Artificial Intelligence, E-Commerce, and Digital Trade across Borders in Africa: Pathways to Inclusive Policy, With a Focus on Nigeria

Egbuna, Ngozi. Eunice[1*], Kalu, Chris Ulua[2], Ekwugha, Uchenna Patricia[3]

[1]Prof Ngozi Egbuna International Center for Regional Integration and Trade Research (ICRITR), Nnamdi Azikiwe University, Awka

[2]Economics Department, Nnamdi Azikiwe University, Awka

[3]Mass Communication Department, Nnamdi Azikiwe University, Awka

[*] Corresponding Author

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ABSTRACT

This paper examines how artificial intelligence (AI), e-commerce, and digital trade are reshaping global trade systems and what these changes mean for Africa in general and particularly for Nigeria. These three elements now sit at the centre of modern economic transformation. AI enhances how firms make decisions, e-commerce changes how goods and services are bought and sold, and digital trade expands how value moves across borders through data, platforms, and digital services. Understanding how these systems interact is essential for countries seeking inclusive and competitive economic growth.

Africa has made notable progress in digital adoption over the past decade, but the region as a whole still lags behind, with respect to global averages, in most digital indicators. Internet penetration remains low, data affordability continues to be a challenge, and many countries struggle with outdated or inadequate digital policies. Despite these challenges, the continent has strong potential driven by a young population, rapid mobile adoption, and emerging digital entrepreneurship ecosystems. The challenge lies in turning this potential into sustained economic gains.

Nigeria reflects many of these continental dynamics. It is a country with tremendous digital promise, driven by a large, youthful population, a vibrant private sector, and significant advancements in digital financial services. The rise of mobile banking, fintech innovation, and online commerce platforms demonstrates that digital transformation is already underway. However, the country still struggles with foundational issues: inconsistent broadband access, high data costs, weak research and innovation capacity, gaps in AI readiness, limited digital skills, and fragmented regulatory frameworks.

The analysis shows that Nigeria performs unevenly across key indicators. On the one hand, the country leads in areas such as mobile money activity, fintech adoption, and commercial-scale potential for AI. On the other hand, it performs poorly in areas like research output, AI patent activity, digital literacy, broadband speed and coverage, and ICT goods production. For example, Nigeria's digitally deliverable services (DDS) exports have grown over the years, but imports remain much higher, creating a persistent trade deficit in high-value digital services. Similarly, ICT goods exports remain extremely low, just 0.1% of total goods exports, highlighting Nigeria's dependence on imported digital technologies.

The policy review shows that Nigeria has made commendable progress in establishing governance structures for the digital economy. Several laws, strategies, and frameworks exist, including the Data Protection Act (2023), Cybercrimes Act (2015), National Broadband Plan (2020–2025), National Digital Economy Policy and Strategy (NDEPS 2020–2030), and the draft National AI Strategy (2024). Together, these frameworks signal a strong

policy intention to drive digital transformation. However, many of these instruments remain under-implemented or lack the coherence needed to fully support innovation, digital trade, and AI development.

One major gap highlighted in the report is the absence of a legally binding AI regulatory framework. The draft National AI Strategy offers an important starting point, but without formal adoption, Nigeria lacks clear rules governing AI risks, data governance, transparency, and accountability. Another gap is the lack of clarity around AI authorship and intellectual property for AI-generated works, which has become increasingly important with the rise of generative AI tools. Additionally, enforcement of cybersecurity and digital consumer protection remains limited, and the dispute-resolution systems for cross-border e-commerce transactions are underdeveloped.

Despite these limitations, Nigeria is at a decisive moment in its digital evolution. If the country strengthens its infrastructure, improves regulatory coordination, invests in research and digital skills, and builds public trust in digital platforms, it can position itself as a digital leader within Africa. The findings of this report make it clear that both government action and private-sector innovation must move in tandem. The opportunities are significant: digital trade can unlock new export markets, AI can drive productivity gains, and e-commerce can expand economic participation for households and small businesses across all regions.

Nigeria's digital future is promising, but unlocking that promise requires deliberate, long-term commitments. With strategic reforms, increased investment, and strong institutional coordination, Nigeria can harness digital technologies as engines for inclusive growth, competitiveness, and sustainable development.

INTRODUCTION

In the context of international trade in the contemporary times, artificial intelligence, e-commerce, and digital trade are three key concepts that need to be studied together, given their extensive interconnectedness in use and design. Artificial Intelligence (AI) is the engine of digital intelligence. According to the World Trade Organisation (2025), AI could yield substantial trade and GDP gains if supported by robust digital infrastructure, skills development, and adaptive policy frameworks. AI is transforming global trade by reducing transaction costs, enhancing compliance, and expanding opportunities for businesses of all sizes. AI is revered for the ability of computer systems to learn, reason, and make decisions from data. It enhances automation, prediction, personalisation, and operational efficiency across digital platforms. Therefore, while AI enables recommendation systems, dynamic pricing, fraud detection, and customer analytics in e-commerce, it supports customs risk management, supply chain optimisation, and digital identity verification in digital trade. According to Bocean et al. (2025), AI's influence is seen throughout the e-commerce value chain, enhancing everything from customer-facing interfaces to back-end logistics and supply chain management.

E-commerce, however, provides the transactional infrastructure for digital trade to thrive as the front-end of commercial exchange, where goods, services, and data are traded electronically. On one hand, e-commerce relies on digital platforms, payment systems, and logistics networks, such that AI algorithms and digital connectivity determine efficiency, market reach, and user experience. On the other hand, e-commerce data feeds AI systems, which in turn enhance sales targeting and logistics optimisation. According to Rep (2025) AI E-commerce Shopper Behaviour Report, the global AI-enabled e-commerce market was valued at $7.25 billion in 2024 and is projected to grow to $64.03 billion in 2034, representing a compound annual growth rate of 24.34% between 2024 and 2032 (Rep, 2025). They further show that shoppers who return to a site and use AI chat during their session spend 25% more than returning customers who don't.

It is therefore evident that digital trade encompasses cross-border electronic transactions in goods and services (cross-border e-commerce), digital service exports (e.g., software, fintech, data analytics), and digital infrastructure that enables data flows. AI and e-commerce are simply the functional and operational layers within digital trade. While AI technologies have the potential to fundamentally change trade and international business models, trade itself can also be an essential mechanism through which countries and firms access the inputs needed to build AI systems, whether goods, services, people, or data, and deploy AI solutions globally (Ferencz et al., 2022; Ozturk, 2024). AI, e-commerce, and digital trade, therefore, represent three layers of one digital ecosystem wherein AI is the intelligence layer (data analytics, automation, personalisation), e-commerce is the

market interface layer (platforms for transactions), and digital trade is the economic and policy layer (cross-border flows and governance). Hence, for regulatory coherence, they need to be studied together.

Interestingly, digital trade, AI, and e-commerce contribute directly and indirectly to almost all the Sustainable Development Goals (SDGs), in particular SDGs 1, 3, 4, 5, 8, 9, 10, 11, 12, 13, 16, and 17. For example, while digital trade and e-commerce expand access to global markets, boosting productivity and entrepreneurship, AI enhances efficiency, innovation, and competitiveness across industries, thereby advancing decent work and economic growth (SDG 8). In addition, digital platforms and AI foster innovation ecosystems and smart industrial processes, while e-commerce accelerates the adoption of digital infrastructure, logistics systems, and data-driven manufacturing. This promotes SDG 9 – Industry, Innovation, and Infrastructure. Also, SDG 17 – Partnerships for the Goals is enhanced when digital trade frameworks facilitate cross-border cooperation. Especially, e-commerce platforms and AI systems enable global collaboration, data exchange, and policy harmonisation. Hence, the relevance of digital trade, AI, and e-commerce for sustainable development is profound.

There is a consensus that the digital ecosystem of AI, e-commerce, and digital trade will significantly boost global macroeconomic fundamentals and economic growth. According to Serena et al (2025), the digital economy today accounts for over 15% of global GDP (US$11–16 trillion) and is growing 2.5 times faster than the physical economy. In addition, the United Nations Conference on Trade and Development (UNCTAD) estimates that the digital economy market will reach $5 trillion by 2033 (UNCTAD, 2025a). AI alone could add $15.7 trillion to the global economy by 2030 (PwC, 2023). Meanwhile, e-commerce reached $5.8 trillion in 2023 and is projected to grow by 39 per cent over the coming years, with expectations of surpassing $8 trillion by 2027 (International Bridge, 2025).

Despite these opportunities, many developing economies, especially low-income countries, face the risk of being left behind due to limited connectivity, inadequate ICT infrastructure, insufficient digital skills, and the absence of a stable and transparent legal and regulatory framework (Ruta & Jakubik, 2023). According to UNCTAD (2025a), without intentional policy measures, the merging of trade and digital transformation could widen existing disparities instead of narrowing them. Presently, less than one-third of developing nations have adopted national AI strategies, approximately 2.6 billion people remain disconnected from the internet, and developing countries account for only about $1 trillion in digital exports, compared to a global market that is nearly five times larger (UNCTAD, 2025a). In spite of these discouraging statistics reflecting developing countries, there is still enormous potential for developing countries. For example, the United Nations OHRLLS and WTO (2022) posit that “digital trade offers more opportunities than challenges to least-developed countries (LDCs), including for their small and medium-sized enterprises”.

Understanding how AI, digital trade, and e-commerce influence economic development is crucial, as these sectors are still evolving and offer significant opportunities for rapid growth if effectively harnessed. According to Rebeca Grynspan, Secretary-General of UNCTAD, “AI’s trajectory isn’t predetermined … Whether it widens divides or closes them depends on the choices we make now – about investment, governance and whose voices shape the rules” (UNCTAD, 2025b). Developing countries like Nigeria must therefore seize the opportunities presented by their teeming youth populations, regional/continental market access, and fintech ecosystems to optimise gains and promote economic development. The Digital Trade for Africa World Bank-World Trade Organisation Joint Project report for Nigeria posits that, though Nigeria has enormous potential to harness digital trade gains for economic growth and development, key challenges must be addressed (World Trade Organization & World Bank, 2025). It is on this premise that this study seeks to critically analyse the potentials, emerging trends, challenges, and policy frameworks shaping artificial intelligence (AI), e-commerce, and digital trade across borders in Africa, with a particular focus on Nigeria as a case study. Specifically, the study seeks to

(i) assess the current state and growth potential of AI, e-commerce, and digital trade in Nigeria within the broader African digital economy.

(ii) analyse the key policy, infrastructural, and regulatory challenges affecting Nigeria’s participation in cross-border digital trade and propose strategies for inclusive and sustainable development.

This study will therefore significantly contribute to understanding the digital ecosystem of Nigeria and Africa by extension. The remaining sections of the paper are structured as follows: a review of the literature, a discussion of the methodology and data, an overview of the digital economy in Africa, an analysis of Nigeria's digital ecosystem, an examination of the policy framework, and finally, the conclusion.

A REVIEW OF THE LITERATURE

The interplay between AI, e-commerce and digital trade and its effect on international trade and development could be hinged on the classical trade theories, and the New Trade Theories. Classical trade theories such as comparative advantage by David Ricardo and factor endowment models by Heckscher-Ohlin emphasise how differences in endowments drive trade flows (Yuni, 2023). However, the emergence of digital trade and AI necessitates extending theory to capture new dynamics: lower trade costs, digital platforms, network effects and data flows. For example, the new trade theories underscores the role of increasing returns and economies of scale in trade among similar countries. Krugman's (1979) New Trade Theory as well as the premier on transaction cost economics by Coase (1937) and Williamson (1985) shed light on this extension. That is, digital trade reduces barriers to participation in global markets such as the reduction in information, coordination, and transaction costs which enables firms, including small and medium enterprises (SMEs), to access international buyers, thereby aligning with transaction cost economics and reducing frictions in global value chains.

In addition, Katz and Shapiro (1985) in their Network Externalities Theory, and Rochet & Tirole (2003) in their paper titled Platform Competition in Two-Sided Markets, basically extended Krugman's (1980) model of product differentiation and increasing returns which provides the foundation for digital platform markets, where larger scale leads to lower costs and greater variety. It is worth noting that e-commerce enables more direct cross-border transactions via digital platforms, thereby amplifying network effects and platform economics, also more users on a marketplace increase value for all participants. Thus, an integrated framework emerges: digital trade and e-commerce reduce transaction and information costs; digital platforms and network effects create scale and connectivity; AI reduces frictions and enhances participation; and development gains hinge on enabling factors (infrastructure, regulation, human capital). Together, they transform trade and development theory by placing digital capabilities, data flows, platforms and networks centre stage. These theories are supported by the empirical findings on the subject.

Empirical studies on digital trade, AI, and technology-driven trade dynamics consistently emphasize their transformative impact on global production and trade structures. While findings differ across countries and methodological approaches, the evidence generally supports the view that digitalization, AI readiness, and technology adoption enhance trade performance and industrial competitiveness. For example, Qiu et al., (2023) examined data from 40 countries between 2010 and 2020 using panel fixed-effect and intermediary effect models and showed that digital service trade significantly promotes the high-quality development of the global manufacturing sector. This suggests that greater participation in digital trade channels can raise productivity and innovation in manufacturing, particularly when economies integrate digital services into production networks.

Similarly, Elnahrawi (2021) used a cross-sectional framework to assess how regulatory preparedness for AI influences trade outcomes. The study found that countries with stronger AI regulatory readiness enjoy substantial gains in digital services trade, with these effects being more pronounced in developed regions, especially Europe and Central Asia, compared to developing economies and those in the Middle East. This highlights the importance of regulatory maturity in enabling economies to benefit fully from AI-driven trade opportunities. In another investigation, Srividhya and Reddi (2025) employed a fixed-effects model to analyze the relationship between AI readiness and Digitally Deliverable Services (DDS) exports. Their results show that AI preparedness enhances DDS exports across both developed and developing countries, though the magnitude of impact varies regionally. Positive determinants of DDS exports include higher gross national income per capita and large population size, while the effects of Information Technology Agreement (ITA) membership and digital laws, such as those governing cybercrime and consumer protection, differ across regions. These findings reinforce the role of economic scale, institutional quality, and legal environments in shaping digital trade competitiveness.

Using a dataset covering 196 countries from 2016 to 2019, Tay (2021), focusing on neural machine translation and search engine dominance found that AI exerts a statistically significant and positive influence on

manufacturing trade, exports, and imports, with effects significant at the 10% level. Furthermore, Bekkers et al. (2020) applied a dynamic computable general equilibrium (CGE) model to simulate the effects of technological change on international trade. Their results indicate that advancements in digital technologies and ICT services can raise global trade growth by an average of two percentage points per year between 2020 and 2030. For developing economies, the trade growth boost could reach 2.5 percentage points annually, especially for those that can accelerate technological catch-up. Additionally, the study projects that services exports will constitute more than one-quarter of global trade by 2030, with technological innovation increasing the share of services imports embedded in manufacturing output. This evolution reflects a structural shift toward more service-intensive production and trade patterns.

The reviewed studies collectively reveal that digitalization, AI readiness, and robust ICT ecosystems are powerful drivers of trade growth and industrial upgrading. Countries that strengthen digital infrastructure, enhance regulatory frameworks, and invest in technological capabilities tend to experience stronger export performance, particularly in digitally deliverable services and manufacturing trade. For Africa, and Nigeria in particular, these findings underscore the urgency of investing in digital infrastructure, AI policy frameworks, and capacity building to harness the full potential of digital trade. As Nigeria positions itself as a regional hub for e-commerce and digital services, lessons from global evidence suggest that strategic regulatory readiness, innovation in digital services, and integration into cross-border value chains will be critical for transforming its digital economy into a sustainable growth engine.

