurement and payments to farmers. Agribusinesses can use the solution to digitally profile farmers and track real-time harvest activity through online dashboards. The service is available through an app for agribusinesses and a USSD channel developed by local agritech company Hamwae. MTN sells the solution to agribusinesses as software-as-a-service (SaaS).

Agribusinesses and farmer cooperatives can use the service to access farmers' digital profiles, Farmers can record crop sales on their digital profile with a digital scale, issue receipts and access the digital payment process. Agribusinesses can also track harvest collection in real time through the app.

To facilitate digital payments, MTN mobile money agents have been trained to register farmers on the MTN MoMo wallet. Tea aggregators pay the tea cooperatives they source tea from via bank transfer, and cooperatives can use MoMo to pay farmers in bulk to their individual MoMo wallet instead of through the local MFI.

Source: GSMA, Improving farmer livelihoods through digitised agricultural value chains, 2023.

C. Manufacturing, construction and mining

Adoption of new technologies by manufacturing firms – usually referred to as industry 4.0 technologies such as IoT, 3D printing, virtual reality, data and analytics, AI and machine learning – **can allow countries to expand manufacturing capabilities and support diversification.** Factory automation with cellular IoT technology optimizes manufacturing processes with increased efficiency, fewer human errors, increased reliability and safety and reduced downtime. Expanded manufacturing capabilities can lead to greater integration to global value chains and further increase in outputs, reduced concentration in products and markets and links to specialised markets.[18]

Across a wide range of sectors, implementing industry 4.0 technologies has been shown to achieve 30 to 50% reductions in machine downtime, 10 to 30% increases in throughput, 15 to 30% improvements in labour productivity, and 85% more accurate forecasting.[19] The application of the Internet of Things in the manufacturing context alone could increase manufacturing productivity by 10 to 25%[20] and value add by 20%.[21]

In the mining industry, industry 4.0 technologies can support **more efficient, safer and more productive smart mines,** with IoT sensors, remote site monitoring and remote-controlled drilling rigs delivering improved efficiency, productivity and safety and a combined ROI of 207% over ten years in surface operations. In underground mining, the ROI equates to 256%.[22] Finally, among the major industrial sectors, the construction industry has huge potential to digitalise, with productivity gains estimated of up to 15% and cost reductions up to 6%.[23]

18 World Bank, World Develpment report 2020.

19 www.mckinsey.com/capabilities/operations/our-insights/capturing-the-true-value-of-industry-four-point-zero ; www.ptc.com/en/solutions/maximizing-revenue-growth

20 www2.itif.org/2018-manufacturing-digitalization.pdf

21 European Parliament Member's Research Service, "Industry 4.0: Digitalisation for Productivity and Growth," (European Parliament, September 2015), http://www.europarl.europa.eu/RegData/etudes/BRIE/2015/568337/EPRS_BRI(2015)568337_EN.pdf.

22 www.orange-business.com/en/blogs/unearthing-future-how-digital-revolutionizing-mining-industry ; blogs.sap.com/2017/08/29/mining-top-5-digital-innovations-for-next-wave-of-productivity-part-2-iotbig-data/

23 www.mckinsey.com/capabilities/operations/our-insights/decoding-digital-transformation-in-construction

Case study: **Additive manufacturing in South Africa**

Additive manufacturing is the application of data processing and 3D printing on an industrial scale, resulting in a revolutionary manufacturing process based on layer upon layer additions, as opposed to subtractive manufacturing methodologies. It allows manufacturing of highly customised products with lower capital investment, creating opportunities for economic diversification and development of semi-finished or finished goods exports.

South Africa has invested significantly into Additive Manufacturing research and development to develop capabilities in 3D printing technologies and infrastructure, focusing in the fields of titanium medical implants and aerospace parts, as well as polymer for design.

The Council for Scientific and Industrial Research (CSIR) and the South African Department of Science and Technology have jointly developed an advanced 3D printer for metal components for the commercial aerospace manufacturing sector. The metal-additive manufacturing system uses a laser to melt titanium powder to produce metal parts, with the ability to produce geometrically complex and customised parts, minimising material wastage while processing difficult-to-machine materials. The system can also be used to produce parts for the power generation, automotive tooling, defence and manufacturing sectors.

It can achieve production speeds of up to 10 times faster than currently available commercial laser melting machines. Furthermore, its production chamber's volume measures about four times than that of the biggest commercial machines currently available.

Source: Technopolis Group (2020) and https://www.csir.co.za/project-aeroswift.

D. Transport and logistics

Digital applications have potential to significantly reduce transport and logistics costs, improve efficiency and links to markets.[24] These include moving freight booking online, automating customer service, installing tracking devices to monitor truck and cargo movements, leveraging real-time weather and traffic data to map the most efficient routes, and remote sensors for vehicle maintenance. For example, the Government of India created a transactional e-marketplace - the National Logistics Platform - to connect shipping agencies, logistics services, container depots and freight stations, banks, and insurance agencies with customs authorities, railway, seaport and airport officials.[25] New city transport systems, such as the Dakar BRT, will include digital systems to monitor performance, GPS-connected vehicles and digital payments.[26]

Roll out of 5G in port infrastructure can improve the efficiency of the logistics activities. This works by facilitating the implementation of new systems such as autonomous driving fleets, container positioning improvement and charging management system, improved management of traffic lights in order to reduce congestion, use of virtual reality and sensors for improving port operations. [27]

Digital and blockchain technologies in logistics and at national borders have the potential to revolutionize the way goods and assets are managed and tracked in the supply chain, increasing transparency of transactions and trust, optimising traceability, enhancing security and enabling to digitise and securely store documents such as invoices, permits, and certifications, simplifying administrative processes and leading to grater customs revenue from reduced leakages.[28]

24 Baldwin (2016).

25 India Department of Commerce (2018).

26 https://blogs.worldbank.org/voices/five-reasons-get-excited-about-bus-rapid-transit-dakar-senegal

27 https://piernext.portdebarcelona.cat/en/technology/5g-connection-in-ports-sector-an-important-step-towards-digitalization/; https://www.linkedin.com/posts/eucompetitionpolicy_ipcei-eustateaid-eucompetition-activity-7137733386218999808-oRcl

28 https://prosertek.com/blog/implementing-blockchain-in-port-logistics-benefits-and-challenges/

E. Trade and E-commerce

Digitalisation of commerce brings benefits through the development of E-commerce, gains from trade in services that can be delivered digitally (e.g. BOP) and for the potential of formalising small trading activities and MSMEs through digital. It also facilitates integration in regional digital trade, for example through the African Continental Free Trade Area (AfCTA).

E-commerce allows the commercialization of new products, expands delivery services and significantly reduces transaction costs related to purchasing, sales, operating, and inventory management. It can enable small retailers to expand without resorting to the capital-intensive brick and-mortar model, by leveraging large platforms. African E-commerce platforms have shown outstanding growth in the past decade, resulting from an improved payment-processing landscape and the rise in mobile adoption. For example, Kenyan e-Commerce startup Copia serves middle to low income customers and has a network of 50,000 agents in Kenya, with each agent increasing their income by 37% through Copia commissions and traffic in their shops by 25% by offering Copia services.[29] Nigeria-founded startup Jumia went public on the New York Stock Exchange and has now a market capitalisation of USD 350 million.[30]

Trade in digitally delivered services is another area where there is much potential for growth. Global trade in services accounts for about a fifth of global trade. Growth is especially high in for digitally delivered services, such as exports in IT or in IT enabled services (ITeS), often also called business process outsourcing (BPO), as well as engineering design or integrated accountancy services – that are increasingly being delivered remotely.[31] African countries account for less than 0.1% of global trade in ICT goods and have struggled to engage in ICT goods trade during the disruption of the Covid pandemic due to low levels of digital readiness.[32] However, there is large potential for growth of digitally delivered services in Africa, which could be an important contributor to economies as it is to the economy of other regions across the world. [33]

Further opportunities can arise from the AfCFTA's Digital Single Market by harmonising policies and regulations to support the development of digital payment services and the reduction of barriers to cross-border digital trade.[34] Better regional integration through AfCFTA can increase digital trade and value add for participating countries, and can be achieved by streamlining policies around: 1) market access, such as taxation and cross-border flows; (2) regulations, including consumer protection and privacy frameworks; (3) trade facilitation, including business adoption of digital systems and electronic authentication. ECOWAS countries have also recently launched a strategy to boost E-commerce in the sub-region.[35] New technologies, such as e-borders and better logistics management, may help to streamline delays and costs from a lack of road infrastructure and lack of physical addressing.[36]

Digitalisation of small businesses can provide a means to formalise economic activities, particularly for those involved in informal trade. Large amounts of imports and exports flow informally in Africa as small and informal traders engage in both smuggling and small-scale cross border trade (SSCBT) for agricultural goods and many industrial goods.[37] In Benin, a comparison between official customs data and surveys of informal traders suggest an underestimation of 50% for imports, and by about 85% for exports.[38] Digitalisation of payments through cost effective technologies such as mobile money has the potential to remove barriers to formalisation, while at the same time sustaining the productivity of informal firms and the livelihoods of those working in informal MSMEs.[39] Moreover, ICTs provide informal enterprises with better access to markets and finance, increase profitability and improve access to a wide range of information and business services. For example, DigiLocker can facilitate business registration and incentivise formalisation.

29 https://copiaglobal.com/our-reach/#potential
30 https://companiesmarketcap.com/jumia/marketcap/
31 IBEF (2018) (pathways source) and WTO (2023).
32 UNCTAD (2018).
33 ODI (2022) and UNCTAD (2018).
34 Link to AU's digital strategy.
35 https://etradeforall.org/news/new-strategy-set-to-boost-e-commerce-in-west-africa/
36 Malherbe (2018) and UNCTAD (2022).
37 WB Benin memorandum 2022.
38 WB Benin memorandum 2022 and (Bensassi et al 2018).
39 World Bank, Digital Africa, 2023.

Case study: **Case study: Copia's E-commerce to middle and low income consumers**

Copia is a mobile retail platform launched in 2013 in Kenya that targets the rural and peri-urban bottom of the pyramid-demographic. It offers an online E-commerce platform with over 4,000 products, as well as the option to buy essential goods through digitally enabled Agents, USSD short code and frequently updated print product catalogues. The platform is designed to meet the specific needs of Africa's middle to low-income households.

Copia serves over 1.9 million Customers in Kenya, with a network of more than 50,000 agents that act as delivery locations across Kenya and receive a commission on every sold product, increasing their income by more than 37% on average.

Source: https://copiaglobal.com/press/.

F. Healthcare

Digital solution for healthcare can deliver better well-being outcomes through improved access to healthcare services, as well as contributing to the economy via cost savings and increased productivity. Digital healthcare applications range from telemedicine consultations allowing doctors to consult with patients over a digital voice or HD video, to electronic health records that enable more accurate diagnoses and reduce administrative costs. Digital payments can also support and improve processes for insurance claims and facilitate contributions to national health insurance requirements.