Overview of the Digital Economy in Africa

Understanding the size, structure and drivers of the digital economy in Africa is key in providing the context and role required by Nigeria. This section discusses the digital economy of Africa in three groups: digital connectivity, access, and usage; digital trade and e-commerce; and innovation capacity and research capacity of the digital ecosystem. To analyse the digital connectivity, access, and usage; we discuss the mobile network coverage, percentage of individuals owning a mobile phone and using the internet, price of data-only mobile and fixed broadband basket, mobile/fixed broadband internet traffic per subscription per month, percentage of individuals using the internet by age, gender and sector, digital gender parity is still a distant prospect in regions with low internet use, and mobile cellular subscriptions. The second, digital trade and e-commerce, will analyse international trade in digitally deliverable services, value, shares and growth; international trade on ICT goods and services, and the total retail e-commerce revenue by region. And the last part will include investment in ICT with private participation, Gross domestic expenditure on R&D, and researchers per million inhabitants.

In terms of coverage, the ITU reports that mobile network coverage in Africa is the least efficient among continents and globally. Table 1 shows that Africa has only 11% 5G coverage, second only to the Arab states and about 5th of global coverage. Unlike other continents, 5G is only in urban areas, with less than 1% in rural regions. Also, Africa has the highest proportion of the population – 25% - without access to 3G or higher network coverage, which is 2.5 times the Global record. In this era of the internet of things and artificial intelligence, the effectiveness of mobile network coverage and its efficiency in production, international trade, and ultimately economic growth and development cannot be overemphasised.

Table 1: Percentage Mobile network coverage in 2024

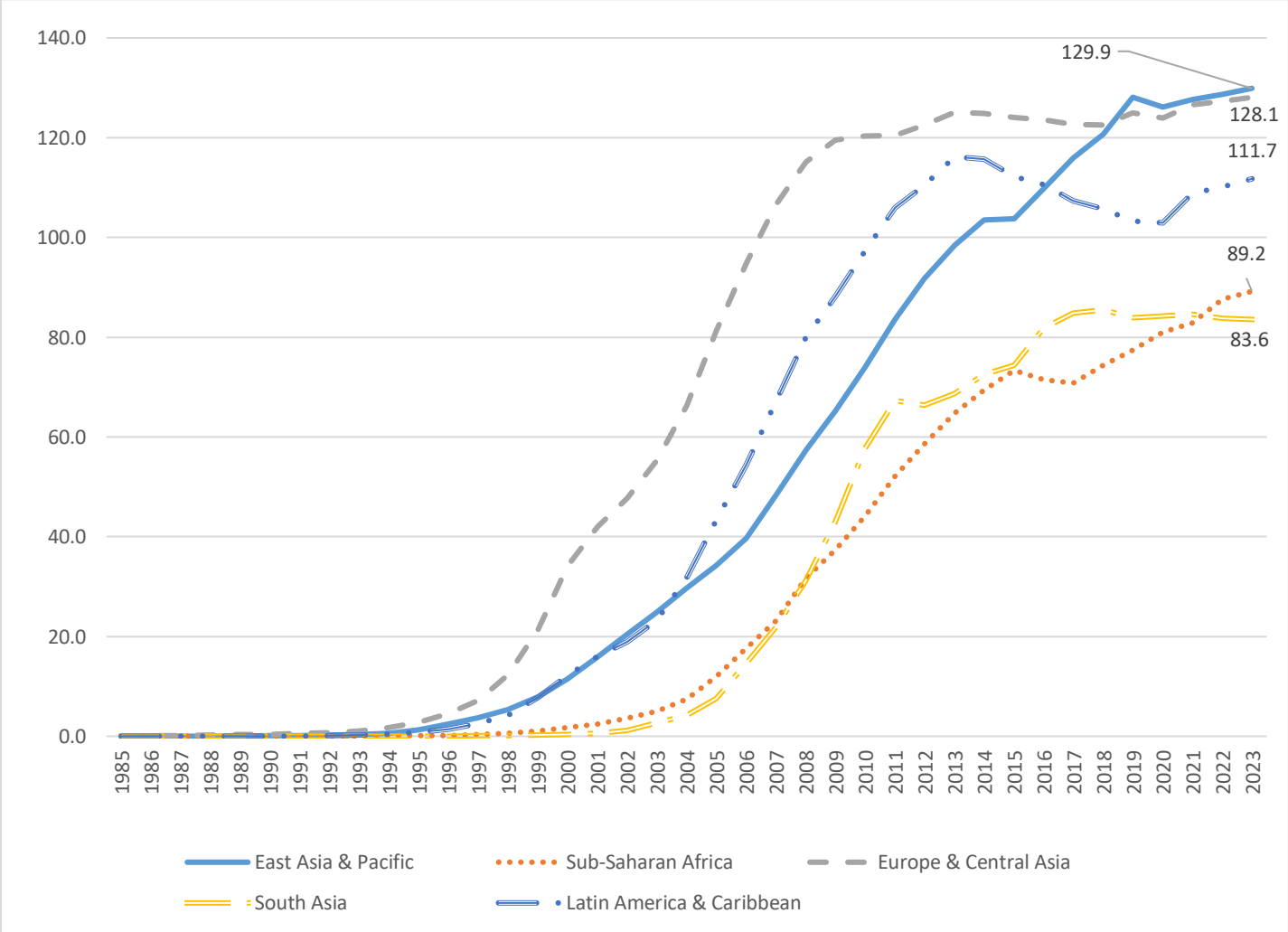
Description	**Total**				**Urban**			**Rural**				**% of pop without access to 3G or higher**
	5G	**4G**	**3G**	**2G**	**5G**	**4G**	**3G**	**5G**	**4G**	**3G**	**2G**	
World	51	41	4	2	67	32	1	29	53	8	5	10
Africa	11	60	15	8	25	73	1		49	26	14	25
Americas	63	30	2	1	70	28	1	31	41	4	6	24

Arab States	13	74	8	3	21	78	1	1	69	18	6	12
Asia-Pacific	62	34	1	1	82	17	1	41	53	1	3	5
Europe	72	27	0.5	0.5	81	19		46	51	1	1	2

Source: Authors' computation of data from ITU (2025)

While the mobile network coverage describes the mobile infrastructure available for the population, the extent of mobile cellular subscriptions shows its utilisation. Figure 1 shows that, in 1985, no continent recorded up to 0.1% mobile cellular subscriptions (per 100 people). Europe & Central Asia recorded 0.1% in 1986, while East Asia & Pacific recorded the same 0.1% in 1989, Latin America & Caribbean in 1991, SSA in 1994, and South Asia only in 1997. SSA began recording meaningful progress only in 2001, and Figure 1 shows it had the lowest rate of growth during the period covered. In 2023, the records show that East Asia & Pacific leads with 129.9% of Mobile cellular subscriptions (per 100 people), while SSA records only 89.2%, suggesting that over 10% of its population have no mobile subscriptions.

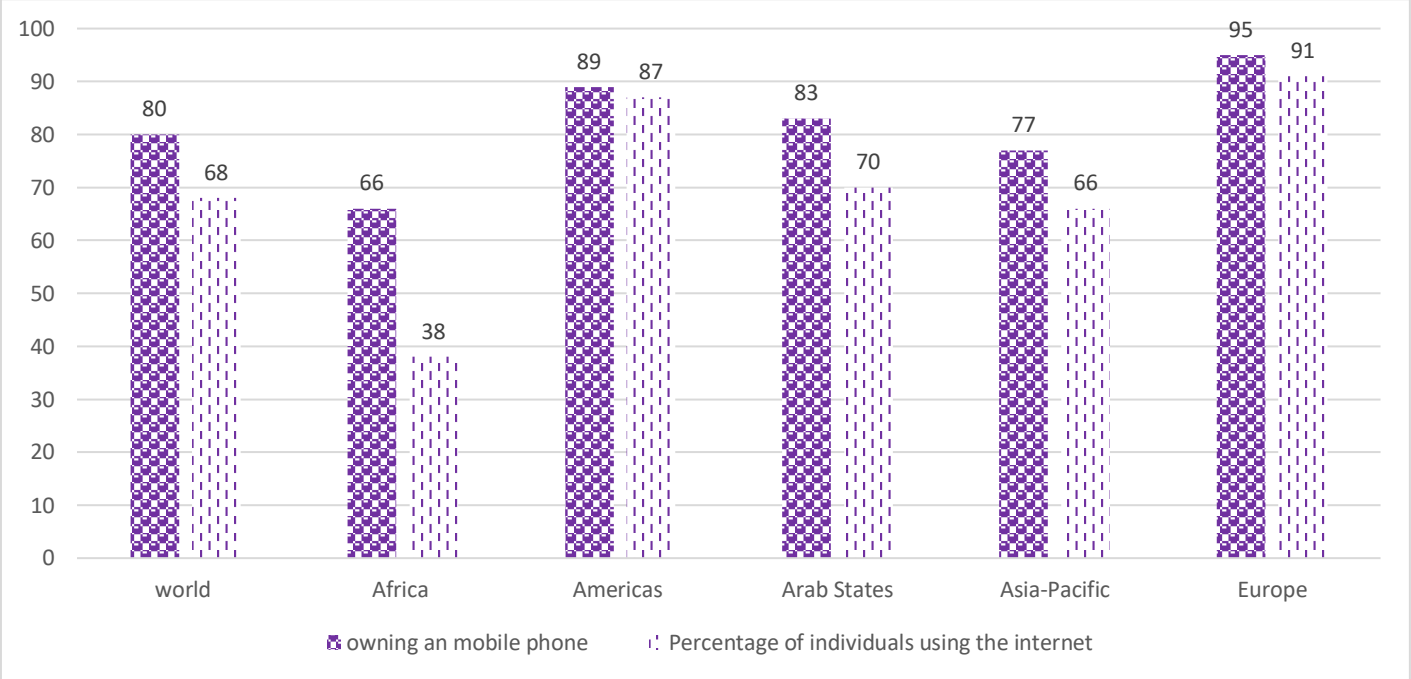
Figure 1: Mobile cellular subscriptions (per 100 people)



Source: Authors' computation of data from World Bank (2025a)

Beyond the number of subscriptions, the percentage of individuals who own a mobile phone and actively use the internet provides a more accurate picture of real digital connectivity, as it excludes subscriptions without internet access. As shown in Figure 3, only 66% of Africans own a mobile phone, and about 33% use the internet, significantly lower than the global averages of 80% and 68%, respectively.

Figure 3: Percentage of individuals owning a mobile phone & using the internet in 2024



Source: Authors' computation of data from the ITU (2025)

A disaggregation of internet-using populations by age, gender, and sector (Table 2) shows that more than 80% of young people in the regions listed below use the internet, compared with a global average of 79%. In contrast, only 53% of Africa's youth are online, and just 34% of the rest of the continent's population use the internet, equivalent to only 52% of the global average for this group. These figures highlight not only a significant digital divide between Africa and other regions of the world but also a worrying generational connectivity gap that limits African youth's participation in global digital learning, trade, and emerging AI-driven job opportunities. The relatively low usage among Africa's youth also reflects structural challenges, including limited access to affordable devices, weaker ICT ecosystems in schools, and lower household incomes. It is, however, worth noting that though young people are more likely to use the internet, the gap is shrinking worldwide due to increasing smartphone penetration, more affordable data packages, and targeted digital inclusion strategies in several developing countries (ITU, 2024).

Females tend to use the internet at a marginally lower rate than their male counterparts in all regions except in the Americas. In Africa, the gap is the widest: only 31% of females compared to 43% of males use the internet, a gap of about 12 percentage points. This persistent gender digital divide reflects more profound socio-cultural, economic, and educational inequalities that limit women's access to digital technologies. Evidence from UNCTAD and the World Bank suggests that women face higher opportunity costs, lower digital skills, and greater safety concerns in online spaces, all of which contribute to reduced digital engagement (UNCTAD 2025b; World Bank, 2025b). Given the role of the internet in the production and trade of goods, and its implications for poverty and inequality, it is imperative to consider minimising this digital gender gap to reduce gender inequality. The empowerment of women in the digital space is strongly correlated with improvements in national productivity, household welfare, and inclusive digital transformation.

As expected, the gap between the percentages of individuals using the internet in urban vs rural sectors of the economy is wide, globally and regionally. In Africa, while 57% of the urban population uses the internet, only 23% in rural areas do. The rural gap is closely linked to infrastructural deficits, such as limited broadband coverage, unreliable electricity supply, and higher effective data prices in sparsely populated areas. Rural communities also tend to have lower levels of digital literacy and fewer public access points, further widening the divide. Addressing the rural–urban connectivity gap is not only critical for inclusive development but also central to expanding digital trade participation, improving access to e-government services, and ensuring that digitalisation contributes meaningfully to poverty reduction across all segments of society.

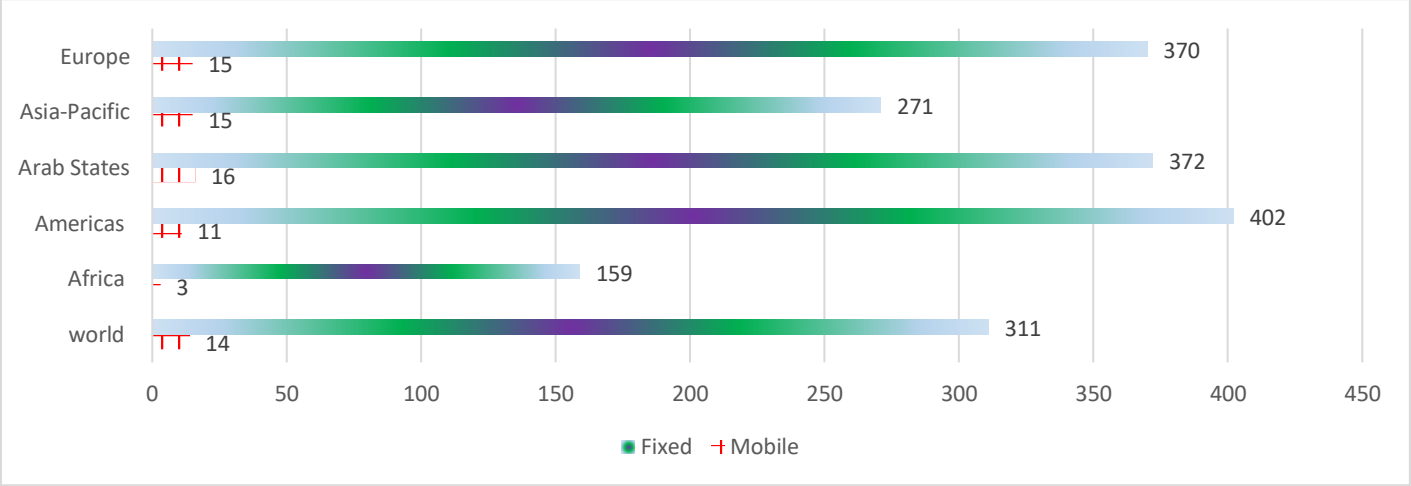
Table 2: Percentage of individuals using the Internet by Age, Gender and Sector in 2024

Description	Youth	The rest of the population	Female	Male	Urban	Rural
World	79	66	65	70	83	48
Africa	53	34	31	43	57	23
Americas	95	85	87	86	90	74
Arab States	86	67	64	75	83	50
Asia-Pacific	81	60	64	68	83	49
Europe	98	90	90	92	93	86

Source: Authors' computation of data from ITU (2025)

Globally, average consumption stands at 14 GB for mobile broadband and 311 GB for fixed broadband, but Africa falls well below these benchmarks, with only 3 GB of mobile traffic and 159 GB of fixed traffic. These low values suggest limited access to affordable data, weaker network capacity, and lower adoption of data-intensive services such as video streaming, cloud computing, and online education. They also indicate that African users face structural constraints, such as limited device capabilities, higher relative data prices, and inconsistent connectivity, that restrict active participation in digital economies (ITU, 2024). In contrast, the Arab States (16 GB mobile; 372 GB fixed), Asia-Pacific (15 GB mobile; 271 GB fixed), and Europe (15 GB mobile; 370 GB fixed) exhibit much higher usage levels, reflecting stronger broadband infrastructure, more affordable data, and greater integration of digital services into daily life and business activities. The Americas also show high fixed broadband consumption (402 GB), which is expected and consistent with widespread home broadband adoption and streaming-heavy digital cultures.