For example, the potential of digitalisation of the healthcare sector in India was estimated to add USD 10 billion to the Indian economy in 5 years, only from the reductions in costs associated to telemedicine enabling doctors to **increase health consultations by 30%.**[40]

In Ghana, the National Health Insurance Scheme (NHIS) introduced a **mobile money payment system for membership renewal and premium payments** to enhance enrolment and retention rates, resulting in the proportion of mobile renewals to total renewals to increase from 67.4% to 82.3% in one year.[41]

A 2021 study estimates that **African health systems could realize up to 15 percent efficiency gains by 2030 and reinvest the savings to improve access and outcomes through expanding digital healthcare applications.**[42]

Increasing digitalisation in healthcare supports better access to basic services, with overall increases in digitalisation found to be associated with improvements in the UNDP's Human Development Index, which tracks global access to health and education as well as overall living standards.[43]

G. Start-up ecosystems and tech hubs

Innovation and entrepreneurship play a pivotal role innovation in African economies and tech hubs have emerged as efficient spaces to foster a digital entrepreneurship ecosystem and a network of innovators and potential investors. Tech hubs' ecosystem includes linking established digital/mobile businesses to new entrepreneurs and consumers, as well as facilitating idea generation and technology-related training opportunities, thanks to frequent links to academic institutions. These technology clusters create a snowball effect, generating mutually reinforcing innovation drivers.

In 2018 the GSMA recorded a total of 442 tech hubs on the continent, up from 117 recorded by the World Bank in 2014.[44] In parallel, in the past decade start-up funding has grown from negligible in 2013 to USD3.4 billion in 2023 across Africa, with a peak of USD5 billion in 2022.[45]

The main tech hubs of South Africa/Cape Town, Nigeria/Lagos, and Kenya/Nairobi dominate in terms of funding, but vibrant and successful hubs have been established across all the sub-regions leading to fast growing ecosystems in DRC, Zambia, Togo and Cote d'Ivoire, amongst others. For example, MEST is a tech hub in Ghana focusing on mentorship and training of early stage software-based companies providing services from real estate marketplace to music industry analytics and farm management tools – it has trained nearly 300 entrepreneurs and invested in over 50 early stage start-ups.[46]

40 McKinsey Global Institute, Digital India Technology to transform a connected nation, 2019.

41 Digitising health protection schemes in Ghana': An enquiry into factors associated with the use of a mobile phone-based health insurance contribution payment system among tertiary students, Anthony Kwame Morgan et al., 2024. Addae-Nketiah A. Examining the benefits and challenges associated with the use of the mobile renewal service in Ghana. Open J Soc Sci. 2022;10:458-475. Addae-Nketiah A. Factors influencing subscribers' use and adoption of the NHIS mobile renewal service. Open J Soc Sci. 2022;10:451-475. Barkman C, Weinehall L. Policymakers and mHealth: roles and expectations, with observations from Ethiopia, Ghana and Sweden. Glob Health Action. 2017;10:22-28.

42 Digital tools could boost efficiency in African health systems | McKinsey

43 Maximizing the Impact of Digitization, Booz & Company, 2012.

44 https://www.gsma.com/mobilefordevelopment/programme/ecosystem-accelerator/africa-a-look-at-the-442-active-tech-hubs-of-the-continent/ and https://blogs.worldbank.org/digital-development/tech-hubs-across-africa-which-will-be-legacy-makers

45 Africa The Big Deal: https://thebigdeal.substack.com/p/2023sum

46 https://meltwater.org/

H. Government services

Digital government, or sometimes referred to as Digital Public Infrastructure, is identified as a critical part of digital transformation programmes. For example, inspired by India's Digital Public Infrastructure programme which is estimated to have added 0.9% to GDP in 2022 and forecasted to have the potential to increase ~3X by 2030[47], last year G20 digital ministers and UNDP have issued a playbook to help governments with their own digital public infrastructure programmes.[48]

In Africa, there has been good progress in digitalisation of government services. This experience shows the potential socio-economic impact of digital government. But much remains to be done.

The African Union's Digital Transformation Strategy 2020 – 2030 identifies Digital Government as a critical sector for digital transformation. This focuses on serving:

> "people, businesses, and government agencies in all aspects of life, including healthcare, education, commerce, transportation, and public benefits…
>
> For the people who use these platforms to receive their monthly pensions, securely login to a government e-services portal, pay their utility bills, submit a complaint, access public information… these platforms can provide a seamless service delivery experience that increases user convenience, savings, and agency…
>
> For governments, digital platforms can increase the efficiency and effectiveness of core functions and services; reduce unnecessary duplication of systems; combat fraud and corruption by increasing the security and traceability of transactions; and improve civic engagement and accountability".[49]

In the last decade, African governments have embarked on e-government and digital government programmes. This has contributed to an 3.6% increase in the United Nations Department of Economic and Social Affairs' E-Government Development Index from 2020 to 2022 (EGDI 2022). EGDI includes assessment of online services provision, telecommunications infrastructure, and e-human capacity. The EGDI 2022 ranks South Africa (0.7357) first in Africa, Ghana (0.5824) seventh in Africa and highest in Western Africa, and most improved is Rwanda (0.5489) rising 10 places.[50]

EGDI 2022 attributes the progress of the higher ranked due to the execution of long-term digital programmes aligned with national strategies and SDGs.[51] Several aspects of digital transformation are common to most of these digital programmes:

- Online government service platforms;
- Digital identity; and
- Government to Business (G2B) and Government to Citizens (G2C) services.

Table 2 below provides some examples of successful digital transformation programmes that have been implemented by governments in Africa.

47 nasscom.in/knowledge-center/publications/nasscom-arthur-d-little-indias-digital-public-infrastructure

48 G20 Digital Ministers Recognize Digital Public Infrastructure as an Accelerator of the Global Goals | United Nations Development Programme (undp.org)

49 Pg 15, African Union, Digital Transformation Strategy for Africa 2020-2030 https://au.int/sites/default/files/documents/38507-doc-DTS_for_Africa_2020-2030_English.pdf

50 Pg 55-63, United Nations Department of Economic and Social Affairs E-Government Survey 2022 https://desapublications.un.org/sites/default/files/publications/2022-09/Web%20version%20E-Government%202022.pdf

51 Pg 64, United Nations Department of Economic and Social Affairs E-Government Survey 2022.

Table 2: **Government digital transformation programmes**

Country	Programmes	Summary
South Africa	Online portal G2B (taxation) G2C (taxation, social welfare)	Consolidation of 150 government services under the national e-government portal,[52] in accordance with its National E-Government Strategy 2017.[53] E-Portal services include applications for ID and passport, tax filings, education applications and results, social welfare benefits, driving license applications, and company registrations.[54] This has resulted in efficiency improvements and increased access to services, for example: • South African Revenue Authority reports that 89.4% of taxpayers used digital services and 77.9% of total value of taxpayer payments through electronic payments in Tax Year 2023.[55] • South African Social Security Agency introduced a digitally administered Covid-19 SRD Grant to benefit more than 8.5 million people between May 2020 to March 2023.[56]
Ghana	Online portal G2C (social welfare)	The Government of Ghana has prioritised digital government as part of the E-transform USD 212 million programme since 2013, followed by the Ghana Digital Acceleration Programme since 2022. Both supported by the World Bank's Digital Economy for Africa (DE4A) initiative.[57] Notable programmes which have increased efficiency of providing government services and utilising digital payments include: • Ghana.Gov online portal provides access to and payment for services of over 1,295 government agencies including: birth, death and marriage certificates, business registration and permits, online passport applications, vehicle registration and drivers' licenses. In 2022, over 10 million transactions with total payments receipts of GHC 62.76 billion recorded.[58] • Livelihood Empowerment Against Poverty (LEAP) social protection programme adopted transfer payments via mobile money in response to the effect of COVID-19 in 2020-2022. This cost efficient and timely approach for payments, relied on Short Messaging Service (SMS) and interactive voice messaging in three local languages to communicate with beneficiaries before and after the transaction. In 2022, GHS 14.6 billion value from 6.1 million transactions were made to pay LEAP cash transfers using an interoperable biometric smart card E-zwich, and in a post-payment monitoring survey 78% of beneficiaries confirmed that they did not have to bear any extra cost to receive the funds, compared to cost and time incurred to travel to a bank or other payment points.[59]
Rwanda	Online portal G2C (Birth certificate registration)	The Government of Rwanda is working on a USD 100 million digital acceleration programme supported by the World Bank to further digital public services, including the integration of the new digital identity programme.[60] Part of the Government's ambitious digital transformation strategy, Irembo provides over 100 government services online. Irembo is also a payment engine and charges a commission on paid services for long-term financial sustainability. The platform has processed over 2.7 million transactions.[61] One service provided on Irembo is the birth registration certificate. Hospital registers a birth online, parents are able to download a birth certificate within hours. The process used to require 4 physical journeys, 3 public offices, 2 supporting documents and would often take a minimum of 4 days.[62]
Egypt	G2C (Digital healthcare)	Vodafone is partnering with the Government on two key digital healthcare projects:[63] • Universal Health Insurance Project includes digital health information systems, unified medical records, payer and claim management system, Enterprise Resource Planning, Healthcare facilities accreditation module, beneficiary management system, healthcare provider portal and health information exchange. All aspects of the UHI ecosystem are integrated and hosted in the cloud to allow smooth operations nationwide. Currently the system is operational in 273 facilities across 6 regional governorates and serving 5 million beneficiaries. • Digital University Hospitals programme, which includes digital hospital Information systems, Payer Systems (using mobile money payments), Enterprise Resource Planning, Hospital Accreditation Modules, Call Centre Management, and Patient Engagement Solutions. These systems are integrated and hosted in the cloud. Currently serving 70 hospitals and helping over 1 million citizens annually. Contributing to reduction of waiting times, improving readmission rates, and reducing paper usage and costs.

52 Pg 64, United Nations Department of Economic and Social Affairs E-Government Survey 2022.

53 "National e-Government Strategy and Roadmap", Government Gazette, 10 November 2017. https://www.gov.za/sites/default/files/gcis_document/201711/41241gen886.pdf

54 https://www.gov.za/services-residents

55 Foreword, Pg 10, https://www.sars.gov.za/wp-content/uploads/Docs/TaxStats/2023/2023-Tax-Statistics-Highlights.pdf

56 Foreword by the Minister, Pg 8-9, https://www.sassa.gov.za/statistical-reports/Documents/SASSA%20ANNUAL%20REPORT%202022-23.pdf.

57 World Bank Implementation Status and Results Report 2023 (P176126) – Ghana Digital Acceleration Project World Bank Document.

58 Pg 14, 23, GSMA Inclusive E-Government Services in Ghana, July 2023. https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2023/07/FINAL_GSMA_Inclusive-E-Government-Services-in-Ghana-Enhancing-Womens-Access_56pp_v5.pdf.

59 Pg 25, 33, GSMA Inclusive E-Government Services in Ghana, July 2023

60 Pg4, Hayward, Isabella Maria Linnea. Disclosable Restructuring Paper - Digital Acceleration Project - P173373 (English). Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/099010424140527178/P173373155e9e50041a10511bcb22c02096

61 10 Examples of Successful African e-Government Digital Services (ictworks.org)

62 https://public.digital/signals/signals-sustainability-in-digital-transformation/the-irembo-model-rwandas-public-private-partnership

63 Pg 19, Vodafone Egypt Sustainability Report 2023 internet.vodafone.com.eg/VFE Sustainability Report 2023.pdf, supplementary information provided by Vodafone Egypt for this report.

Digital Identity is a key part of most digital government programmes. Digital ID cards with biometrics play a critical role in most digital government programmes. Approximately 85% of African countries have national ID systems backed by electronic databases, with more than 70% collecting biometric data.[64]

This is having a positive socio-economic impact. For those registered, Digital ID is enabling citizens' access to financial services, government services, social benefit welfare, healthcare services, telecoms, utility services, a requirement for jobs, voting in elections.

However, many countries are facing challenges in digital ID adoption. This is due to a range of factors such as:

- citizens' concerns about data protection, privacy, fraud, and common linkage of IDs to national security;
- limited IDs and other documentation required to complete digital ID processes, such as not having completed birth registration (in 2021, the World Bank Identification For Development (ID4D) estimated over 470 people in Sub-Saharan Africa did not have an ID. 40% of ID4D survey cited lack of document as a reason for not registering 65); and
- costs of completing digital ID process including travel and time required (36% of the 2021 ID4D survey cited as a reason for not obtaining an ID).

Gaps in adoption of digital ID risks increasing exclusion of marginalised citizens from basic and digital services. For example, a 2021 survey found higher levels of those without IDs in the following groups: women, youth, not completing primary school education, unemployed, lower incomes, and from rural areas.[66]

The African Union has set at target of 99% of Africans to have a digital legal identity by 2030.[67] It is working with national governments and international institutions programmes such as ID4D (including its Principles on Identification,[68] sharing of international experiences and learnings), African Union Interoperability Framework for Digital ID,[69] UNECA, [70] Smart Africa Trust Alliance,[71] and West Africa Unique Identification for Regional Integration and Inclusion (WURI)[72] to increase adoption of digital IDs. Common pillars of these programmes include:

- ensuring legal and regulatory framework in place, including legal mandate for digital identification, data protection and privacy, fraud, and cyber security;
- ensuring platforms are secure and easy to use for citizens;
- a phased implementation and inclusive by design approach (removing barriers) to ID registration for citizens; and
- increasing reasons for digital IDs through embedding in digital government services and other services in country and interoperable with other African regions and countries' digital ID programmes (e.g. WURI, AfCFTA).[73]

There is more work to do, building on digital government progress and learnings. No African country features in the Very High EGDI 2022 Group and the region (0.4054) remains below the global average (0.6102). The EGDI 2022 cites barriers including: use of the internet and access to fixed broadband and mobile cellular networks whilst growing remain below corresponding global averages; cost of mobile broadband subscriptions as a percentage of national gross income is significantly higher than other parts of the world; and inadequate investment in e-government development.[74]

64 Pg 7, Africa Digital Identity Landscape 2022 (uneca.org)

65 World Bank. ID4D GLOBAL DATASET - Volume 1 2021 : Global ID Coverage Estimates (English). http://documents.worldbank.org/curated/en/099705012232226786/P176341032c1ef0b20adf10abad304425ef

66 World Bank. ID4D GLOBAL DATASET - Volume 1 2021 : Global ID Coverage Estimates (English). http://documents.worldbank.org/curated/en/099705012232226786/P176341032c1ef0b20adf10abad304425ef

67 https://au.int/sites/default/files/documents/38507-doc-dts-english.pdf

68 https://documents1.worldbank.org/curated/en/213581486378184357/pdf/Principles-on-Identification-for-Sustainable-Development-Toward-the-Digital-Age.pdf .

69 43393-doc-AU_Interoperability_framework_for_D_ID_English.pdf .

70 UNECA African Digital Identification Landscape 2022 https://www.uneca.org/sites/default/files/DITE-AFRICA/Africa%20Digtial%20ID%20Landscape%20Report%20%282023%29.pdf .

71 BLUEPRINT-SMART-AFRICA-ALLIANCE---DIGITAL-IDENTITY-LayoutY.pdf (smartafrica.org).

72 West Africa Unique Identification for Regional.Integration and Inclusion (WURI) Program World Bank Document .

73 Authors assessment and summary from review of literature, programmes and interviews for this report.

74 Pg 55-63, United Nations Department of Economic and Social Affairs E-Government Survey 2022.

The majority of African Governments have set clear digital transformation objectives. Most of them have commenced programmes and these increasingly involve financial and technical support from institutions such as the World Bank, African Development Bank, and the European Investment Bank.[75] Such programmes when designed are seeking to address barriers identified and learnings from earlier programmes, notably:

- the importance of coordinated programme management, including intra-governmental collaboration;
- continued telecommunication infrastructure deployment and increased access points for digital government services;
- measures and incentives to reduce affordability barriers to digital government services;
- ensuring safety and security of digital government platforms through world class data privacy and cyber security systems and monitoring, governing regulatory framework, public information and training;
- improved platform performance (including reduced platform downtime, increased speed times for transactions, data light versions for mobile devices) and customer focused ease of use design principles for digital government platforms; and
- enhanced digital literacy and skills programmes and public awareness information for government institutions and citizens, including embedded in digital government platforms.[76]

Whilst digitalisation brings many benefits, it also raises important public policy issues which governments, industry, and non-government organisations must work together on to protect citizens' interests and the planet as part of digital government and digitalisation programmes. For example:

- Cyber security and data protection - in 2023, the African Union Convention on Cybersecurity and Personal Data Protection (Malabo Convention) entered into force. It criminalises a broad range of cyber activities, including hacking, cyber fraud, and identity theft. It also establishes procedures for investigating and prosecuting cybercrime, including international cooperation between African countries[77].
- Circular economy to address e-waste – 50 million metric tonnes (Mt) of e-waste is generated globally per year. Africa generates 2.9 million Mt of e-waste annually, with only 1% formally collected and recycled. Many governments are introducing e-waste legislation and regulations, and are establishing programmes with industry and non-government organisations to enhance collection and recycling of e-waste. For example, in Nigeria, the National Environmental Regulations were amended in January 2023, and the E-waste Producer Responsibility Organisation Nigeria (EPRON) has been set up to coordinate programmes including the collection of fees to be paid by E-Waste producers to re-invest in collection and recycling. [78] The GSMA and mobile operators recognise their role and are implementing programmes[79], further information can be found in the Making-Circularity-Work-How-digital-innovation-enables-circular-economy-approaches-in-waste-management-1.pdf (gsma.com) published this year.

75 Digital Economy for Africa Initiative (worldbank.org); Bank Group strategy | African Development Bank Group (afdb.org); The rise of Africa's digital economy – The European Investment Bank's activities to support Africa's transition to a digital economy (eib.org)

76 Authors' assessment and summary from review of literature, programmes and interviews for this report.

77 https://au.int/sites/default/files/treaties/29560-treaty-0048_-_african_union_convention_on_cyber_security_and_personal_data_protection_e.pdf

78 The Global E-waste Monitor 2024 (itu.int)

79 See Airtel Africa FY23 Annual Report, Page 51 Airtel_Africa_Annual_Report_FY_2022_2023.pdf (airtelstream.net); MTN Group Sustainability Report FY22, Page 21 https://www.mtn.com/wp-content/uploads/2023/04/MTN-Group-FY-22-Sustainability-Report.pdf; Vodacom's Stephen Chege Highlights Urgent E-Waste Solutions and Circular Economy - TechAfrica NewsTechAfrica News

3. Modelling the economic impacts of policy reform and digitalisation of economic sectors

This section provides a summary of the methodology used in the studies to estimate the economic impacts of policy reform and digitalisation.

A. Data sources

The following data sources have been used for the analysis:

- Mobile market data: GSMA Intelligence, ITU DataHub, national regulatory authorities and local mobile operators
- Mobile money data: World Bank Findex, central banks, national regulatory authorities and local mobile money providers
- Economy and demographics: World Bank World Development Indicators, UN Population Prospects 2022
- Government finance and GDP: IMF World Economic Outlook October 2023, Ministry of Finance
- GDP and shares by sector and sub-sector: National accounts – National Statistical Institute, Central Bank or Ministry of Finance
- Digitalisation of MSMEs: Research ICT Africa Access survey 2017

B. Telecoms sector modelling approach

The impact on the uptake of either mobile internet or mobile money is estimated for a number of policy scenarios. Table 3 shows an example of the policy reforms scenarios that can be modelled for a country. These are identified based on the specific characteristics of the telecoms market and policy priorities and therefore vary by country.

Table 3: **Modelled policy and regulatory reform scenarios**

Policy/regulatory change	Expected Impact
Reduce sector-specific taxes on the mobile industry	Reducing sector-specific taxes on the mobile industry and setting appropriate spectrum fees, will lower retail prices which will boost uptake and adoption of mobile broadband. It will also make it more commercial viable to invest in rural areas which will increase network coverage.
Amend QoS regulations	Amending the QoS regulations QoS to set objectives targets that protects the interest of consumers, promotes fair competition and choice, and encourages investments in network infrastructure and services. Aligning with international best practice will lower retail prices and make investment in capacity upgrades and coverage in rural areas more commercially viable.
Sustainable investment environment	In some countries, we also consider sustainable investment scenarios that arise from sources other than QoS improvements. This can be the result of a more sustainable market structure, in which all operators are able to reach the level of 4G and 5G coverage predicted for the market leader Modernising the licensing framework will boost investment, improve the quality of network services and will strengthen competition between players in the market. This will feed through into increased adoption of mobile broadband and lower prices.
Demand-side policies	Adoption and usage of mobile internet and mobile money is also affected by demand-side factors. Increased demand increases adoption and usage ceteris paribus. Policies aimed at supporting demand and close the usage gap could include interventions such as handset subsidies, digital skills training programmes, business support for SMEs, digitalisation of government services, programmes to increase adoption of new technologies by business and consumers, including mobile money. We use a hypothetical increase with an upper bound value based on World Bank (2022) handset subsidy scenario.
Remove or reduce the mobile money levy	Removing or reducing the mobile money levy will boost investment in the mobile financial services ecosystem. In particular, it will increase spending on the agent network, thereby expanding coverage and uptake of money services.

Mobile internet uptake modelling approach

GSMAi data and forecasts were used as the base case for unique mobile subscribers and unique mobile internet users[80], as well as for population and current coverage information where relevant.

Price elasticities of adoption and migration were taken from the World Bank 2022 study "Using geospatial analysis to overhaul connectivity policies" and the GSMA 2020 report "Mobile taxation studies: Methodology documentation". The elasticities used are detailed in Table 4.