Figure 4: Mobile/fixed Broadband internet traffic per subscription per month (GB) 2024



Source: Authors' computation of data from ITU (2025)

Table 3 measures affordability by expressing the cost of basic data baskets as a share of gross national income per capita. The global trend shows meaningful declines in relative cost between 2023 and 2024, with a reduction of 15%. However, Africa's baskets remain substantially more expensive relative to income: the mobile 2GB basket is about 4.2% of GNI per capita in 2024, and fixed broadband 5GB is about 13.4%, considerably above the world averages of 1.1% and 2.5%, respectively. This persistent affordability gap helps explain lower internet adoption rates in Africa, despite strong mobile network coverage in many countries. Policy implications are direct: reducing effective prices through competition policy (lower mobile termination rates, more efficient

wholesale pricing), targeted taxation reforms (such as lowering or removing VAT on data for low-income users), and public investments in backbone infrastructure can materially increase affordability. The slower rate of reduction in Africa (−8.7% mobile, −9.5% fixed) compared to other regions suggests that global trends toward cheaper data have not translated into local gains in purchasing power as rapidly as expected. Affordability must therefore be a central objective of digital inclusion strategies.

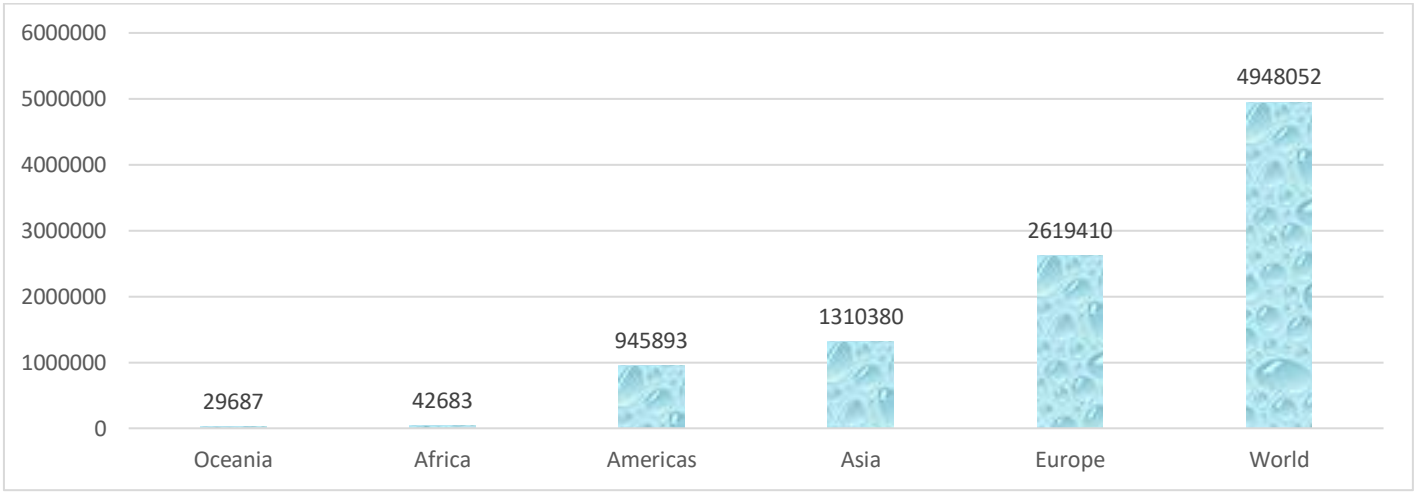
Table 3: Price of data-only mobile and fixed broadband basket as % of gross national income per capita

Description	Price of data-only mobile broadband (2GB) basket as % of gross national income per capita			Price of fixed broadband (5GB) basket as % of gross national income per capita		
	2023	2024	Rate of reduction	2023	2024	Rate of reduction
World	1.3	1.1	-15.4	2.8	2.5	-11
Africa	4.6	4.2	-8.7	14.8	13.4	-9.5
Americas	2.3	1.9	-17.4	3.9	3.5	-10
Arab States	1.1	0.8	-27.3	3.2	3.2	0
Asia-Pacific	1.2	0.9	-25.0	3	2.4	-20
Europe	0.4	0.3	-25.0	1	1	0

Source: Authors' computation of data from ITU (2025)

Figure 4 illustrates international trade in digitally deliverable services, value, shares and growth, across several regions. Digitally deliverable services (DDS) underscores the structural asymmetry in digital trade: high-income regions (Europe, North America, Asia) dominate export value and shares, while Africa's DDS exports are comparatively small both in absolute terms and as a share of services trade. Figure 4 shows robust growth of DDS globally, reflecting cloud services, software, digital content, and remote professional services, but Africa's share remains constrained, possibly by limited firm capabilities, lower broadband quality, and weaker participation in global IT value chains. Practically, the chart implies that African policy should not only boost domestic demand but also target export readiness: support for language-specific AI tools, B2B platform intermediaries, export promotion for DDS, and targeted skills programmes can raise competitiveness.

Figure 4: International trade in digitally deliverable services, value, shares and growth, annual (analytical) in 2024



Source: Authors' computation of data from United Nations Conference on Trade and Development (2025)

Table 4 provides a global comparison of DDS exports and imports. Africa has second to the lowest DDS exports of about US$42.7 billion, after Oceania with DDS exports of about US$29.7 billion, and one of the lowest export-to-import ratios of 57%, indicating persistent deficits in high-value digital services. The share of DDS in Africa's total trade in services is 26.85%, which is also significantly lower than the world average of 55.9% and far below Europe or the Americas. This suggests that Africa remains primarily a consumer, rather than producer, of digital services. According to the International Data Centre Authority (2025), the challenges facing digital economies in Africa include: Power infrastructure deficit, digital skills gap & workforce development deficit, high connectivity costs & limited telecom liberalisation, fragmented digital infrastructure & regulatory frameworks, limited access to capital, and cybersecurity risks & digital trust deficit. However, the International Data Centre Authority (2025) also highlight the prospects of fintech & financial inclusion, digital trade & e-commerce growth, artificial intelligence & cloud computing in agriculture as huge opportunities for Africa's digital transformation. African countries can leverage AfCFTA-Digital protocols to harmonize regulations and expand regional digital trade.

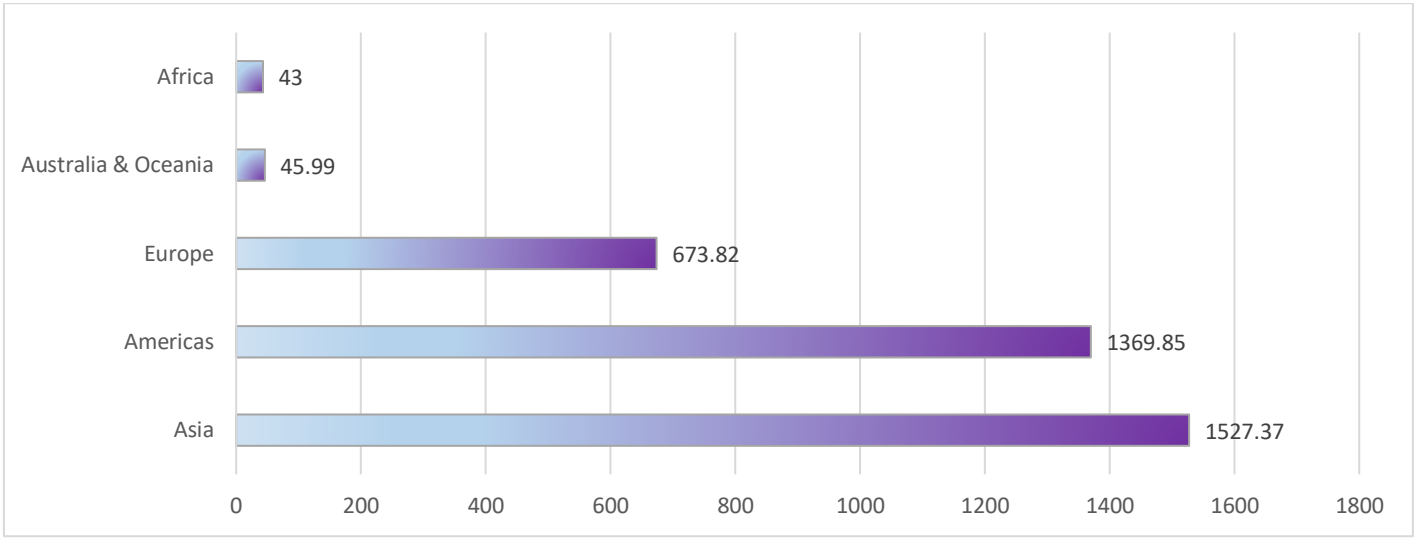
Table 4: International Trade in Digitally-deliverable services

Description	**Digitally-deliverable services (US$ at current prices in millions)**			**Digitally-deliverable services (% of total Trade in Services)**		
	Export	**Import**	**Export as a proportion of imports**	**Export**	**Import**	**Export as a proportion of imports**
World	4948052	4117048	120.18	55.9	50.96	109.69
Africa	42683	74751	57.10	26.85	34.85	77.04
Americas	945893	707316	133.73	59.31	52.84	112.24
Asia	1310380	1104418	118.65	48.77	41.78	116.73
Europe	2619410	2175249	120.42	60.87	58.04	104.88
Oceania	29687	55312	53.67	27.53	41.19	66.84

Source: Authors' computation of data from World Bank (2025a)

Figure 5 depicts retail e-commerce revenue disaggregated by region and highlights major concentration in Asia-Pacific, followed by North America and Europe, while Africa's contribution is comparatively small. The distribution reflects structural differences: consumer purchasing power, logistics and payments infrastructure, and prevalence of platform ecosystems, while Asia's leading position could be said to be driven by large domestic markets (China, India), advanced digital payment rails, and integrated logistics networks. By contrast, African e-commerce's modest share reflects constraints on both the demand side (lower disposable incomes and higher prices, as shown above) and the supply side (such as logistics bottlenecks and higher fulfilment costs). Policy implications include prioritising last-mile logistics, strengthening parcel delivery ecosystems, enabling secure digital payments, and incentivising local platform development. The experience from Southeast Asia suggests public-private investments in logistics hubs and digital payment standardisation can accelerate growth of the digital infrastructure (Organisation for Economic Co-operation and Development, 2019).

Figure 5: Total retail e-commerce revenue worldwide in 2025, by region (in billion U.S. dollars)



Source: Authors computation of data from Statista (2025)

Table 5 compares ICT goods exports/imports and ICT services exports across regions, exposing stark contrasts. For example, East Asia & Pacific lead in ICT goods exports about 28% of total goods exports, reflecting manufacturing strength and export competitiveness in electronics. By contrast, SSA posts ICT goods exports of merely 0.3% of total goods exports and ICT service export shares around 6.8%, which is far below global averages. The proportion of ICT goods export to goods imports suggests SSA is a net importer of ICT hardware, reinforcing dependence on external supply chains and implications of vulnerability. For African policymakers, this table underscores two critical points: (i) the urgent need to develop local ICT manufacturing and assembly capacity where feasible, perhaps via special economic zones or incentives targeting high-value assembly; and (ii) the strategic imperative to scale ICT services exports through skills development, and targeted trade facilitation. The data aligns with literature showing that digital adoption alone does not automatically translate into export competitiveness; complementary industrial policy, human capital investments, and export promotion are necessary to convert domestic digitalization into tradeable ICT outputs (Alraja et al., 2023; Asia-Pacific Economic Cooperation, 2024)

Table 5: International Trade on ICT goods and services in 2021

Description	**ICT goods exports (% of total goods exports)**	**ICT goods imports (% total goods imports)**	**proportion of ICT goods export to goods imports**	**ICT service exports (% of service exports, BoP)**
World	13.2	14.1	93.6	15.4
Arab world	3.8	8.2	46.3	
East Asia and Pacific	27.9	24.9	112.0	10.2
Europe and Central Asia	4.7	7.8	60.3	16.4
Latin America and Caribbean	6.4	11	58.2	8.4
North America	7.4	13	56.9	8.9
SSA	0.3	4.6	6.5	6.8

Source: Authors' computation of data from World Bank (2025a)

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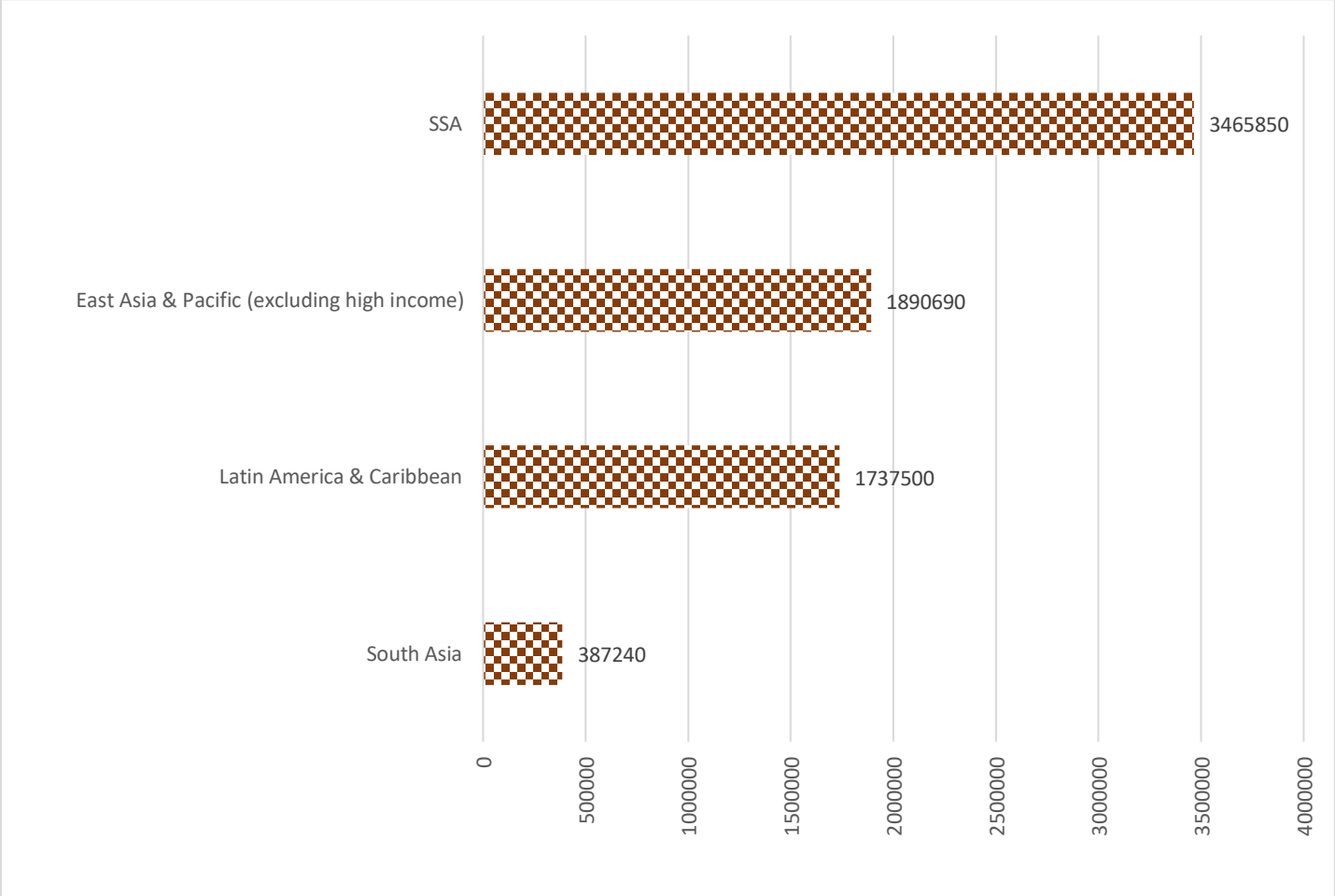
Having examined the extent of network coverage, use, speed, and affordability of the internet, as well as the trade in ICT goods and services, it is important to understand the nature of investment and R&D that drive the digital ecosystem. Figure 6 shows private sector investment in ICT across regions. In contrast to the previous statistics, which showed the SSA underperforming across almost all indicators, the SSA records the highest investment in ICT with private participation. SSA records about 3.47 million USD, which is much higher than South Asia (387,240 USD), Latin America & the Caribbean (1.74 million USD), and East Asia & the Pacific (excluding high-income countries) (1.89 million USD). This no doubt raises a major concern: SSA spends more on investment but records relatively poorer digital indicators than its regional counterparts. Given the high rate of corruption and weak institutions in most African countries, it is difficult not to assume that these investments require audits to identify the source of the discrepancy and take onward action to optimise investments.