Table 4: **Elasticities**

Elasticities	Services	Handsets
Adoption elasticity	-0.90	-1.30
Migration elasticity	-0.32	-0.47

Source: World Bank 2022, Using geospatial analysis to overhaul connectivity policies. GSMA 2020, Mobile taxation studies: Methodology documentation.

Cost pass through assumptions are based on the same studies. Operator cost/tax reductions are assumed to have an 85% pass through, while consumer tax reductions are assumed to have a 90% pass through.

Table 5: **Cost pass through assumptions**

	Pass through rate
Operator tax/cost	85%
Consumer tax	90%

Source: World Bank 2022, Using geospatial analysis to overhaul connectivity policies. GSMA 2020, Mobile taxation studies: Methodology documentation.

The modelling approaches for mobile internet uptake scenarios are outlined below.

80 In this report "mobile internet users" or "unique mobile internet users" refers to unique individuals using the mobile internet. It does not refer to the number of SIM cards or mobile internet accounts, which is usually greater than the number of individuals using the internet.

Tax reduction scenarios

For our tax reduction scenarios, we estimate the impact reducing telecom sector specific fees. These can include a combination of:

a) operator taxes and fees, such as license fees, NRA revenue shares, etc;

b) consumer taxes, such as communications service taxes

c) handset taxes and import duties.

The reduction in these taxes feed through to price reductions for consumers, which in turn lead to greater uptake of mobile internet than in the BAU scenario. This process is illustrated in Figure 3.

Figure 3: **Tax reduction scenario**

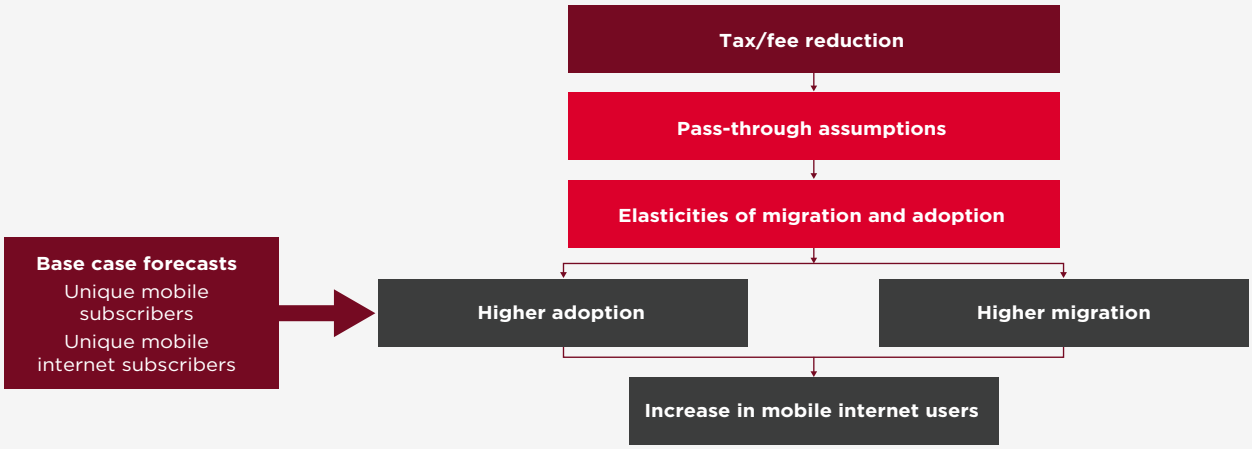


Table 6 shows illustrative impacts of the tax reduction in terms of prices and the increase in the number of users compared to the BAU in the same year.

Table 6: **Illustrative table of impacts of tax reduction scenario**

Impacts of tax reduction	2023	2024	2025	2026	2027	2028
Data price reduction vs BAU	-13%	-13%	-13%	-13%	-13%	-13%
Handset price reduction vs BAU	-7%	-7%	-7%	-7%	-7%	-7%
Y-on-Y mobile internet user increase vs BAU	X.Xm	X.Xm	X.Xm	X.Xm	X.Xm	X.Xm
Y-on-Y mobile internet user increase vs BAU (%)	0%	3%	4%	5%	5%	6%

QoS reduction scenarios

For the QoS reduction scenarios, we consider the impact on investment of QoS requirements. Our analysis shows that high QoS requirements can have a very significant impact on the cost and economics of upgrading or expanding a mobile network. For instance our analysis of mobile cost models shows that doubling the speed requirements on a network increases capex cost by 20%-50%.[81] Reliability requirements can have similarly large impacts, with a study by the IMF finding that reducing busy hour 4G reliability from 95% to 50% would reduce the cost of providing universal broadband in Sub-Saharan Africa by 30% (from USD 91bn to USD 64bn).[82]

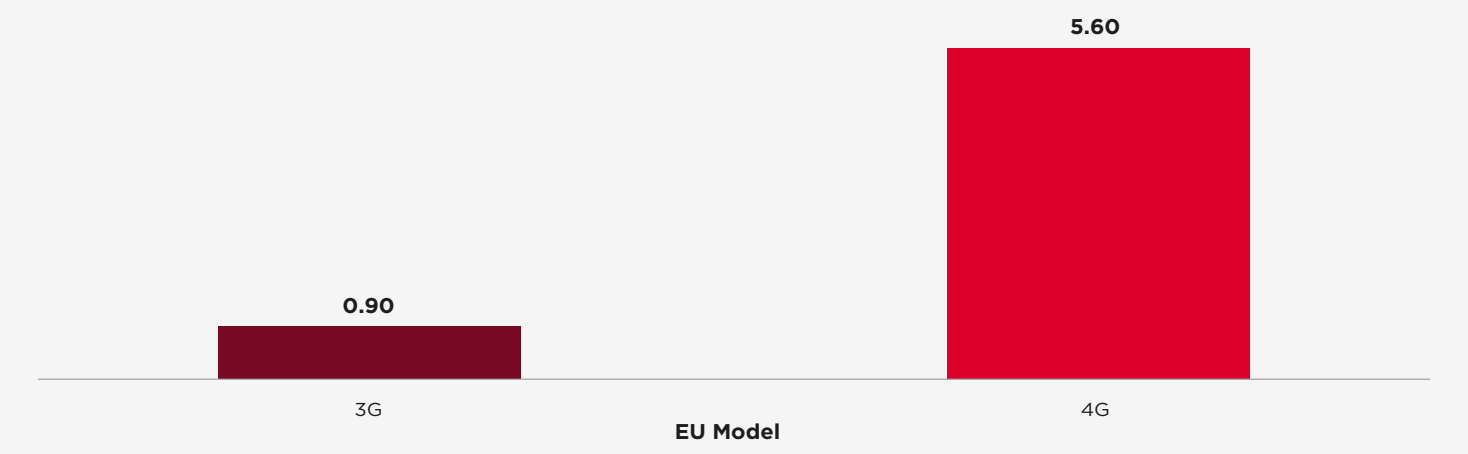
Reducing QoS requirements would therefore significantly improve the economics of upgrading a network and would create a much more sustainable investment environment for all operators. Together with other modelled improvements to the investment environment (such as greater demand stimulation), this would lead to greater and more balanced network upgrades, with all operators potentially rolling out 5G, expanding 4G, and continuing to increase 3G coverage where necessary.

Table 7: **Illustrative coverage assumptions**

Population covered (2028)	
3G	100%
4G	95%
5G	30%

On a per MB basis, providing data services over 4G is significantly cheaper than over 3G, and providing services over 5G is significantly cheaper than over 4G. This is because the data capacities of 4G and 5G equipment are much greater than for the previous generation of technology, which more than offsets the higher cost of the equipment. Figure 4 below shows the increase in sector capacity for 4G compared to 3G from the EU's Mobile Termination Rate Model.

Figure 4: **Sector capacity per carrier (3G vs 4G)**



Source: EU Mobile Termination Rate Model

81 For this analysis, we ran a network cost model using different base levels of traffic. From each base, we then doubled the capacity requirements of the 4G equipment and assessed the change in the NPV of 4G network build cost as a result. This yielded an NPV cost increase of 20%-50%, depending on the starting level of traffic used as the base.

82 IMF 2023, Working Paper, Estimating Digital Infrastructure Investment Needs to Achieve Universal Broadband.

As a result of this effect, we estimate that the cost of providing data to customers decreases by at least 50% as those customers shift from 3G to 4G, and again as customers shift from 4G to 5G.

As all operators to invest in 4G and 5G upgrades, we assume that these marginal cost reductions will be passed through as lower data prices in line with the operator cost pass through shown in Table 5 above (85%). Since data prices are a weighted average of customers on all technologies, the total price reduction is a function of the number of customers have access to the higher technology.

In addition, any increase in 3G coverage means that more of the population has access to mobile internet. This newly covered population is assumed to catch up to the rest of the population in terms of mobile internet uptake over the course of five years.

Figure 5 below provides an illustrative overview of this modelling.

Figure 5: **QoS requirements reduction and sustainable investment scenario**

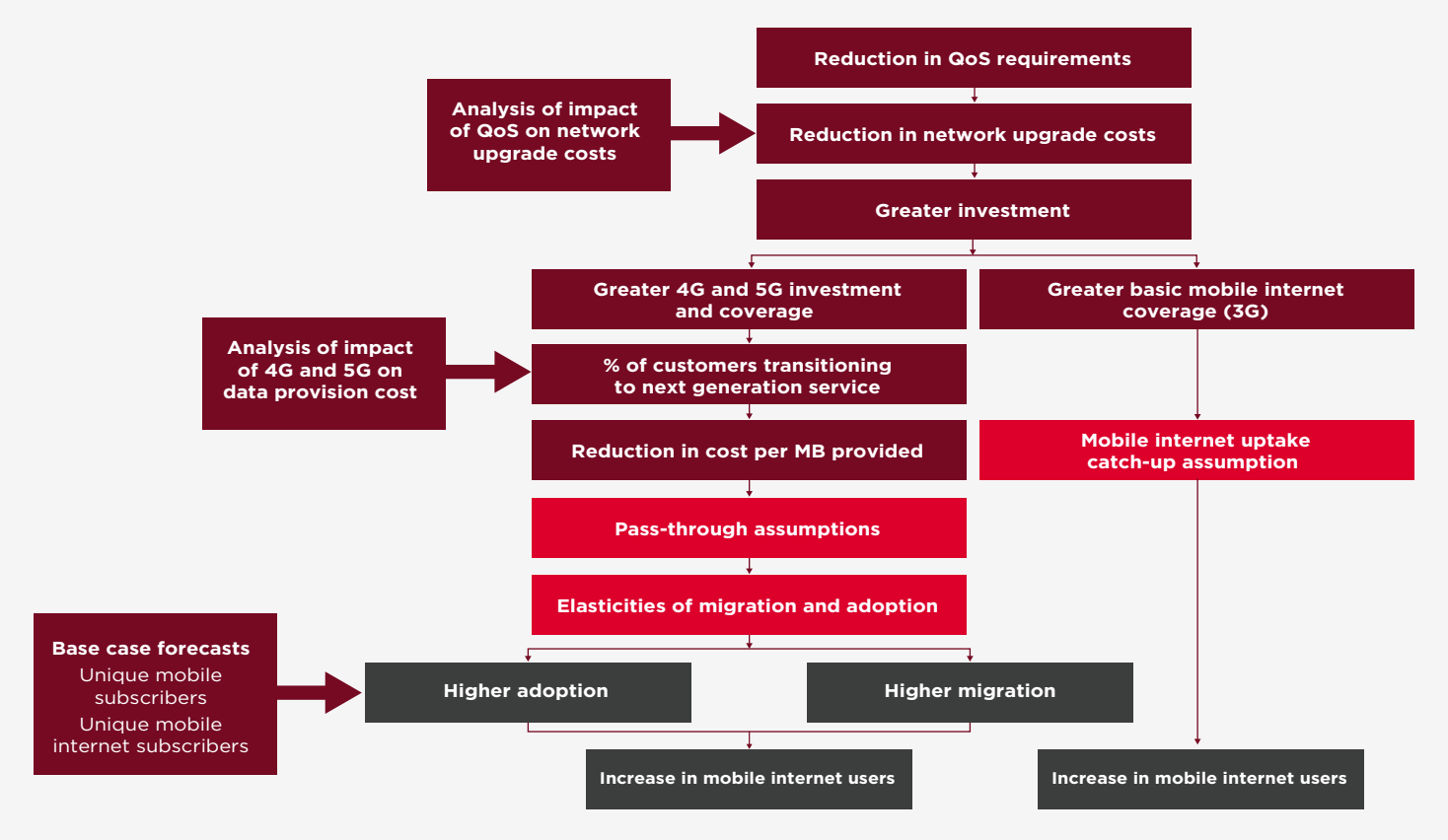


Table 8 shows illustrative impacts of these changes in terms of the number of customers who can move up the technology ladder to 4G or 5G, price reductions, and the increase in the number of mobile internet users compared to the BAU in the same year.

Table 8: **Impact of reduced QoS and more sustainable investment**

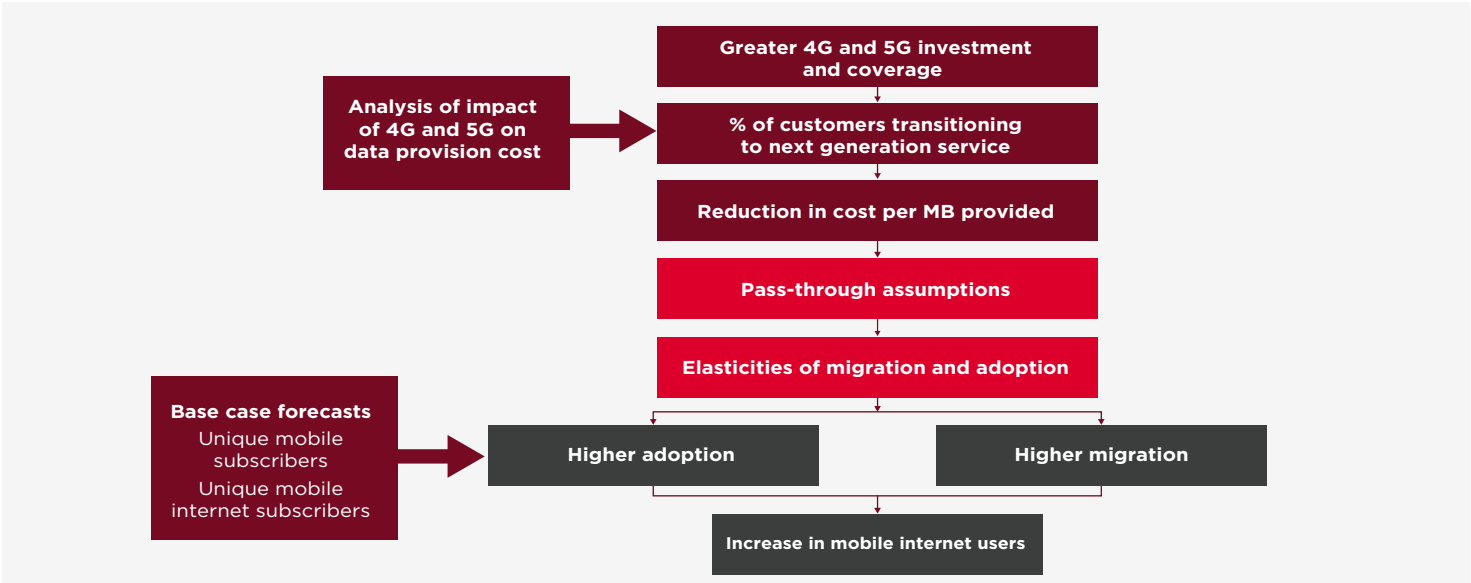
	2023	2024	2025	2026	2027	2028
Customers moving up technology ladder	0%	5%	10%	20%	30%	40%
Potential price reduction	0%	-6%	-13%	-19%	-26%	-33%
Y-on-Y mobile internet user increase vs BAU	X.Xm	X.Xm	X.Xm	X.Xm	X.Xm	X.Xm
Y-on-Y mobile internet user increase vs BAU (%)	0%	4%	8%	13%	18%	23%

Sustainable investment scenarios

In some countries, we also consider sustainable investment scenarios that arise from sources other than QoS improvements. This can be the result of a more sustainable market structure, in which all operators are able to reach the level of 4G and 5G coverage predicted for the market leader.

As discussed for the QoS scenarios, providing data services on a higher generation of mobile technology provides significant unit cost benefits compared to the previous generation (e.g. the per-MB cost of providing data over 4G is significantly lower than the per-MB cost of providing data over 3G). As a conservative assumption, we have assumed a 50% reduction in the marginal cost of providing data when customers move to the next generation (either 3G to 4G or 4G to 5G). As a result of all operators being able to offer the same level of next-generation mobile broadband, we assume that much of the per-MB cost benefits of these technologies will be passed through to customers, leading to greater uptake of mobile internet. This is illustrated in Figure 6.

Figure 6: **Sustainable investment scenario**



Demand stimulation scenario

For the demand stimulation scenario, a proxy for the aggregate effect of demand-side policies is based on a study by the World Bank in Benin which estimated that providing handset subsidies would increase mobile internet uptake by 12.7 percentage points after five years and 16.2 percentage points after 10 years.[83]

This data is used for all countries unless country-specific estimates are available. Since it is only based on handset subsidies, it is a conservative estimate and if all proposed policies are implemented, it is possible that the effect will be larger. This scenario is illustrated in Figure 7.

Figure 7: **Demand stimulation scenario**

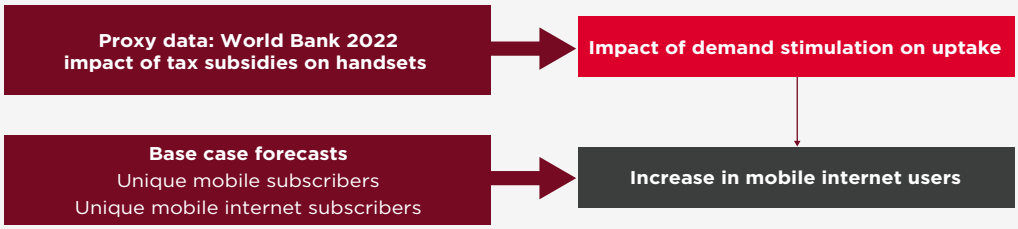


Table 9 shows illustrative impacts of the demand stimulation scenario in terms the increase in the number of users compared to the BAU in the same year.

Table 9: **Impacts of demand stimulation scenario**

	2023	2024	2025	2026	2027	2028
Y-on-Y mobile internet user increase vs BAU	X.Xm	X.Xm	X.Xm	X.Xm	X.Xm	X.Xm
Y-on-Y mobile internet user increase vs BAU (%)	0%	3%	5%	8%	10%	13%

83 World Bank 2022, Mobile Infrastructure in Benin.

Mobile money uptake modelling approach

Rather than modelling unique subscribers as in the case of mobile internet, for mobile money we model the number of active accounts. Depending on data availability, data on active users is sourced from the central bank, the NRA, and/or operators. Several general scenarios and modelling approaches are used, depending on the country:

The modelling approaches for these scenarios are outlined below.

The removal of the levy where it is directly passed through to consumer prices

Where a levy is passed through to consumers, it has a direct effect on the number of active users and the value of transactions of those users. Recent GSMA papers have analysed the impact of a mobile money levy on the mobile money transactions, and the follow-on effects on tax revenue.[84] We have specifically analysed the impact of a levy on the uptake of mobile money and the number of active mobile money accounts.

We have used data on the number of active users over time to perform a difference-in-difference regression on the impact of the levy on the number of mobile money accounts, controlling for trend. We use this to calculate the impact removing the levy would have on the amount of mobile money uptake. This analysis is illustrated in Figure 8 below.

Figure 8: **Mobile money levy removal scenario (direct impact)**

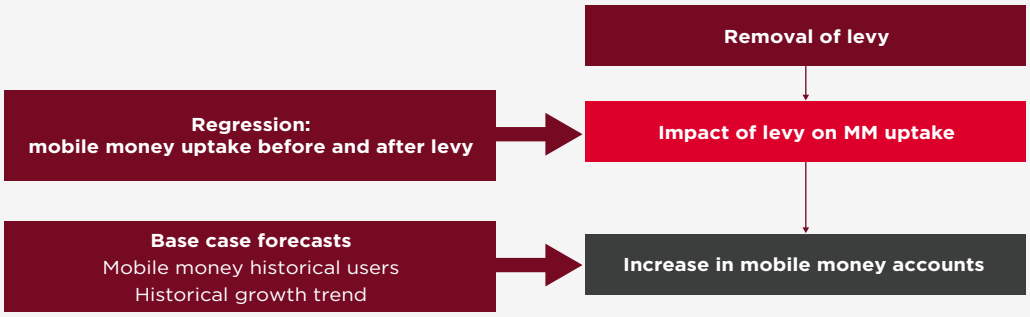


Table 10 shows illustrative impacts of the levy removal scenario in terms the increase in the number of active accounts compared to the BAU in the same year.