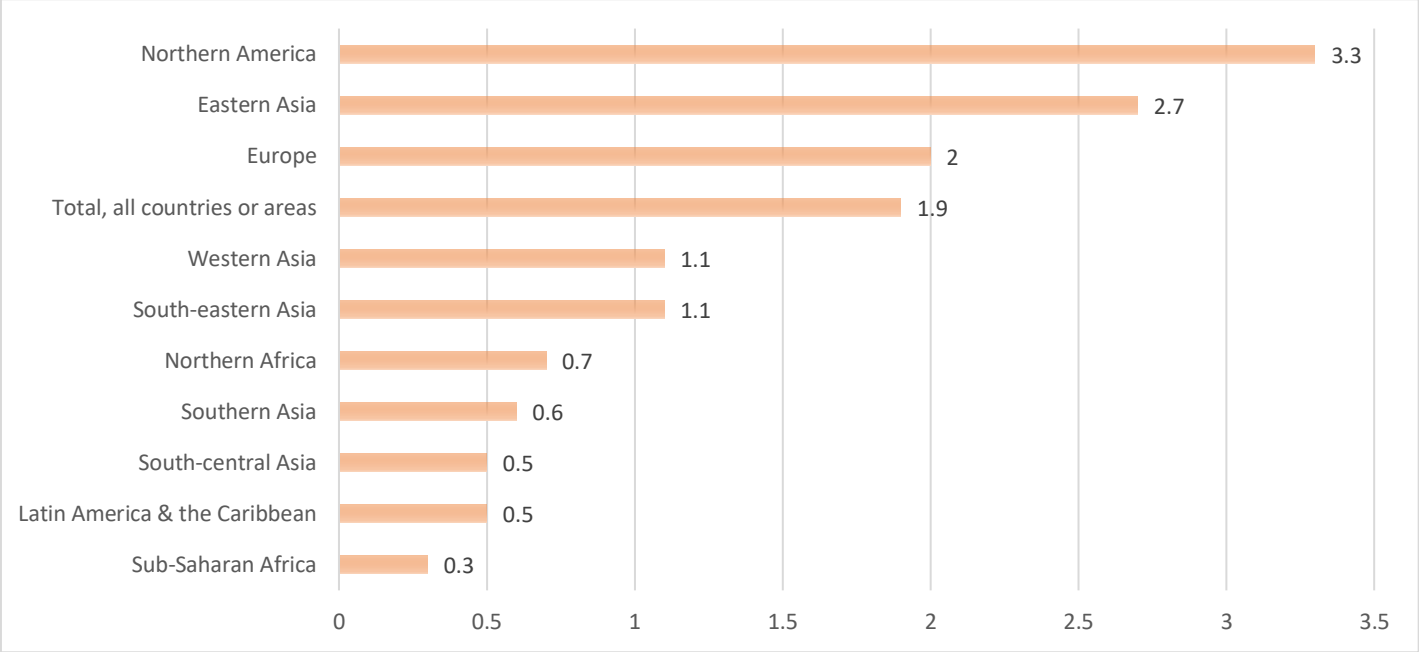
Figure 6: Investment in ICT with private participation (current US$) in 2023



Source: Authors' computation of data from World Bank (2025a)

Figure 7 charts the Gross Domestic Product (GDP) on R&D (GERD) as a percentage of GDP and highlights a persistent R&D investment gap between high-income countries and most African economies. The SSA records a GERD of 0.3, which is about 6 times lower than the global average of 1.9. Low R&D intensity constrains indigenous innovation, local AI development, and the ability to deliver high-value, digitally delivered services. Countries with higher GERD tend to have stronger research ecosystems, more patents, and greater absorptive capacity to adopt and adapt AI and digital technologies, an advantage reflected in their higher shares of digital trade. The policy takeaway is clear: raising R&D intensity through public funding, incentives for private R&D, and university-industry partnerships is essential for long-term digital competitiveness. However, R&D policy must be strategic due to the limited fiscal space; many African countries will benefit most by focusing R&D funding on application areas with high local returns (agritech, fintech, and health tech, etc). Donor and development bank funding can be leveraged to co-finance centres of excellence. At the same time, tax credits and innovation grants can mobilise private R&D.

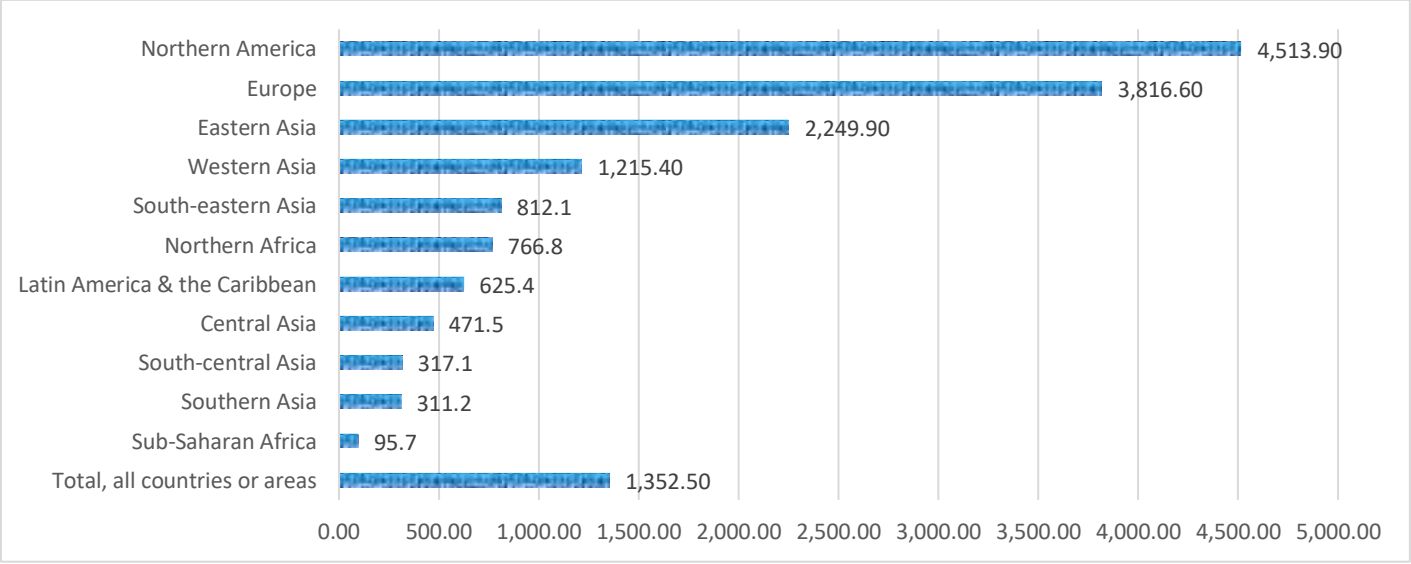
Figure 7: Gross domestic expenditure on R&D: as a percentage of GDP



Source: Authors' computation of data from UNESCO Institute for Statistics (UIS) statistics (2025).

In an effort to understand the extent of GERD's limitations, Figure 8 shows that human capital constraints, measured by researcher density (Full-time Equivalent [FTE] per million), remain modest in many African countries compared with those in advanced economies. SSA records the lowest, a ridiculous 95.7 researchers per million inhabitants, North America records the highest with about 4,513 researchers per million inhabitants and the global average is about 1,352 researchers per million inhabitants. This shortage limits the pool of skilled professionals who can design, adapt, and scale AI solutions or provide high-value digital services for export. Research capacity affects not only basic scientific output but also applied R&D that underpins AI algorithms, data governance frameworks, and domain-specific innovation. Therefore, the need to expand graduate STEM programs, provide incentives to retain talent (such as research grants and competitive salaries), and foster diaspora engagement to transfer skills cannot be overemphasised. Additionally, building networks of regional research centres and facilitating collaborative research with global partners can amplify limited domestic capacity.

Figure 8: Researchers per million inhabitants (FTE)



Source: Authors' computation of data from UNESCO Institute for Statistics, (2025)

This section discusses the digital connectivity, access, usage, trade, e-commerce, innovation capacity and research capacity of the digital ecosystem. The findings show that SSA ranks lowest or near the bottom on all indicators except Investment in ICT with private participation. This is strange, given that it is the same investment that is required to boost the other indicators. It, however, connotes that the volume of investment does not translate into meaningful impact on the potential of AI, e-commerce and digital trade. At the regional level, therefore, there is a need to address the efficiency of investments in the sector, even as more foreign and domestic investments are sought to boost the industry. Despite the generally weak performance across most indicators, the regional averages mask significant variation within Africa, with some countries demonstrating faster progress and more dynamic digital ecosystems than others. Nigeria, in particular, presents an interesting case because it combines relatively strong private-sector investment and rapid digital adoption with persistent structural constraints. The next section, therefore, examines Nigeria's digital landscape in detail, highlighting its performance relative to peer countries and assessing the opportunities and challenges it faces in strengthening AI readiness, digital trade, and e-commerce.

METHODOLOGY AND DATA

The study employed an expository analysis and descriptive statistics to diagnostically explain, clarify, and interpret the key concepts and relationship raised in the specific objectives. The goal of the expository analysis is to inform and deepen understanding by systematically presenting facts, theories, and perspectives drawn from existing literature, reports, and empirical observations. In this context, we explained the "what," "how," and "why" of digital trade trends, AI and e-commerce adoption in Nigeria. The expository discussion employed two key techniques: the literature synthesis so as to integrate findings from academic papers, UN and World Bank reports, or national policy documents; as well as the comparative analysis to contrast experiences across countries or regions.

Descriptive statistics, such as means, ratios, and percentages, were presented numerically and in charts to understand trends and highlight areas of concern. The expository analysis and descriptive statistics complemented each other to address the stated objectives. The numerical analysis for section 5 discussed the digital ecosystem of Nigeria in comparison to 5 key countries: Algeria, Egypt, Kenya, Morocco, and South Africa. This is for comparing Nigeria to its peers, given that these countries constitute the countries with the highest GDP in Africa. The study, however, notes that this does not translate to the countries with the greatest digital ecosystem in Africa, but provides an economic basis for Nigeria to perform comparatively better.

Numerical data for the descriptive analysis were sourced from International Telecommunication Union (ITU), World Bank, United Nations Conference on Trade and Development (2025), Statista, Tortoisemedia (2024), World Intellectual Property Organization (WIPO) statistics database, IMF, and the United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute for Statistics.

For the purposes of this paper the following definitions are adopted in the discussion of the concepts.

- "Artificial intelligence (AI) is technology that enables computers and machines to simulate human learning, comprehension, problem solving, decision making, creativity and autonomy" (IBM, 2025).
- "E-commerce refers to the sale or purchase of goods or services conducted over computer networks by methods specifically designed for receiving or placing orders." (Organisation for Economic Co-operation and Development, 2025)
- "Digital trade refers to all international trade that is digitally ordered and/or digitally delivered." (International Monetary Fund [IMF], et al., 2023)

These definitions guide the choice of data and statistics used for the analysis and discussion.

Analysis of Nigeria's digital ecosystem,

For developing countries such as Nigeria, the evolution of digital infrastructure, digital skills, and online participation represents both a major opportunity and a structural challenge. As global trade becomes

increasingly digitally enabled through data flows, digitally deliverable services, and platform-mediated e-commerce, countries with robust digital ecosystems are better positioned to diversify exports, attract investment, and create new forms of employment; ultimately improving growth and development. Conversely, countries with weak digital infrastructure or insufficient digital preparedness risk falling behind, thereby perpetuating productivity gaps and economic vulnerability. This section examines the state of AI readiness, e-commerce performance, and digital trade, to ascertain the digital ecosystem in Nigeria.

AI readiness of Nigeria

To appreciate the AI readiness of Nigeria, the report discusses the global AI index, and the total patent applications for Intellectual Property rights for AI products, for Nigeria, compared to other countries. The Global AI Index aims to make sense of artificial intelligence across 83 countries, scoring them on AI capacity using 122 indicators grouped into three pillars of analysis – Implementation, Innovation, and Investment (Tortoisemedia, 2024). Table 6 presents comparative scores and rankings for Nigeria and five other African countries based on the Global AI Index dimensions: implementation, innovation, investment, scale, intensity, talent, infrastructure, operating environment, research, and development. The data show that South Africa and Egypt lead the continent in AI readiness, with comparatively higher scores in research output, infrastructure, and operating environment. Nigeria's performance is mixed; Nigeria ranks highest in terms of AI talent and infrastructure. However, its overall rankings remain lower than those of South Africa, Egypt, and even Kenya in several categories. Nigeria's weak scores in infrastructure, talent, and research intensity are particularly concerning, as these are critical foundations for AI adoption and innovation. The country's relatively stronger scores in "commercial" and "scale" reflect the dynamism of its private sector, especially fintech, yet this has not translated into broad AI capability across industries. Nigeria's ranking suggests that, while it possesses market-size advantages, it lacks the research ecosystem and talent pipeline required to build indigenous AI solutions.