Table 10: **Illustrative impacts of levy removal**

	2023	2024	2025	2026	2027	2028
Y-on-Y active account increase vs BAU	X.Xm	X.Xm	X.Xm	X.Xm	X.Xm	X.Xm
Y-on-Y active account increase vs BAU (%)	0%	1%	2%	4%	7%	9%

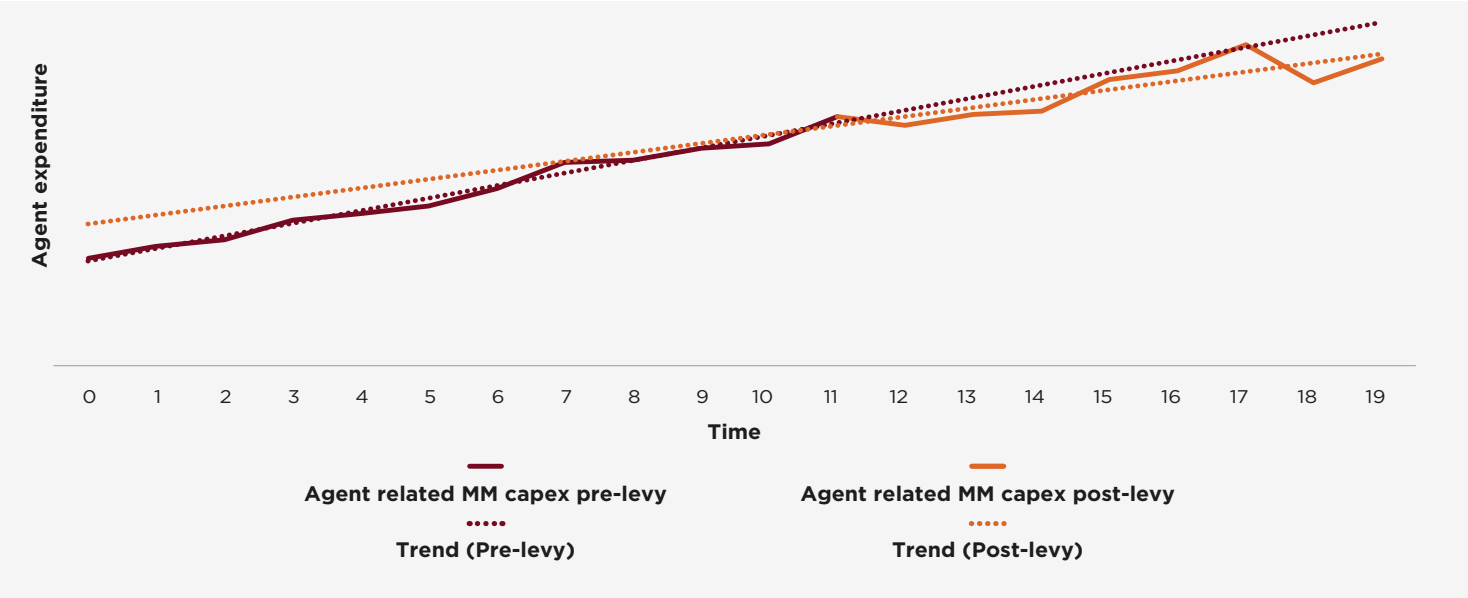
84 See for instance GSMA 2023, The E-levy in Ghana: Economic Impact Assessment

The removal of the levy where it is not directly passed through to consumer prices

Where a levy is not directly passed through to consumers, the levy becomes purely a cost of providing the mobile money service, reducing its profitability. As a result, operators will seek to reduce their expenditure on other costs of providing mobile money, including reducing investment in the network. Conversely, removing the levy will reduce operator costs and lead to greater investment in mobile money services.

Using operator data on agent expenditure over time, a difference-in-difference regression was run to analyse the impact of a levy introduction on mobile money agent expenditure. This shows a significant decrease in the trend of agent expenditure as a result of the introduction of a levy on mobile money (relative to the trend before the levy was introduced). This is illustrated in Figure 9.

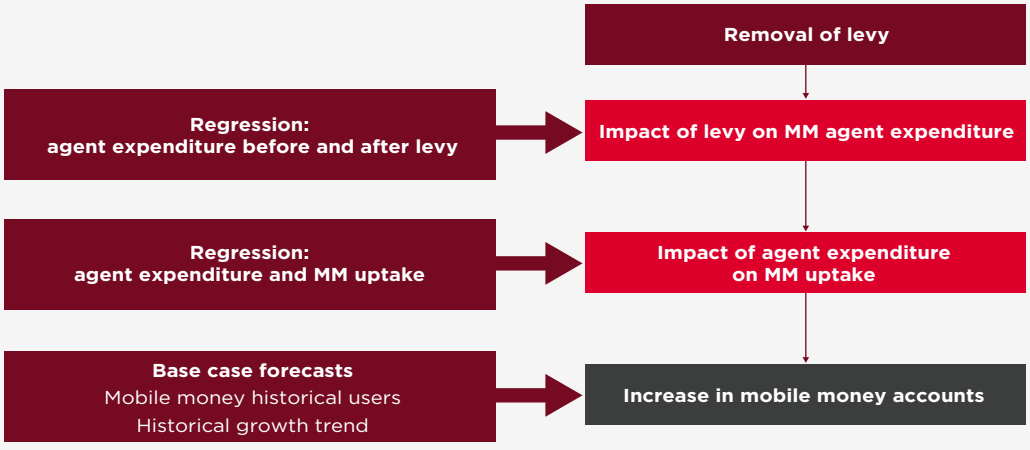
Figure 9: **Agent expenditure before and after levy**



Using operator data on mobile money uptake and agent expenditure, a linear regression was also run to calculate the impact agent expenditure on mobile money uptake. This shows that agent expenditure has a strong and significant effect on mobile money uptake. Controlling for time trends, a 10% increase in agent expenditure increases mobile money uptake by 4%.

These effects are combined to calculate how the trend in uptake of mobile money would increase if the levy was removed. This is illustrated in Figure 10.

Figure 10: **Mobile money levy removal scenario (indirect impact)**

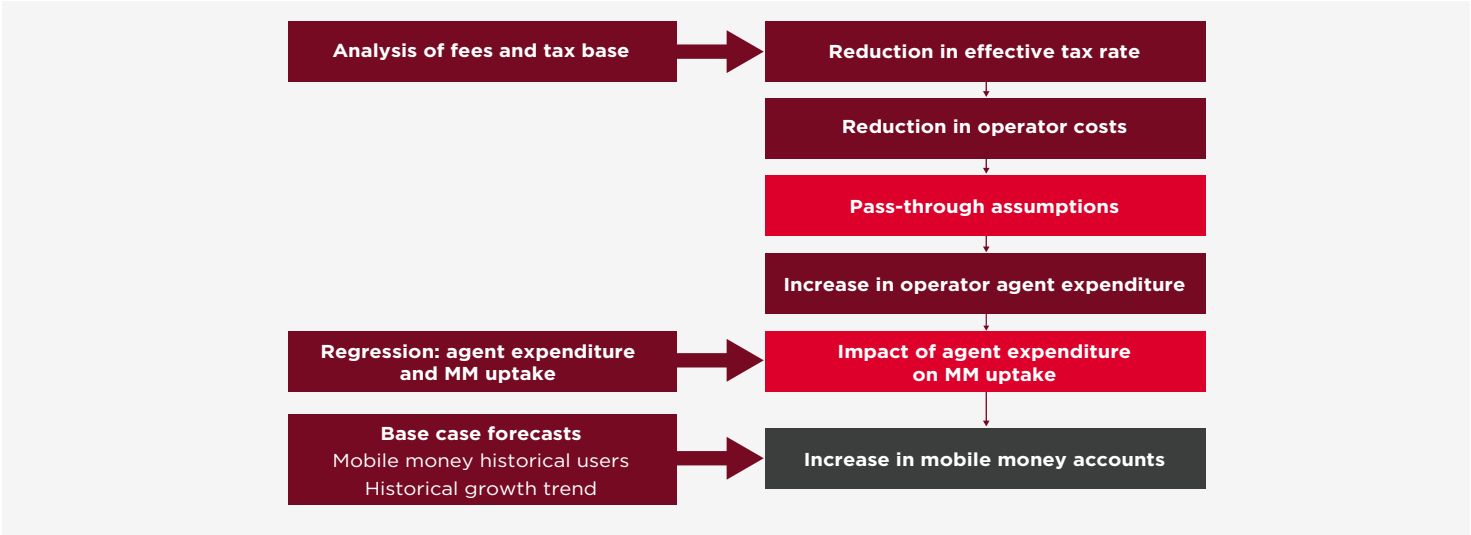


The reduction of the levy where it is not directly passed through to consumer prices

The effective tax rate of a mobile money levy is a function of the fee structures, the value of different types of transaction and any tax base thresholds set by the government. As above, where a levy is not directly passed through to consumers, any reduction in the effective tax rate results in a cost reduction to operators.

The reduction in these taxes feed through to greater agent expenditure(based on the operator cost pass-through assumption), which in turn leads to greater uptake of mobile money than in the BAU scenario. This is illustrated in Figure 11.

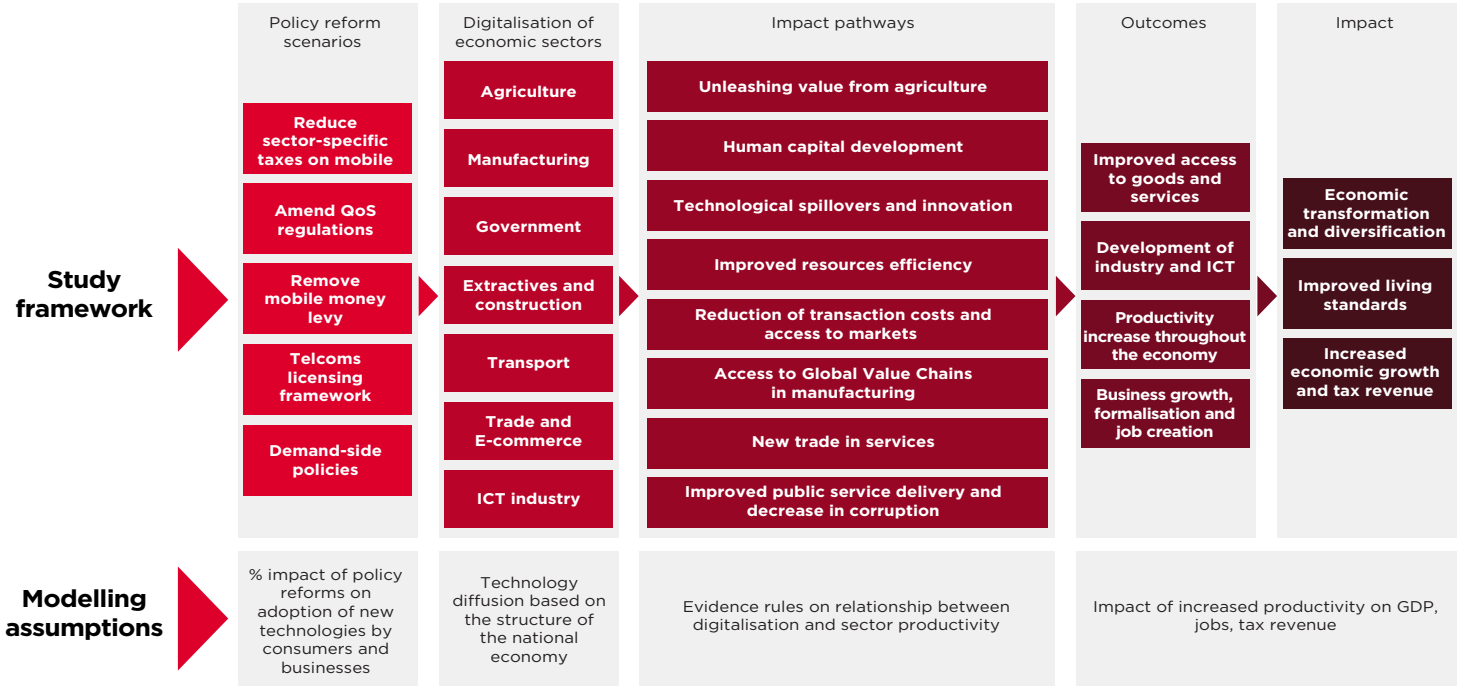
Figure 11: **Mobile money levy reduction scenario (indirect impact)**



C. Approach to modelling the impacts of digitalisation by sector

The overall approach to modelling the impact of digitalisation on other sectors is shown in Figure 12.

Figure 12: **Impacts of digitalisation framework and methodology**



The following assumptions were made in estimating the impact of digitalisation by sector:

- The increase in adoption of new technologies is taken from modelling of the policy reforms above, based on the combination of the identified priority policy reforms
- The impacts by year are then applied to shares of each sector and sub-sector within the economy (agriculture, transport, manufacturing, etc.) taken from the latest values in national accounts and forecasts or governments' objectives if available.
- A productivity effect is then applied for each sector and sub-sector based on the coefficients resulting from the evidence review as detailed below. For the impact on trade, growth in value add is taken from McKinsey (2022) and applied to the size of E-commerce within the trade sector.
- Where impacts on GDP are not available from the literature, productivity growth is assumed to translate to GDP 1-to-1. Employment elasticity to GDP growth is assumed to be 0.7 from Khan (2007).
- Impact on tax revenue is based on tax-to-GDP ratios from IMF.

Evidence review for impacts of digitalisation by sector

The evidence review was based on search and assessment of studies on the impacts of digitalisation by sector, for agriculture, transport, construction, manufacturing, trade, as well as formalisation of SMEs. The initial screening identified over 50 studies through systematic searches using Google, Google Scholar and Semantic Scholar AI tool. These included journal articles and publications by multilateral development banks and consultancies. Studies that included a quantitative impact assessment were then selected and included in (Table 11) below.

Table 11: **Review of evidence of impact of digital technologies by sector**

Sector	Relationship being quantified	Evidence rule	Impact coefficient	References
Agriculture	Access to technology by farmers → productivity	Sending SMS messages to smallholder contract sugarcane farmers about when to perform specific agricultural tasks increased yields by 11.5%	11.5% crop yield	Casaburi et al. (2019); Cole and Fernando (2016)
	Access to technology by farmers → productivity	Farmers also had maize yields about 10.5% higher than those who did not view the targeted video	10.5% yield	Campenhout, Spielman, and Lecoutere (2021)
	Access to technology by farmers → productivity	Smartphone-based, decision-support-tool app increased their yields by an average of about 7% and increased their profit from rice by about 10%. Households that received the personalized advice in combination with a grant that financed the recommended level of fertilizer increased their yield by about 20% and their profit by about 23%	20% yield 23% profit	Arouna et al. (2021)
	Access to technology by farmers → productivity	Digital land-registry records could make crop insurance available to more farmers. Precision agriculture—delivering real-time data to farmers' mobile phones to help them optimise fertiliser, pesticide, and other inputs—can increase yields by 15% or more	15% yield	WEF (2017); International Fertilizer Development Centre (2017)
	Access to technology by farmers → productivity	Aerobotics SA: if farmers the information collected, this can improve the crop yields by at least 20% over 5 years	20% yield in 5 years	South Africa The Department of Science and Innovation (2022)
	Access to technology by farmers → better access to market	The government's electronic National Agriculture Market digital platform, or eNAM, is available in 585 locations in 16 states and shows potential to increase prices realised by farmers by 155	15% prices	Ramesh Chand (2017); Government of India (2018)
	Access to technology by farmers → better access to market	In Kerala, mobile phones allowed fishermen to determine the most profitable port to sell their fish; by equalising access to information, price variance in the market declined, boats' profits rose by 8%, and consumer prices fell by 4%	proftit increase 8%	Jensen (2007)
	Access to technology by farmers → productivity	15% increase in productivity	15% productivity	WEF (2023); Government of India (2019)
Extractives	Advanced analytics enabled by IoT → optimisation and increased plant yields	Plant yields of gold, nickel, phosphate, and other processed minerals can often be improved by 3 to 10% with advanced analytics	3-10% plant yield	McKinsey (2015)
	5G networks in plants → efficiency, productivity	5G networks in mining with autonomous vehicles, real-time site monitoring and remote-controlled drilling rigs deliver improved efficiency, productivity and safety anda combined ROI of 207% over ten years in surface operations. In underground mining, the ROI equates to 256%.	11.9% profit	Orange (2021)

Table 11: **Review of evidence of impact of digital technologies by sector (cont.)**

Sector	Relationship being quantified	Evidence rule	Impact coefficient	References
Manufacturing	Adoption of new technologies by firms → productivity	A European Commission report estimates that Industry 4.0 will increase production by 20% (while cutting downtime by an estimated 50%) and increase total value added from manufacturing to a targeted 20% of all value added by 2020.	20% value add	European Parliament (2015)
	Adoption of new technologies by firms → productivity	The application of the Internet of Things in the manufacturing context alone—in other words, using sensors to bring intelligence to each piece of production equipment on the factory floor to optimize their collective use—would increase manufacturing productivity by 10 to 25%,	15-25% manufacturing productivity	McKinsey's (2015)
	Adoption of new technologies by firms → GDP	General Electric report, "Industrial Internet: Pushing the Boundaries of Minds and Machines," which estimated that the Industrial Internet could boost annual U.S. productivity growth by 1 to 1.5 percentage points and add USD 10 to USD 15 trillion to global GDP over the next 20 years	1-1.5% GDP growth	Evans, Annunziata (2012)
	Adoption of new technologies by firms → productivity	Implementation of industry 4.0 had a 50% ROI in the first year	50% ROI	Ericsson (2018)
Construction	Digitalised construction industry → productivity	When digitalized, the construction industry can realize productivity gains of up to 15% and cost reductions up to 6%.	15% productivity 6% cost reductions	McKinsey (2019)
Trade	Digital technologies → increased E-commerce	Digital retail to increase its share of trade from 5% currently to about 15% by 2025.	5-15% value	McKinsey Digital India (2019)
	Digital technologies → Increased service exports	BPO sector accounts for 7.3% of GDP	7.3% of GDP	World Bank (2018); Errighi (2016); IBEF (2018)
	Digital technologies → Increased service exports	A 10 percentage point increase in the growth of web hosts in a country leads to about a 0.2 percentage point increase in export growth	0.2 pp exports	Freund, Weinhold (2004)
	Digital technologies → Increased service exports	The long-run positive impact of digitisation on service export ranges from 0.087% to 0.159%,	0.087% - 0.159% service exports	Azu, Nwauko (2021)
	Access to digital by MSMEs à increased incomes and economic opportunity	Formal firms with a 1 point higher score in the technology adoption index are associated with labor productivity increases of 1.9%, 1.2%, 1.4%, and 2.0% in Ghana, Kenya, Malawi, and Senegal, respectively. And 4% for informal fimrs in Senegal. Job growth between 0.03 and 0.23%	1.2% to 4% productivity	Cirera, Comin, and Cruz 2022. Also: Bhattacharya, 2019

Table 11: **Review of evidence of impact of digital technologies by sector (cont.)**

Sector	Relationship being quantified	Evidence rule	Impact coefficient	References
Health	Digital payments → increased access to health insurance	A mobile money payment system for membership renewal and premium payments to enhance enrolment and retention rates, resulting in the proportion of mobile renewals to total renewals to increase from 67.4% to 82.3% in one year	67.4% to 82.3% increase in access	Morgan (2024)
	Digital health → increased access to health services and productivity	Digital health solutions enable doctors to increase visits by 30%	30% increase in productivity	McKinsey (2019)
Transport & logistics	Digital platforms and infrastructure in port operations → reduce costs and better access to markets	Digitising port operations can reduce logistics costs by 15 to 25%	15%-25% cost reduction	McKinsey (2019); IMF(2022)
	Port capacity → GDP	1% increase in port throughput capacity can increase local/ regional GDP between 0.04% and 0.2%	0.2% GDP	Bottasso et al. (2013)
	Digital platforms and infrastructure → increase productivity, incomes	The welfare gains from road and border investments in West Africa are estimated to amount to almost 10% of real income for [insert country] when road upgrades are complemented by reducing border delays. Transport upgrades and reduction of border delays increase incomes by 10%	10% incomes	Lebrand (2021)
	Digital platforms and infrastructure in port operations → increase tax base	More efficient border controls in ports increases tax revenue. Reduce border delays, customs duty and tax leaks. Digital procedures for customs increases revenue collected by 54% in 5 years and 8.63% per year	8.63% tax increase	Ancharaz (2017)
Government	Mobile money adoption → increase GDP	Mobile money adoption increases tax revenue by 1.71 percentage points in mobile money countries compared to non-mobile money countries. Relative to the control group, these coefficients represent between 7% and 17%—12% on average – of non-conditional average tax revenue	12% tax revenue% GDP	Apeti, Edoh (2023)
	P2G adoption → increase tax revenue	Countries that adopt P2G services experience a 1.2–1.3 percentage point boost in direct tax revenue as a share of GDP	1.3 ppt tax revenue% GDP	Wandaogo, Sawadogo (2022)
	Digital government payments adoption à → increase tax revenue	Digitalizing government payments in developing countries could save roughly 0.8–1.1% of GDP	0.8-1.1% GDP	Lund et al. (2017)
	Digital government → increase transparency of transactions, reduce leakage	Biometric identification for deployment of social protection schemes resulted in a 41% decrease in NREGS leakages and a 47% decrease in SSP leakages.	41-47% reduction in leakages	Muralidharan et al. (2023)

4. Bibliography

Acemoglu, Daron and Simon Jonhson, Power and Progress, 2023.

Addae-Nketiah A. Examining the benefits and challenges associated with the use of the mobile renewal service in Ghana. Open J Soc Sci. 2022;10:458-475.

Addae-Nketiah A. Factors influencing subscribers' use and adoption of the NHIS mobile renewal service. Open J Soc Sci. 2022;10:451-475.

African Union, Digital Transformation Strategy for Africa, 2020-2030.

Apeti, Ablam Estel and Eyah Denise Edoh, "Tax revenue and mobile money in developing countries", 2023.

ATAF, Africa Tax Outlook, 2023.

Aker, J.C., 2008. Does Digital Divide or Provide? The impact of cell phones on grain markets in Niger. SSRN Electron. J. https://doi.org/10.2139/ssrn.1093374

Atkinson, R., Castro, D., Ezell, S., 2009.The Digital Road to Recovery: A Stimulus Plan to Create Jobs, Boost Productivity and Revitalize America. The Information Technology & Innovation Foundation (ITIF), January 2009.