Table 6: The Global AI Index of some Selected African Countries

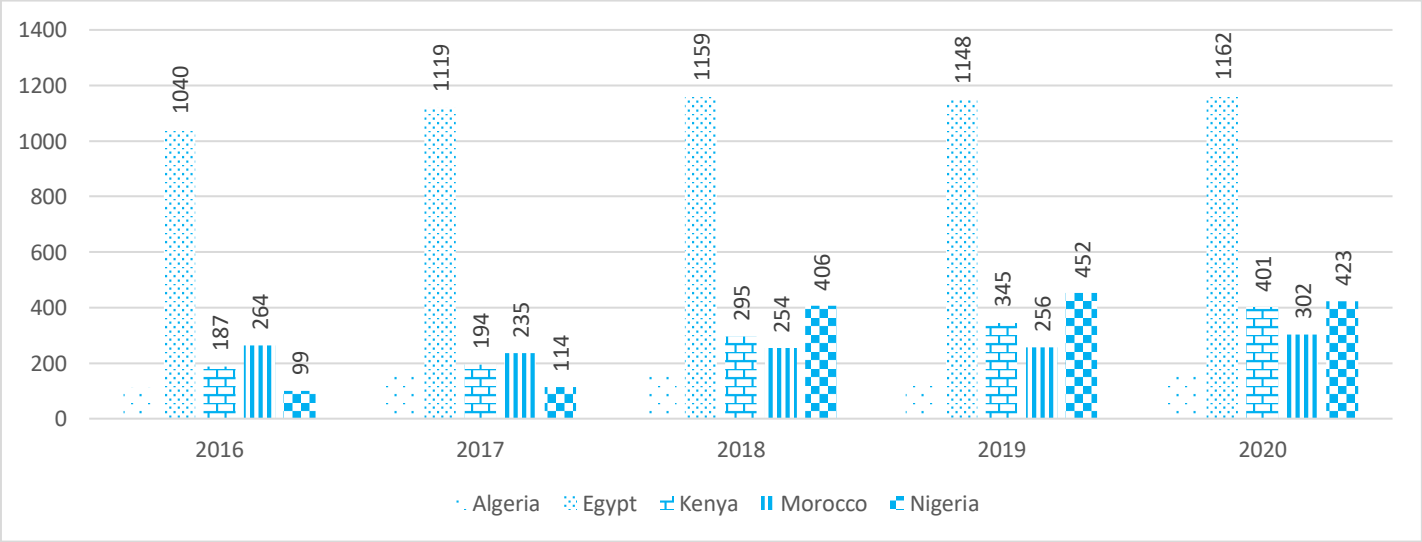
Description		**Egypt**	**South Africa**	**Nigeria**	**Morocco**	**Algeria**	**Kenya**	
Overall		8	5	5	4	4	4	Score
Implementation	Talent	2	1	3	2	1	1	
	Infrastructure	12	5	16	14	5	5	
	Operating Environment	49	58	49	40	68	68	
Innovation	Research	1	1	1	1	0	0	
	Development	3	0	1	0	0	0	
Investment	Government Strategy	2	25	3	10	2	2	
	Commercial	6	1	0	0	3	3	
Scale		7	5	5	4	4	3	
Intensity		11	8	7	7	6	6	
Overall		52	69	73	79	80	81	Rank
Implementation	Talent	69	77	67	70	79	79	

	Infrastructure	74	79	63	73	80	80
	Operating Environment	62	45	60	72	24	24
Innovation	Research	64	70	57	60	82	82
	Development	41	73	50	79	69	69
Investment	Government Strategy	79	51	76	70	79	79
	Commercial	35	68	79	82	51	51
Scale		45	70	68	79	80	81
Intensity		61	71	76	75	82	78

Source: Authors' computation from Tortoisemedia (2024)

Figure 9 illustrates the volume of AI-related patent applications across countries, showcasing the global distribution of innovation in artificial intelligence. The World Intellectual Property Organisation [WIPO] Statistics (2025) shows that AI patents are dominated by technologically advanced economies, such as China, the United States, Japan, and South Korea; meanwhile, African countries, including Nigeria, register almost no presence in global AI patent output. For Nigeria, the near absence of AI patents indicates that while private firms adopt AI-enabled tools, the country lacks indigenous capacity to produce AI products or algorithms. This limits Nigeria's ability to participate in global AI value chains and reduces opportunities for high-value digital exports, hence the need to strengthen university-industry collaboration, incentivise local R&D, and establish innovation hubs in Nigeria.

Figure 9: Total patent applications -Intellectual Property rights for AI products

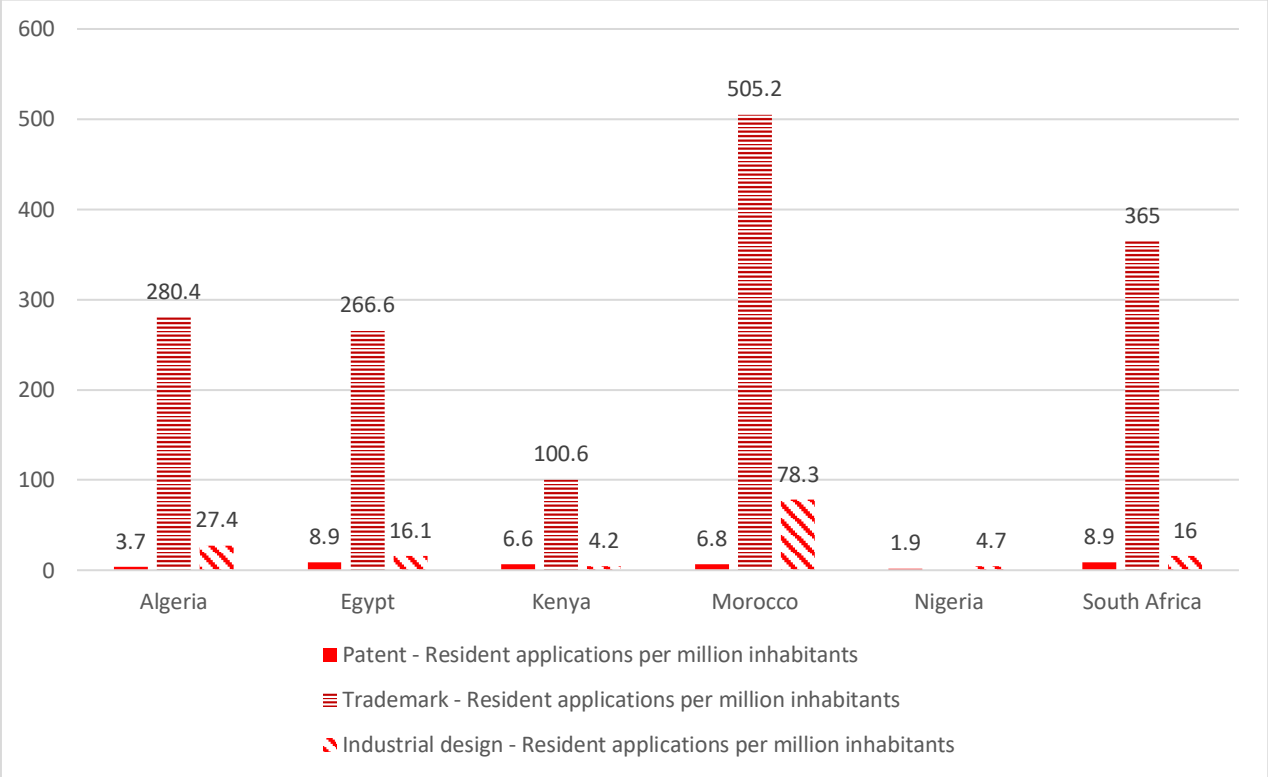


Source: Authors' computation of data from WIPO statistics database.

Figure 10 zooms into the resident application for pattern, trademark, and design. The figure reinforces findings in Table 6, where African countries ranked poorly in research, development, and infrastructure. The bar chart shows that Nigeria records the least applications in pattern, trademark and design, when compared to Egypt, South Africa, Algeria, Morocco and Kenya. Morocco is evidently leading the six countries in the sample, followed by South Africa and Algeria. For Nigeria, the weak differential in patents shows that it not expanding

its innovation frontier at a pace that reflects its population size or market dynamism, and this is evident in its research and development capacity. Nigeria can therefore improve its performance through targeted R&D funding, technology transfer incentives, and strengthening of IP protection systems.

Figure 10: Resident Application for Pattern, Trademark, and Design in 2020

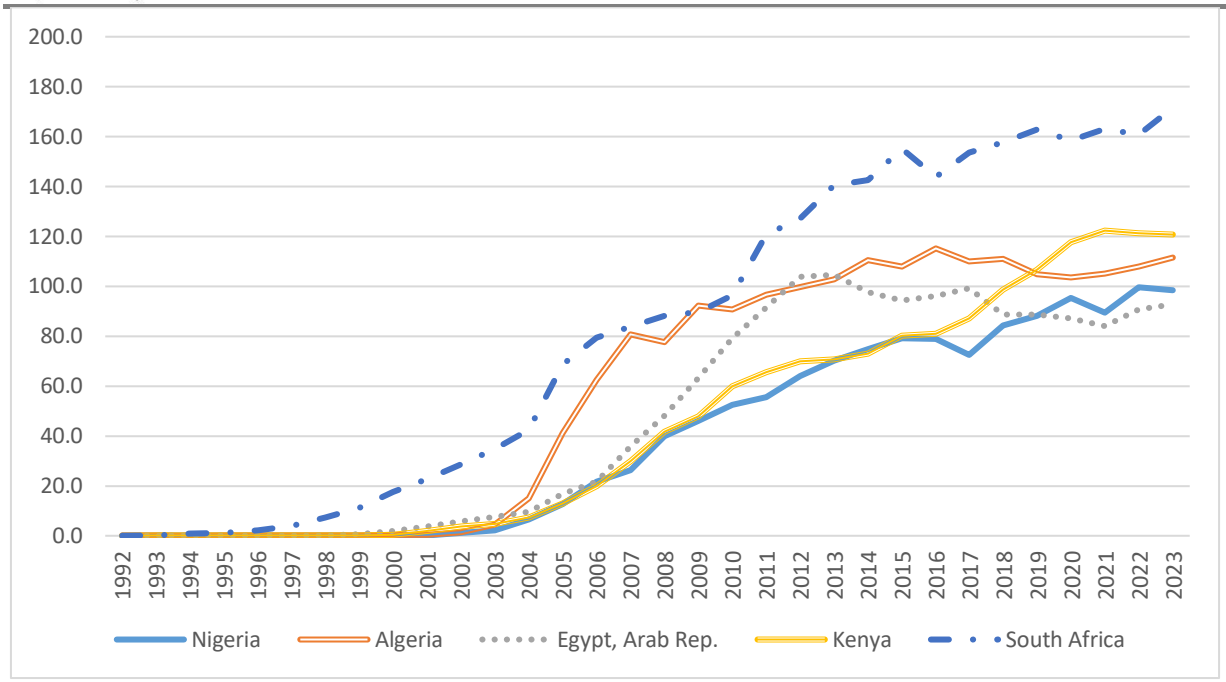


Source: Authors' computation of data from WIPO statistics database.

E-commerce and the digital economy

To understand e-commerce performance in Nigeria, the paper discusses the mobile cellular subscriptions, international trade on ICT goods and services, digital financial inclusion, and mobile money transactions and account ownership. In Figure 11, the study illustrates the mobile cellular subscriptions per 100 people across regions, providing insight into mobile penetration as a foundational element of e-commerce and digital inclusion. In 1992, none of the 5 countries had recorded 0.1% of mobile cellular subscriptions. By 1993, South Africa was the first to record 0.1%, the other countries followed, and Nigeria was the last of the five countries to register 0.1% of mobile cellular subscriptions. Nigeria's growth rate is the slowest, though it was higher than only Egypt's in 2023, but lower than those of South Africa, Kenya, and Algeria. High mobile penetration is a critical enabler of digital transformation, as mobile devices serve as the primary access point to the internet in developing countries. However, the figure also shows that Nigeria's subscription rate still lags behind regions such as Europe, the Americas, and parts of Asia. Hence the need to strengthen access and utilization of mobile phones.

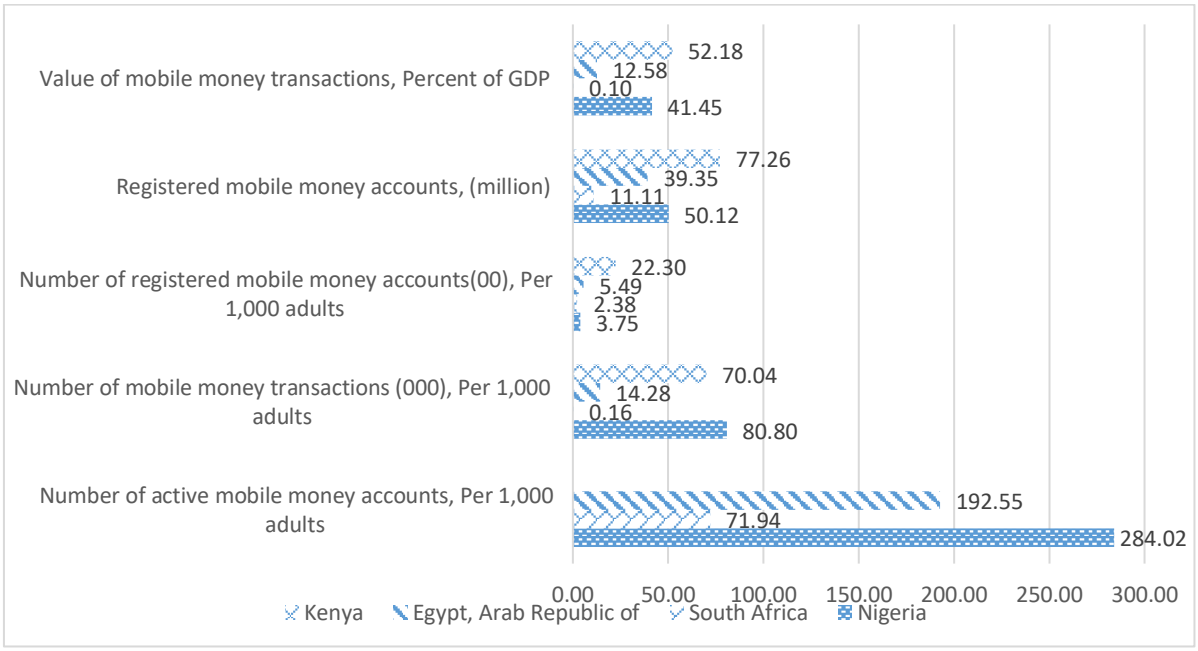
Figure 11: Mobile cellular subscriptions (per 100 people)



Source: Authors' computation of data from World Bank (2025a)

Beyond mobile cellular subscriptions, Figure 12 presents trends in digital financial inclusion, with indicators such as mobile money account ownership, transaction volumes, and usage intensity. While Nigeria dominates in terms of the number of active mobile money accounts per 1,000 adults, and the number of mobile money transactions per 1,000 adults, Kenya dominates in terms of the number of registered mobile money accounts, value of registered mobile money accounts, and the value of mobile money transactions as a per cent of GDP. Though there is no data for the number of active mobile money accounts per 1,000 adults for Kenya, it is safe to say that Nigeria is following Kenya in terms of the core indicators of mobile money transactions. Overall, this suggests that mobile money is not yet as deeply integrated into Nigeria's financial ecosystem as in East Africa. This partly reflects historical regulatory constraints, and bank-led mobile money models.

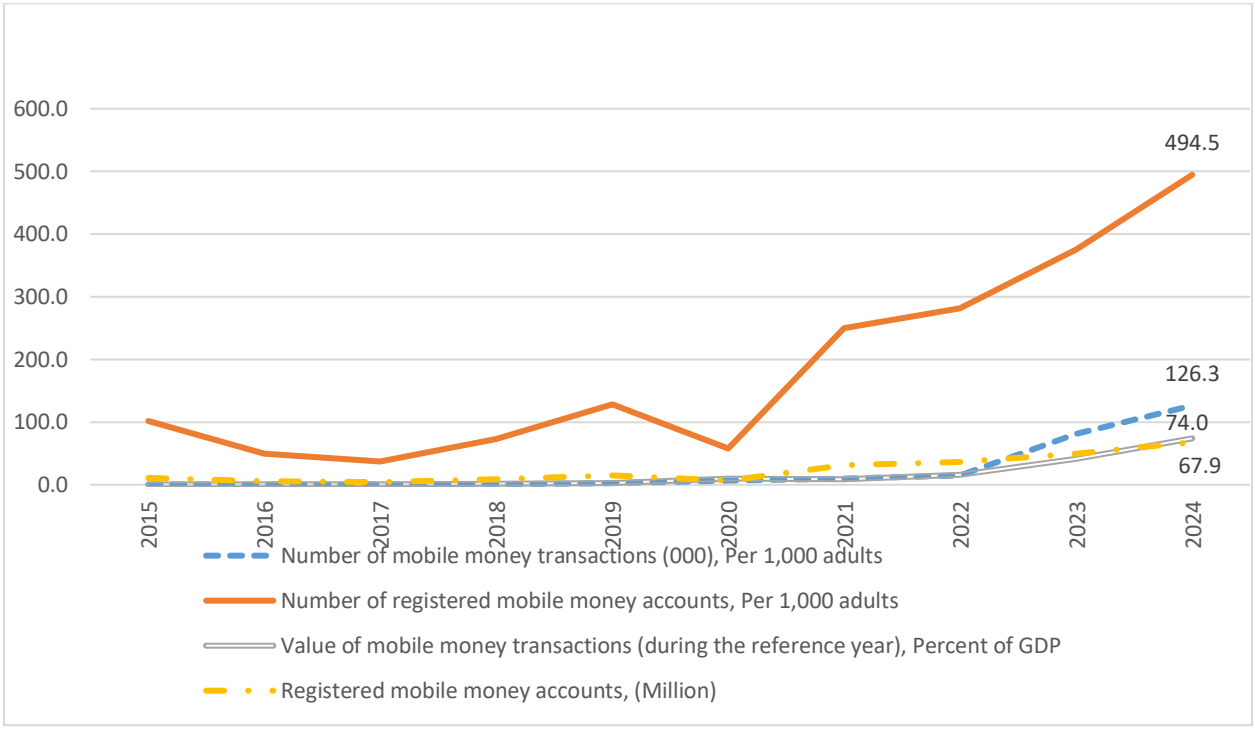
Figure 12: Mobile Money Transactions and Account Ownership in 2023



Source: Authors' computation of data from Authors computation of data from IMF (2025)

A closer look at the time series trend as shown on Figure 13 illustrates the growth in mobile money accounts and transaction values over time in Nigeria. It shows a pronounced upward trend in recent years, with account ownership expanding alongside rising transaction volumes, especially after the apparent COVID-19 effect of 2020. It is however worth noting that, though the number of registered mobile money accounts has increased at a geometric rate since 2020, the number of mobile money transactions per 1,000 adults, the registered mobile money accounts, and the value of mobile money transactions (as a percent of GDP) only increased at a much slower rate since 2022. The widening gap between account ownership and transaction values highlights the fact that, while more Nigerians are opening mobile money accounts, active usage is slower. Given that transaction growth suggests increasing reliance on mobile money for remittances, bill payments, and small business operations, there is need to implore policies that facilitate this process in Nigeria.

Figure 13: Mobile Money Transactions and Account Ownership in Nigeria (2015- 2024)



Source: Authors' computation of data from the IMF (2025)

Digital trade in Nigeria

Section 5.3 discusses the digitally-deliverable services, international trade on ICT goods and services, gross domestic expenditure, volume of researchers, individuals using the internet, and investment in ICT with private participation. Table 7 provides a regional a comparative profile of six African countries based on the value and composition of their DDS trade. Nigeria exports US$1.55 billion in DDS while importing US$5.79 billion, producing an export-to-import ratio of 27% in value terms, which indicates a substantial deficit. However, when expressed as the share of total trade in services, Nigeria's DDS exports represent 33.96%, slightly higher than its imports (32.28%), giving an export-to-import proportion of 105.2%. This means that although Nigeria imports much more DDS in absolute value, digitally intensive services constitute a relatively stronger share of its export basket than its import basket.

When compared with its peers, Nigeria ranks behind South Africa and Morocco in DDS export performance. Morocco's DDS exports (US$6.9 billion) and that of South Africa (US$8.4 billion) significantly exceed Nigeria's figure, reflecting stronger outsourcing industries, better digital skills, and more mature ICT service sectors. Kenya's export share (32.6%) is similar to Nigeria's, but Kenya maintains a smaller deficit due to lower imports. Overall, the table suggests that Nigeria's DDS sector shows pockets of competitiveness, driven by fintech and telecommunications services. However, the large import bill reveals structural weaknesses in high-end digital capabilities, and advanced IT services. To strengthen Nigeria's digital trade position, policies should

focus on improving digital skills, enhancing broadband reliability, and promoting the export of tech-enabled services.

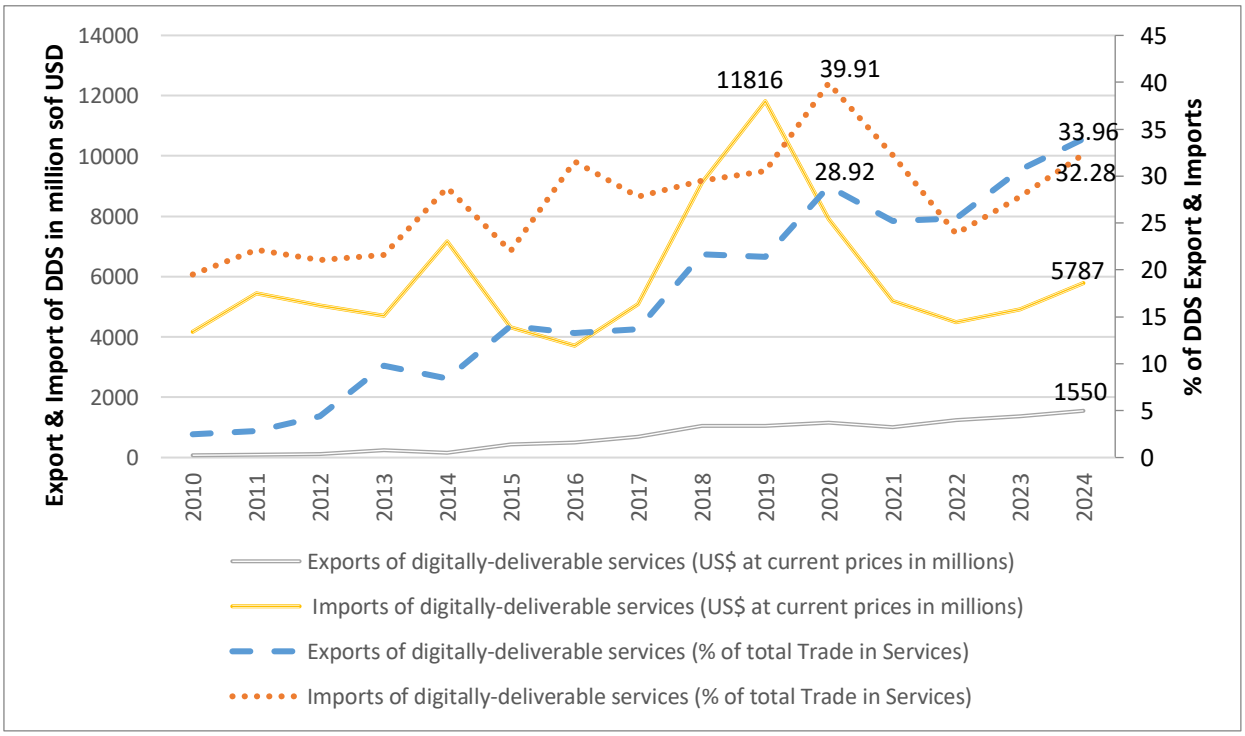
Table 7: Digitally-deliverable services

Description	Digitally-deliverable services (US$ at current prices in millions)			Digitally-deliverable services (% of total trade in Services)		
	Export	Import	Export as a proportion of Import	Export	Import	Export as a proportion of imports
Nigeria	1550	5787	373	33.96	32.28	105.20
Algeria	1084	2588	239	22.54	28.47	79.17
Egypt	4311	8792	204	14.59	31.98	45.62
South Africa	8435	10540	125	52.92	53.3	99.29
Kenya	1804	2196	122	32.62	44.61	73.12
Morocco	6923	3245	47	24.97	22.32	111.87

Source: Authors' computation of data from World Bank (2025a)

Figure 14 provides a detailed breakdown of Nigeria's DDS profile from 2010 to 2024, showing that DDS imports have been highly volatile, with the highest levels occurring between 2019 and 2020 (coinciding with the COVID-19 pandemic). Meanwhile the exports of DDS show a steady increase during the period. There is a need to boost the growth of exports in DDS in Nigeria to reduce vulnerability to shocks associated with higher imports, as is the case with the COVID-19 pandemic.

Figure 14: Digitally-deliverable services in Nigeria (2010-2024)



Source: Authors computation of data from World Bank (2025a)

Table 8 compares ICT goods and services trade across selected African countries. Nigeria performs very poorly in ICT goods exports, with only 0.1% of its total goods exports attributable to ICT goods, significantly lower than Egypt (2.9%), Morocco (2.1%), South Africa (0.7%), and Kenya (0.3%). This portrays Nigeria's heavy dependence on ICT imports and limited domestic manufacturing capacity. The proportion of ICT exports to imports is equally the lowest (3.6%), indicating structural dependence on external suppliers for hardware and ICT components. However, Nigeria shows a slightly stronger position in ICT service exports (4.2%), relative to the ICT goods export, though it remains weaker than Kenya (18.1%) or Morocco (12.7%). This suggests that Nigeria's ICT competitiveness lies more in services, fintech, software development, and support services, than in goods. The weak goods performance reflects infrastructure constraints, limited industrial capacity, and an import-dependent ICT sector. To strengthen ICT trade, Nigeria should invest in local assembly plants, promote software exports, and enhance trade facilitation for ICT-intensive industries.

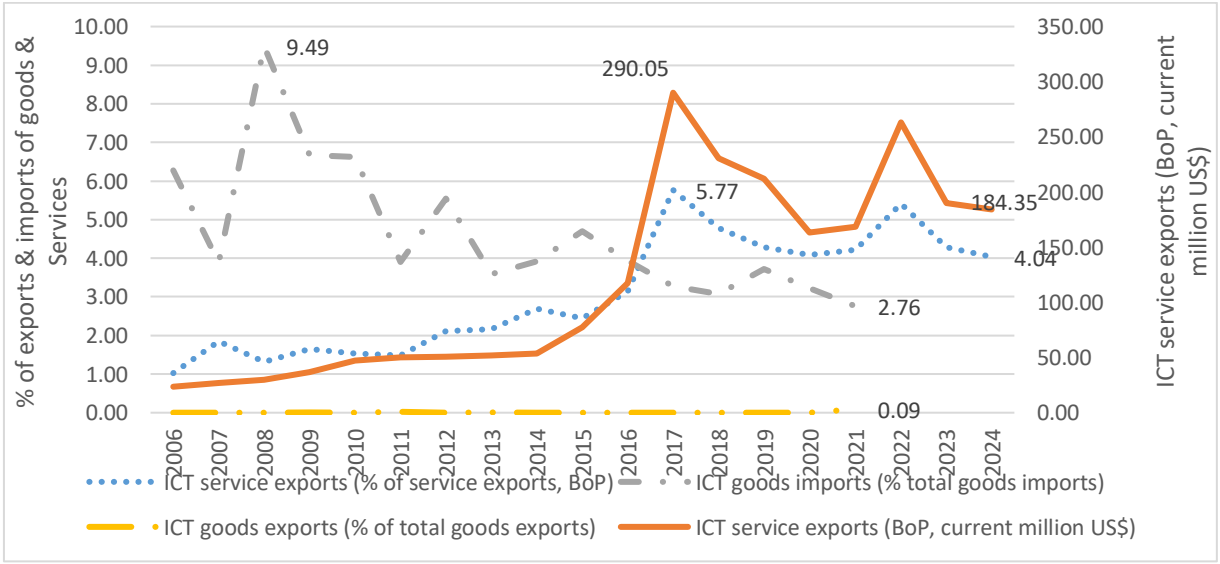
Table 8: International Trade on ICT goods and services in 2021

Description	ICT goods exports (% of total goods exports)	ICT goods imports (% total goods imports)	Proportion of ICT goods export to goods imports	ICT service exports (% of service exports, BoP)
Egypt	2.9	4.8	60.4	6.4
Morocco	2.1	4.1	51.2	12.7
South Africa	0.7	7.9	8.9	8.9
Kenya	0.3	3.6	8.3	18.1
Nigeria	0.1	2.8	3.6	4.2

Source: Authors' computation of data from World Bank (2025a)

Similar to the trade in DDS, Figure 15 shows that imports of ICT services are volatile, with a peak in 2009, which corresponds to the 2009 Global Financial Crisis. Interestingly, ICT service export is also volatile, especially between 2016 and 2024, with the peak in 2017. Though ICT service exports have been oscillatory, they generally grew from their 2006 figures, unlike the ICT goods export that has been relatively stagnant for the full period between 2006 and 2024.

Figure 15: International Trade in ICT services and goods (2006-2024)



Source: Authors' computation of data from World Bank (2025a)

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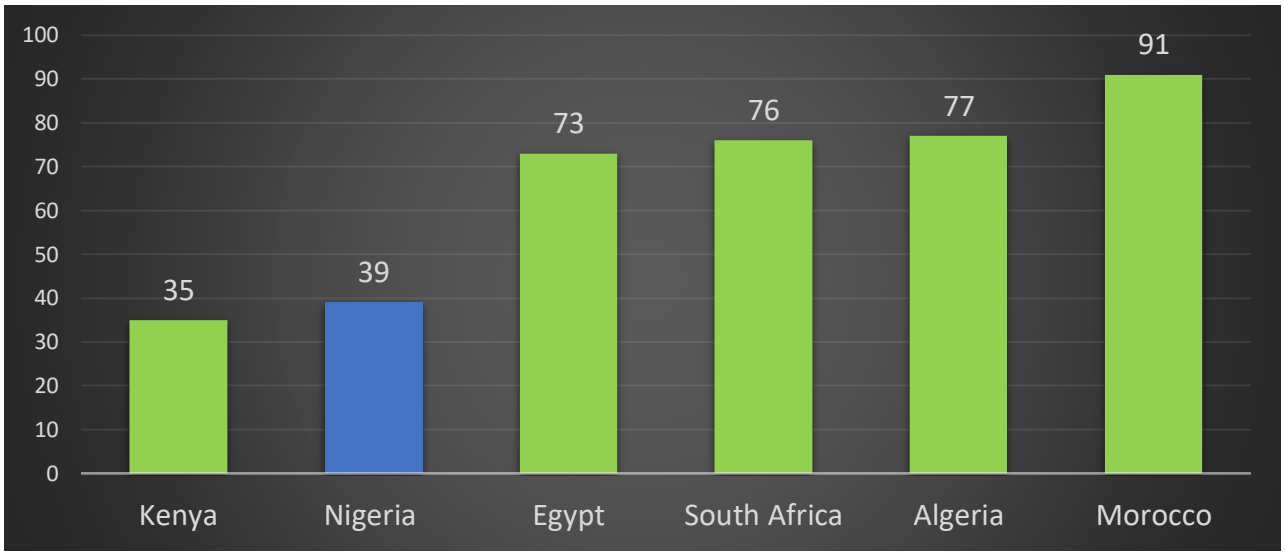
Figure 16 shows that Nigeria's internet usage rate lags regional averages. This is not surprising given Nigeria's relatively lower mobile cellular subscriptions compared to its peers. Given that internet access is a foundational requirement for e-commerce, AI adoption, and participation in digital trade, Nigeria's relatively low connectivity poses a major challenge. The low internet use could be associated with factors such as poor internet connectivity (Radio Nigeria, 2025), technological infrastructure, affordability, digital skills, and literacy (Host Africa, 2025). Improving access requires policy interventions such as lowering data taxes, expanding fibre infrastructure and improving digital skills literacy.