Azu, N. P., & Nwauko, P. A. (2021). Evaluating the Effect of Digital Transformation on Improvement of Service Trade in West Africa. Foreign Trade Review, 56(4), 430-453. https://doi.org/10.1177/00157325211032021

Barkman C, Weinehall L. Policymakers and mHealth: roles and expectations, with observations from Ethiopia, Ghana and Sweden. Glob Health Action. 2017;10:22-28.

Bartelsman, E.J., Falk, M., Hagsten, E., Polder, M., 2019. Productivity, technological innovations and broadband connectivity: firm-level evidence for ten European countries. Eurasian Bus. Rev. 9, 25–48. https://doi.org/10.1007/s40821-018-0113-0

Bhattacharya, R. (2019). ICT solutions for the informal sector in developing economies: What can one expect? The Electronic Journal of Information Systems in Developing Countries 85(83). Available at: https:// onlinelibrary.wiley.com/doi/full/10.1002/isd2.12075

BCG, 2014. Digital infrastructure and economic development: An analysis of the potential growth of data centers in PA as a result of the proposed data center sales and use tax exemption. The Boston Consulting Group

Bottasso, A., Conti, M., Ferrari, C., Merk, O., Tei, A., 2013. The impact of port throughput on local employment: Evidence from a panel of European regions. Transport Policy 27, 32–38. https://doi.org/10.1016/j.tranpol.2012.12.001Cirera X., Diego Comin, and Marcio Cruz, Bridging the Technological Divide: Technology Adoption by Firms in Developing Countries, 2022.

British International Investment, Evaluating the Impact of British International Investment's Infrastructure Portfolio Date: March 2022.

Casaburi et al., Harnessing ICT to Increase Agricultural Production: Evidence From Kenya, 2019.

Cole A., A. Nilesh Fernando, 'Mobile'izing Agricultural Advice: Technology Adoption, Diffusion and Sustainability Shawn 2016.

Comin, Diego A., Marcio Cruz, Xavier Cirera, Kyung Min Lee, Jesica Torres, Technology and resilience, Working Paper 29644, National Bureau of Economic Research, 1050 Massachusetts Avenue Cambridge, MA 02138 January 2022

Dalgıç, B., Fazlıoğlu, B., 2020. The impact of broadband speed on productivity: findings from Turkish firms. Appl. Econ. Lett. 0, 1–4. https://doi.org/10.1080/13504851.2020.1722789

European Parliament Member's Research Service, "Industry 4.0: Digitalisation for Productivity and Growth," (European Parliament, September 2015)

Ericsson, Industry 4.0 case study: www.ericsson.com/en/cases/2018/industry-4-0

Errighi, L. Khatiwada, S. and Bodwell, C. (2016). Business process outsourcing in the Philippines: Challenges for decent work. ILO Asia-Pacific Working Paper Series. Bangkok: International Labour Organisation

Fedderke, J.W., Bogetic, Z., n.d. Infrastructure and Growth in South Africa: Direct and Indirect Productivity Impacts of 19 Infrastructure Measures. Working Paper 39. University of Cape Town.

Freund, C.L., Weinhold, D., 2004. The effect of the Internet on international trade. J. Int. Econ. 62, 171–189. https://doi.org/10.1016/S0022-1996(03)00059-X

Government of India, eNAM, Ministry of Agriculture and Farmers Welfare, May 2018.

Government of India, Ministry of Electronics and Information Technology (MeitY), "India's Trillion-Dollar Digital Opportunity", n.d., https://www.meity.gov.in/writereaddata/files/india_trillion-dollar_digital_opportunity.pdf

India Department of Commerce developing national logistics portal", Ministry of Commerce & Industry press release, August 23, 2018, pib.nic.in

Grimes, A., Ren, C., Stevens, P., 2012. The need for speed: impacts of internet connectivity on firm productivity. J. Product. Anal. 37, 187–201. https://doi.org/10.1007/s11123-011-0237-z

GSMA, Mobile Economy Sub-Saharan Africa, 2023.

GSMA, Improving Farmer Livelihoods Through Digitised Agricultural Value Chains Results and lessons from the GSMA Innovation Fund, 2023.

GSMA, The E-levy in Ghana: Economic Impact Assessment, 2023.

GSMA, Tanzania Mobile Money Levy Impact Assessment, 2023.

GSMA, Mobile Money Regulatory Index, 2021 and 2024.

GSMA, Inclusive E-Government services in Ghana, 2023.

IBEF (2018). IT & ITeS, February 2018, New Delhi: India Brand Equity Foundation.

IFC, Google, e-conomy Africa 2020.

IMF, Customs matters: Strengthening customs administration in a changing world, 2022.

IMF, Benin first reviews under the extended fund facility and the extended credit facility arrangements – press release; staff report; and statement by the executive director, 2022.

International Fertilizer Development Centre, Rapid introduction and market development for urea deep placement technology for lowland transplanted rice, 2017.

Ismail, N.W., Mahyideen, J.M., 2015. The Impact of Infrastructure on trade and economic growth in selected economies in Asia. SSRN Electron. J. https://doi.org/10.2139/ssrn.2709294

ITU, Economic contribution of bbroadband, digitalization and ICT regulation – Econometric modelling for Africa, 2019.

Karthik Muralidharan & Paul Niehaus & Sandip Sukhtankar, 2023. "General Equilibrium Effects of (Improving) Public Employment Programs: Experimental Evidence From India," Econometrica, Econometric Society, vol. 91(4), pages 1261-1295, July. See a summary here: https://www.povertyactionlab.org/evaluation/improving-governance-through-biometric-authentication-and-secure-payments-india

Khan, Azizur Rahman, DESA Working Paper No. 49 ST/ESA/2007/DWP/49, Growth, employment and poverty: An analysis of the vital nexus based on some recent UNDP and ILO/SIDA studies, July 2007.

Mazzucato, M. and Rodrik, D. (2023). Industrial Policy with Conditionalities: A Taxonomy and Sample Cases. UCL Institute for Innovation and Public Purpose, Working Paper Series (IIPP WP 2023-07).

McKinsey Global Institute, "Digital India", 2019.

McKinsey Global Institute, "Industry 4.0: How to Navigate Digitization of the Manufacturing Sector, 2015.

McKinsey Global Institute, Impact of digitalisation on construction sector: www.mckinsey.com/capabilities/operations/our-insights/decoding-digital-transformation-in-construction

McKinsey Global Institute, Impact of digitalisation on mining sector: www.mckinsey.com/industries/metals-and-mining/our-insights/how-digital-innovation-can-improve-mining-productivity and https://www.mckinsey.com/industries/metals-and-mining/our-insights/productivity-in-mining-operations-reversing-the-downward-trend (2015)

Morgan et al., Digitising health protection schemes in Ghana': An enquiry into factors associated with the use of a mobile phone-based health insurance contribution payment system among tertiary students, 2024.

Mothobi, Gillwald, and Aguera, A demand side view of informality and financial inclusion, (2020)

MTN Group, Consolidated accounts, 2022 and 2023, and other MNO group accounts, e.g. Airtel, Vodafone, Orange.

Nalule, Victoria R. , Mining Law and Governance in Africa: Transformation and Innovation for a Sustainable Mining Sector, Taylor & Francis, 2023.

ODI, Alberto Lemma, Max Mendez-Parra and Laura Naliaka, The AfCFTA: unlocking the potential of the digital economy in Africa, 2022.

OECD productivity statistics: https://www.oecd.org/economy/growth/digitalisation-productivity-and-inclusiveness/

Orange, Digital mining case study: www.orange-business.com/en/blogs/unearthing-future-how-digital-revolutionizing-mining-industry (2021)

Peter C. Evans and Marco Annunziata, "Industrial Internet: Pushing the Boundaries of Minds and Machines" (GE, November 26, 2012), 3, www.ge.com/docs/chapters/Industrial_Internet.pdf.

Presidency of the Republic of Benin, Government Action Program, 2021-2026, and strategic plans and visions from other Governments such as Ghana, Nigeria, Kenya

Ramesh Chand, Doubling farmers' income: Rationale, strategy, prospects and action plan, National Institution for Transforming India policy paper number 1/2017, March 2017.

Rodrik, Dani, Premature deindustrialization, Springer Science+Business Media New York 2015.

South Africa, The Department of Science and Innovation, Case study report: Transformative farming through local and remote sensing decision support, Number: DST/CON 0094/2020 May 2022

Sudhir Dey Ancharaz, Best practices in digital customs: A critical assessment of the success story of the Mauritius Revenue Authority, 2017, Mauritius Revenue Authority: www.wcoesarocb.org/wp-content/uploads/2018/09/best-practices-in-digital-customs-in-east-and-southern-africa.pdf

Susan Lund, Olivia White, and Jason Lamb, The Value of Digitalizing Government Payments in Developing Economies, in Digital Revolutions in Public Finance, IMF 2017.

Technopolis & Research ICT Africa & Tambourine Innovation Ventures, October 2019 STUDY REPORT unlocking the potential of the fourth industrial revolution in Africa

Tuan Anh Luong, Thu Hang Nguyen, The Singapore Economic Review VOL. 66, NO. 04, The impact of ICT on service trade, https://doi.org/10.1142/S021759082049003X

UNCTAD, E-Commerce and the Digital Economy in LDCs: At Breaking Point in COVID-19 Times, 2020.

UNCTAD. (2018). UNCTAD Rapid eTrade Readiness Assessments of African Least Developed Countries (eT Ready)

UNCTAD, Member States of the Economic Community of West African States eTrade Readiness Assessment , 2022.

UNU-Wider Research Paper No. 2006/49 Manufacturing, Services and Premature Deindustrialization in Developing Countries A Kaldorian Analysis Sukti Dasgupta1 and Ajit Singh2 May 2006

UNU-Wider Working Paper 2022/18 Does the adoption of peer-to-government mobile payments improve tax revenue mobilization in developing countries? Abdoul-Akim Wandaogo, 1 Fayçal Sawadogo, 2 and Jesse Lastunen, February 2022.

US International Trade Commission, 2009. Sub-Saharan Africa: Effects of Infrastructure Conditions on Export Competitiveness, Third Annual Report. USITC Publ. 4071 195.

World Bank, Policy Research Working Paper 9855, Corridors without Borders in West Africa, Mathilde Lebrand, 2021.

World Bank, Benin Country Economic Memorandum, 2022, and other Country Economic Memorandums, e.g. Ghana, Nigeria, Kenya.

World Bank, Benin Digital Economy Assessment Country Report, 2021.

World Bank, Benin Country Climate and Development Report, 2023.

World Bank, Digital Dividends, World Development Report 2016.

World Bank, Using geospatial analysis to overhaul connectivity policies, 2022.

World Bank, Mobile Infrastructure in Benin, 2022.

World Economic Forum, Digital transformation initiative: Unlocking $100 trillion for business and society from digital transformation, January 2017.

World Economic Forum, "Scaling Agritech at the Last Mile: Converging Efforts for Farmers' Prosperity", 2023

WTO, Handbook on Measuring Digital Trade SECOND EDITION, 2023.

Digital strategies published by each countries Ministry of ICT where use where available.

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