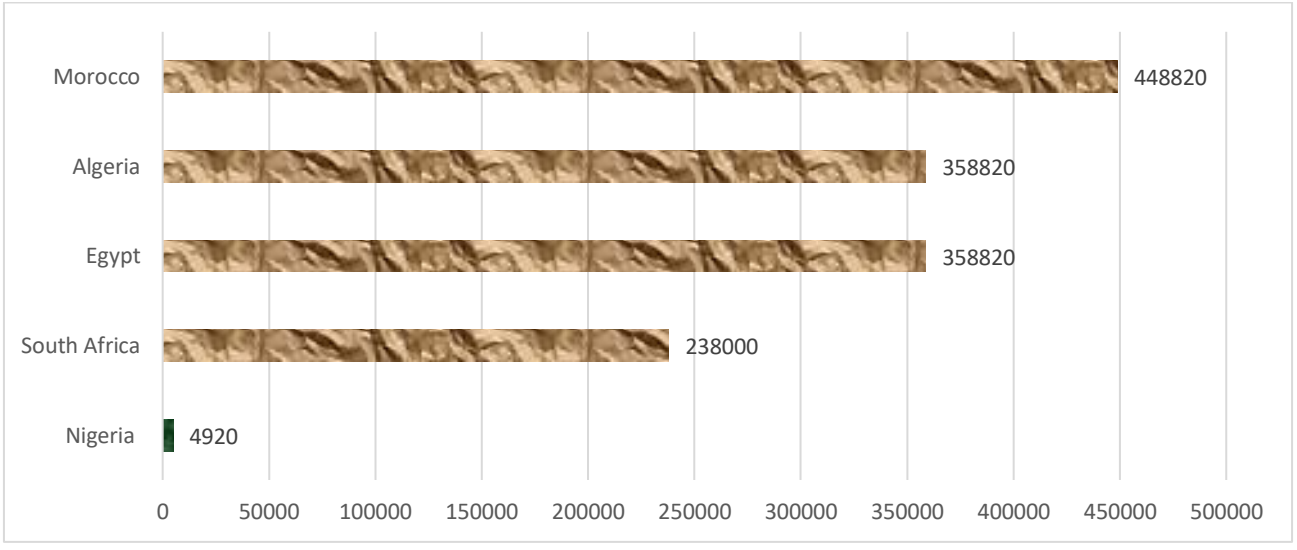
Figure 16: Individuals using the Internet (% of population) in 2023



Source: Authors' computation of data from World Bank (2025a)

Due to the poor internet usage in Nigeria and the reference to poor technological infrastructure, it is important to analyse ICT investment in Nigeria. Figure 17 shows Nigeria as one of the top recipients of ICT investment in Sub-Saharan Africa. While this indicates strong private-sector confidence, the earlier indicators show that this investment has not yet translated into proportional improvements in digital outcomes such as broadband quality, innovation capacity, or AI readiness. This suggests inefficiencies in investment allocation. Strengthening governance and improving the transparency and accountability in ICT investments could enhance the impact of digital investment.

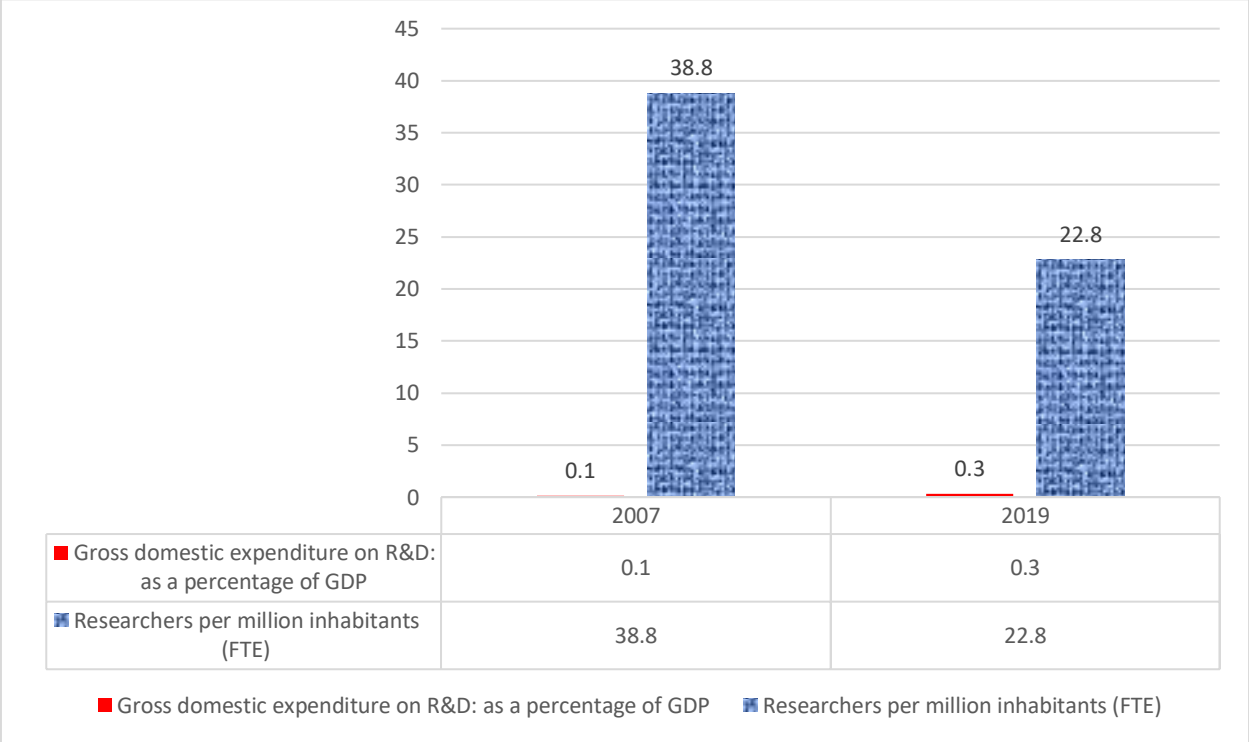
Figure 17: Investment in ICT with private participation (current US$) - Sub-Saharan Africa in 2023



Source: Authors' computation of data from World Bank (2025a)

Similar to examining the ICT investment in Nigeria, Figure 18 illustrates Gross Domestic Expenditure on R& D (GERD) and the number of researchers in Nigeria. The figure highlights Nigeria's chronic underinvestment in R&D. Nigeria's GERD (% of GDP) is substantially below South Africa and Egypt (from 0.4 in 2010 to 1 in 2022) . Likewise, the researcher density (FTE per million inhabitants) is lower, highlighting weak human capital capacity for innovation. While South Africa (from 354.7 in 2005 to 472.7 in 2020) and Egypt (from 472 in 2010 to 841.4 in 2022) have improved their research ecosystems over time, Nigeria's progress has been slow. These weaknesses undermine Nigeria's ability to develop AI solutions, innovate domestically, and compete internationally in digital services. It also supports the view for the need to improve digital skills literacy in Nigeria, hence the need to increase funding for R&D, stronger linkages between universities and industry, and incentives for private-sector R&D investment.

Figure 18: Gross Domestic Expenditure and Researchers in Nigeria



Source: Authors' computation of data from UNESCO Institute for Statistics, (2025).

Nigeria stands at a pivotal moment in its digital transformation journey. While the country has a dynamic private sector, strong entrepreneurial culture, and growing digital services industry, the combined evidence from the tables and figures shows that structural constraints continue to limit its competitiveness in AI, e-commerce, and digital trade. Across nearly all indicators, digital infrastructure, internet usage, innovation capacity, research intensity, ICT goods exports, and globally competitive digital services, Nigeria falls below global benchmarks and lags behind regional leaders such as South Africa, Egypt, Kenya, and Morocco. A recurring theme is that Nigeria's digital progress is driven more by private initiative than coordinated national strategy. Investment levels are relatively high, yet outcomes are weak, suggesting a need for regulatory reform and more strategic public investment. Nigeria's digital ecosystem also suffers from low R&D expenditure, limited AI research output, and persistent gaps in connectivity and digital skills, all of which hinder its ability to build and export high-value digital products. Nevertheless, the figures also show areas of opportunity in terms of Nigeria's growing mobile money ecosystem, expanding digital financial inclusion, and improving digitally deliverable services exports point toward strong underlying demand and market potential. By investing in broadband infrastructure, developing AI talent, strengthening research institutions, and improving policy coherence, Nigeria can position itself as a leading digital economy in Africa and a competitive player in global digital trade.

Examination of the Policy Framework

Review of Global policies on AI, Digital Trade and e-commerce

The emergence of Artificial Intelligence (AI) and the popularity of digital trade and e-commerce are increasing, generating important discourse across the globe, including the regulatory policies guiding their operations. Therefore, while the popularity of AI, digital trade, and e-commerce resonates, there has also been increased focus in the global landscape of legislation, frameworks, policies, regulations, and principles to build moral integration, trust and accountability that guide their operations (Goldfarb & Trefler, 2018).

The Organisation for Economic Co-operation and Development (OECD) is popular in its support towards global policies on AI through the development of a set of Principles known as the OECD Principles on AI. Adopted in 2019 and signed by governments, the Principles aim at popularising AI that is innovative, trustworthy, and respects human rights and democratic values (Ferencz, González & García, 2022). The Principle provides a supportive guide in the areas of privacy, digital security risk management and responsible business and trade conduct. In 2020, the OECD launched the OECD AI Policy Observatory, a platform for sharing and shaping AI policies, including an online database of AI policies. The observatory, therefore, provides practical guidance and shared procedural means to aid actors and policymakers in implementing effective, efficient, and fair policies for trustworthy AI.

More so, the European Union has been active with series of policy measures to support the use of trustworthy AI across the globe, especially with the adoption of EU AI Act (AIA) in 2024 which happens to be the first comprehensive horizontal global legal basis on AI. The legal basis broadly aims at ensuring that AI system are safe and operate according to extant laws on fundamental rights, norms and values within the EU. The AIA employs a risk-based approach to regulating AI systems, which classifies AI according to the potential risks it poses to human health, fundamental rights, and safety, in order to apply appropriate rules based on the risk level. The AIA Act divides AI related risks into four groups, namely, minimal risk, limited risk, high risk, and unacceptable risk (Chamberlain, 2023). Risk-based approach to regulating AI tries to prohibit potential unacceptable AI risk, mitigate potential severe ones, while allowing those with lower potential risk to operate with minimal regulatory constraint.

Global policies on digital trade and e-commerce focus largely on regulating operations of cross-border data flows, data localization requirements, as well as initiating standards for mitigate data privacy, customer protection and cyber threat. The enabling policies therefore include policy measures that enhance competition in digital trade and commerce and stipulate legal frameworks for digital transactions, and promote consumer trust in digital trade. The Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) and the Digital Economy Partnership Agreement (DEPA), which stipulate cross-border e-commerce, guarantee data flow protections, as well as facilitate regulatory healthy transaction relationship among countries are part of new trade agreements that create enabling policies (Ferracane, Ugarte & Rogaler, 2025). In 2024 The World Trade Organization (WTO) has also demonstrated commitments towards advancing digital trade and e-commerce advancing rules that govern digital trade and e-commerce (DiCaprio, 2024). DiCaprio, (2024) further posit that it establishes a comprehensive and robust approach to enabling a set of global rules aim at supporting all member countries in leveraging opportunities of the digital economy. It equally outlines three steps countries could take to facilitate digital and e-commerce trade, namely: 1) countries should design an agreement on data trade that sets clear guidelines for data exchange across borders; 2) countries should put up a governance structure for digital and e-commerce trade that keeps rules updated; and 3) countries should establish a community of practice that consolidate existing digital and e-commerce trade and e-commerce efforts.

Review of Regional policies on AI, Digital Trade and e-commerce

Regionally, several policy efforts have been made to optimize the opportunities presented by the increasing popularity of AI, Digital trade and e-commerce. In Africa, the African Commission on Human and Peoples' Rights (ACHPR) adopted in 2021 initiated Resolution 473 on AI, robotics, as well as other new technological innovation. The initiatives ensure that countries in the African Union (AU) adopt and use technological innovations that are compatible with the rights as stipulated in the African Charter. The initiatives caution

countries in AU on the need to maintain human control over AI, adding that the requirement should be codified as a principle of human rights in the region (Union, 2024). The 2024 AU Data Policy Framework (DPF) provides a blueprint that regulate the efforts of countries in Africa towards establishing effective data governance systems, as well as harnessing data for technological innovation and development. The Digital Transformation Strategy for Africa 2020-2030 promotes entry into force the African Union Convention on cyber Security and Personal Data Protection by 2020 for its member countries to adopt a comprehensive set of legislation that covers e-commerce, personal data protection and privacy, consumer protection, and cybercrime (Union, 2020).

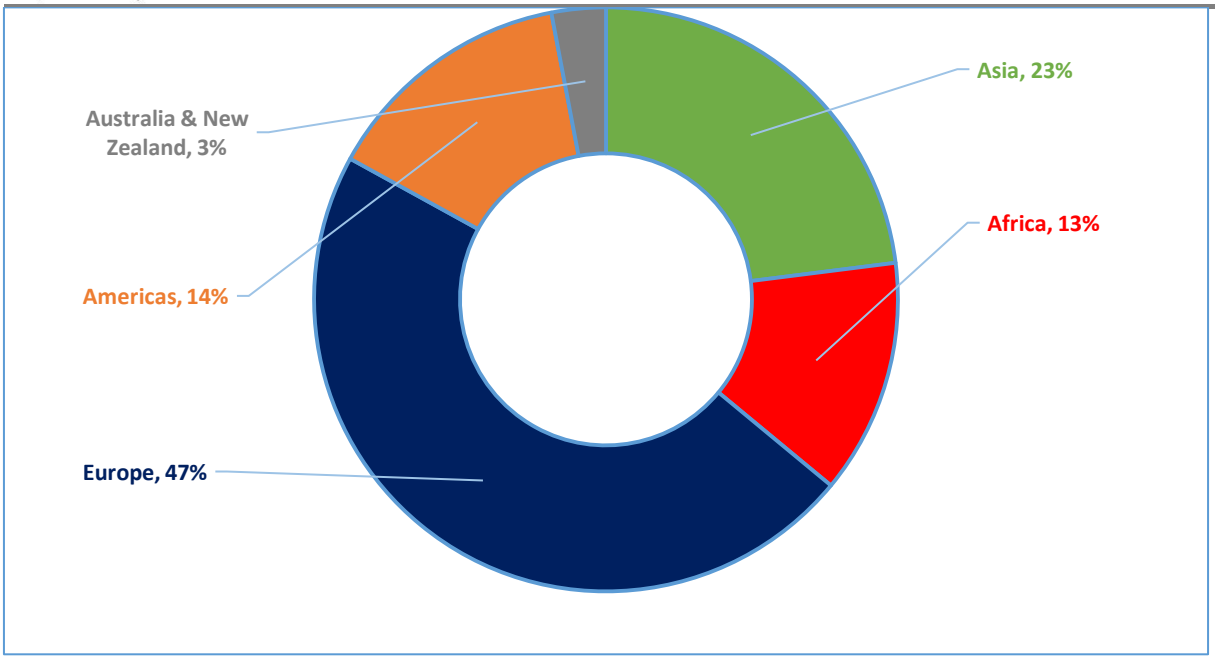
The Economic Community of West African States (ECOWAS) E-commerce Strategy 2023-2027 was designed to guide e-commerce and digital trade development and integration in the region. The core policy areas of the regional strategy dwells on four important areas, namely: strengthening of institutions to promote cross-border e-commerce and digital trade, as well as aligning policies to enhance e-commerce and digital trade activities in the region; securing trust through measures such as cybercrime initiatives and consumer protection in order to build confidence in the operation of e-commerce and digital trade in the ECOWAS region; e-commerce and digital trade intelligence that promotes e-commerce and digital trade data availability and accessibility to aid decision making in the region; and inclusion which ensure that inclusiveness (micro, small and medium enterprises (MSMEs), youths, women, etc.) in the benefits of e-commerce and digital trade. The ECOWAS Supplementary Action Data Protection is a regional framework initiated to enable a harmonized legal environment for the protection of personal data within the ECOWAS region. The Act ensures that countries in ECOWAS sub-region establish a local legal framework, as well as independent local data protection authority to implement the provisions of the Act (Act, 1-1, 2010).

Other regions have also made frantic efforts initiating policies that guide the operation of AI, and leveraging its potentials both for digital trade and e-commerce. The Asian's G7 Hiroshima AI Process initiated in 2024 serves a one of the comprehensive efforts towards guiding safe and responsible AI operation in the region. The G7 Hiroshima Principles provide ethical blueprint for generative AI that include digital rights and privacy issues, cross-border AI risk and data governance. The Digital Policy Alert (DPA) indicates that the region of Asia has been experiencing impressive improvement in the adoption of different kinds of policies that shape digital trade and e-commerce, particularly in China, Australia, the Republic of Korea and India. Following this, several countries have equally adopted positive regulations, including dispute settlement mechanisms to address disputes in cross-border digital trade and e-commerce, online tax registration, and to promote data transfer to countries with similar data protection regimes (Suominen, 2023).

The EU's regional policies make provision for digital trade and e-commerce that large dwell on a one market approach via regulations such as the Digital Services Act (DSA) and Digital Markets Act (DMA). These regional regulatory provisions enhance healthy competition and content moderation. On the other hand, the EU's E-commerce Directive enshrines fundamental rules for digital transactions, whereas initiatives such as Data Act and the General Data Protection Regulation (GDPR) regulate the activities of data flow and the privacy of users (Monteleone, 2025). On the other hand, the EU AI Act makes provisions for enabling regional policies that guarantee adequate adoption of ethics that guide AI in the public sector, and also stipulate guideline on responsible use and enhanced data accessibility.

The OECD Database on AI policies however shades light on the degree of AI policy initiatives according to regions in 2024.

Figure 19: Share of AI Policy Initiatives by Region (2024)



Source: Authors' computation of data from OECD (2025)

Figure 19 show that as at 2024, most of AI policy initiatives are largely concentrated in the region of Europe (47%). This is followed by Asian region (23%), and then the Americas (14%), the region of Africa recorded 13%, while Australia & New Zealand has the lowest share (3%). The statistics as shown in Figure 19 indicates further that while on one hand there has been regional policy efforts towards guiding the operation and activities of AI, on the other hand there has a growing AI policy initiatives divide across the regions.

Review policy evolution and institutional/policy architecture in Nigeria on AI, Digital Trade and e-commerce

Like many other countries, Nigeria has shown commitment in establishing legal frameworks and policies that mitigate threats associated with AI and digital transactions, while leveraging their transformative capacities. Prior to the 2024 Nigeria National AI Strategy (NAIS), the country operated unregulated and non-specific legal framework for AI activities (Salihu, 2024). The country therefore leveraged regulatory provisions that focused largely on technology laws which includes:

1) Nigeria established Cybercrimes Acts (2015) and Cybersecurity Policy (2021). The legal provisions aim at mitigating potential cybercrimes, as well as the institutional framework for addressing them which includes prevention, detection, investigation, and prosecution but do not contain specific policy regulations for AI. However, none of the legal provisions made specific regulations for AI.

2) The Federal Competition and Consumer Protection Act (FCCPA, 2018) which makes provision and guidelines that promote regulation of digital market competition that discourages monopolistic practices in the country.

3) The Nigeria Data Protection Act (NDPA, 2023) which does not make specific provisions for AI regulation or moderation but stipulates guiding principles for managing personal data.

The legal provisions though helpful, failed to explicitly regulate AI associated risk. The legal lacuna motivated the country's Federal Ministry of Communications, Innovation, and Digital Economy (FMCIDE) to launch AI national policy strategy termed "National AI Strategy (NAIS) in 2024. The strategy articulates the guiding framework for harnessing the potential of AI through responsible, ethical, and inclusive innovation. The Nigeria's National AI strategy is guided by a policy framework that promotes principles of fairness, transparency, accountability, and privacy. Its major ethical principles include: ethical and inclusive AI which prioritizes the use of AI that is ethical, fair, inclusive, and benefits the entire citizens; human-center transition

which focuses on mitigating possible disruptions associated with the use of AI; data ethics and agency which lays emphasis on data privacy, consent, as well as fairness in data collection and usage. While the NAIS (2024) remains a right step in the right direction towards providing a comprehensive regulatory strategy for AI, the strategy has however remained at the draft stage.

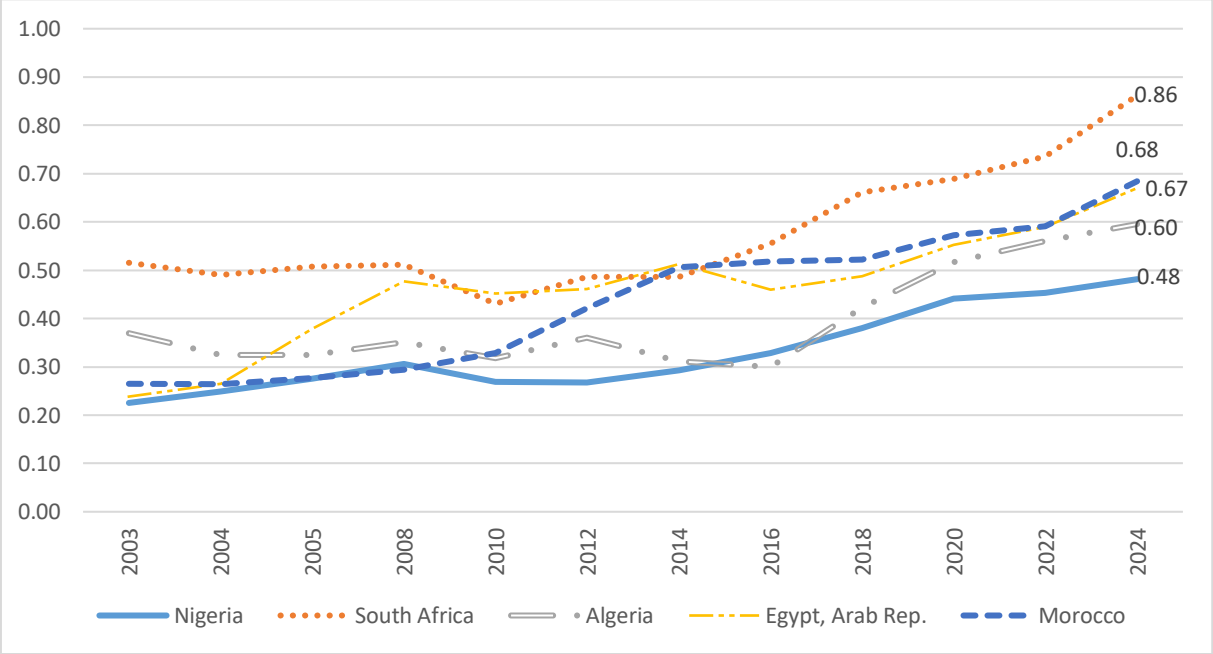
Also, Nigeria's National AI Strategy (NAIS) does not reflect regulation around AI authorship which is increasingly being debated. The country's Copyright Act (2022) was developed for AI, and defined AI authorship as human, thereby leaving a legal lacuna regarding who claims ownership of AI-generated works. Countries such as United Kingdom, Ireland, Hong Kong, India, and New Zealand have legal provisions that clarify ownership of computer generated works.

The Nigeria's Finance Act (2023) serves as a major regulatory milestone towards a more coordinated e-commerce and digital trade activities. The Act makes provisions that mandate both domestic and international digital businesses including digital trade and e-commerce to comply with Nigeria's tax laws, makes provisions for taxing non-resident companies and firms that offer digital services, as well as creating enabling ground for domestic businesses.

The Nigeria's National Digital Economy Policy and Strategy (NDEPS) 2020-2030 is a digital policy tool that projects a more strategic approach for digital trade and e-commerce. The regulatory policies structured around the implementation of NDESP, 2020-2030 includes: the Nigeria Data Protection Act (NDPA) 2023 and the Cybercrimes Act (2015) earlier discussed; the National Broadband Plan (2020-2025) that aims at enhancing the broadband penetration in the country; the National Digital Literacy Framework that focuses on building a digitally literate country; the National Block-chain Policy aims at catalysing talent development in the country; the National Digital Economy and E-Governance Act (2024) which promote paperless governance, e-commerce consumer protection, as well as seamless data sharing in government services; and the National Information Technology Development Agency (NITDA) that stipulate guidelines and standard for cloud computing and IT domestic content development.

While Nigeria has made efforts in driving it digital services available data indicate that the country compare relative low in terms of E-governance Development Index.

Figure 20: E-Government Development Index (EGDI)



Source: Authors' computation of data from Authors' computation of data from United Nations Department of Economic and Social Affairs (2025).

From Figure 20, while all the selected countries maintained an upward trend on the average over the periods (2003-2024), Nigeria remained the lowest compared with other countries in almost all the periods. Specifically, in 2024, Nigeria recorded the lowest score (0.48) as against countries like South Africa and Morocco that recorded as high as 0.86 and 0.68 respectively. This implies that Nigeria is still saddle with relatively poor online public services and weak telecommunications infrastructure for digital technology.

Strengths and Limitations of the policies and comparison with best practices

Given the rising popularity of AI, digital trade and e-commerce alongside the associated risks of unregulated digital activities, Nigeria has made efforts towards strengthening its regulatory frameworks. Even though the country's National AI Strategy (NAIS) established in 2024 has remains at the draft stage, however it is a good efforts to achieving responsible AI, promoting data privacy, addressing ethical issues, and enhancing inclusive innovation. On the other hand, the Nigeria's National Digital Economy Policy and Strategy (NDEPS) 2020-2030 and the Cybersecurity Policy (2021) were initiated to safeguard digital infrastructure, mitigate digital transactions risks, as well as enhance trust on digital trade and e-commerce through their regulatory provisions.

While the policy measures are obvious, there still remain some limitations associated with the country's policies on AI, digital trade and e-commerce as discussed below:

1) Nigeria still lack dedicated AI regulatory law. The National AI Strategy (NAIS) drafted in 2024 is still at the draft stage. The draft stage implies that the framework is still at the review stage, and as such lack full legal implementation backing. This is unlike the United States, China, among others that have dedicated and well-structured AI regulatory policies. The EU AI Act (2021) which structured AI systems based on risk levels- minimal, high, and unacceptable risk serves as a typical example of a well-structured AI law.

2) AI has continued to grow in complexity especially in the areas of algorithmic bias, generative AI, as well as advanced data processing issues. Nigeria's ICT environment has not developed fully to effectively address these AI associated complexities, and the draft National AI Strategy failed to clearly stipulate how they are to be addressed.

3) Lack of clarity on AI authorship. Nigeria's copyright law traditionally recognizes human author. But there has been a rising debate about who should claim the original ownership of a work generated by AI system. This debate has been on before the National AI Strategy (NAIS) was drafted in 2024, and the national strategy failed to clearly address it.

4) Lack of effective enforcement and cross-border transaction dispute resolution mechanism. Though, Nigeria has existing Cybercrimes Acts (Cybercrimes Acts, 2015 and Cybersecurity Policy, 2021), enforcement of digital transaction issues especially resolution of cross-border transactions are quite challenge largely as a result of huge legal costs implications.

5) Lack of complete trust on digital platforms. Despite the existing Data Protection Act which aims at reposing confidence on the use of digital platforms, as well as enhance digital transactions, many people are still sceptical about sharing their financial information online. This poses a major constraint to digital trade and e-commerce activity in the country.

POLICY RECOMMENDATIONS AND CONCLUSION

Policy recommendations focus on addressing the identified limitations associated with Nigeria's policies on AI, digital trade and e-commerce. To this effect, the following policy recommendations were made:

i) As far as the Nigeria's National AI Strategy (NAIS) remains a draft it remains a proposal or a working document that lack the force of law. As such, Nigeria should expedite efforts towards formalizing and approving the national strategy on AI to enable it have legal implementation backing. This can be achieved through the relevant institutions which includes the Federal Ministry of Communications,

Innovation, and Digital Economy (FMCIDE), the senate, led by the relevant senate committees on ICT, Science and Technology or Communication.

ii) The Nigerian policymakers should channel policy efforts towards curbing AI complexities. This can be achieved by creating robust rules that promote algorithmic transparency and effectively regulate generative AI in the country. The policy efforts should be complemented with collaborating with foreign organizations that promote generative AI for relevant assistance.

iii) The growing popularity of AI generative system will continue to promote the debate around AI authorship. Therefore, there is need to clarify the AI authorship using appropriate policy measure. Since the country's National AI Strategy (NAIS) is still at the proposal (draft) stage, Nigerian lawmakers should take advantage of the stage and revise the draft strategy to clarify the AI authorship.

iv) The Nigerian government through it law enforcement agencies should demonstrate political commitment towards effective implementation of cybersecurity crimes especially on digital trade or cross-border transaction. This should be complemented with sanctions for non-compliance.

v) Policy interventions should be channelled towards reposing adequate confidence on the use of digital platform to enhance digital transactions. This will entail combination of policy interventions that includes strengthening digital platforms security measures and promotes digital literacy skills, especially at the rural parts of the country.

CONCLUSION

Nigeria stands at a crucial turning point in its journey toward digital transformation. The findings of this report show that although the country has a dynamic private sector, rising digital adoption, and growing interest in AI and digital trade, its progress is slowed by structural barriers that cannot be ignored. Weak digital infrastructure, uneven internet penetration, a fragile innovation ecosystem, and limited R&D funding continue to constrain Nigeria's ability to compete globally. In addition, low digital literacy, high data costs, and lingering distrust of online platforms limit the participation of millions of Nigerians in digital economic activities.

While Nigeria has taken important steps by introducing digital policies and regulatory frameworks, these instruments need stronger implementation. The draft National AI Strategy is a promising framework, but its lack of legal force means Nigeria does not yet have a clear, enforceable system for managing AI risks, ensuring transparency, and addressing ethical considerations. The absence of explicit provisions on AI authorship also leaves unanswered important legal and economic questions, especially as AI-generated content becomes more common.

The data presented in the report makes one thing clear: Nigeria's digital progress is being driven more by private innovation than by coordinated national policy. This imbalance limits the reach and inclusiveness of digital transformation. For Nigeria to become a regional leader in AI, digital trade, and e-commerce, government institutions must work more collaboratively, invest more strategically, and regulate more confidently. Strengthening research capacity, expanding broadband infrastructure, and supporting digital skills development must become national priorities.

At the same time, Nigeria must take deliberate steps to rebuild trust in digital platforms. Many Nigerians still hesitate to engage in online transactions due to cybersecurity concerns, privacy fears, and experiences with fraud. Addressing these issues will require not just better laws, but visible enforcement, consumer education, and stronger accountability for digital service providers.

Despite the challenges, Nigeria's potential remains enormous. The country is home to a youthful population eager to embrace technology, a flourishing fintech ecosystem, and a growing number of digital entrepreneurs. By aligning investments, regulations, and institutional efforts, Nigeria can convert this potential into meaningful economic transformation.

Ultimately, Nigeria's ability to thrive in the digital age will depend on how effectively it mobilizes political will, strengthens institutions, and builds public trust. The recommendations provided in this report offer a realistic and actionable path forward. If implemented with commitment and consistency, Nigeria can position itself as a competitive digital economy, expand its share of global digital trade, and ensure that the benefits of technological advancement are widely shared across its society.

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