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DEVELOPMENT AND GOVERNANCE IMPACTS OF DIGITAL PUBLIC INFRASTRUCTURE IN ETHIOPIA (DPI ETHIOPIA)

Degye Goshu & Mezid Nasir

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DEVELOPMENT AND GOVERNANCE IMPACTS OF DIGITAL PUBLIC INFRASTRUCTURE IN ETHIOPIA (DPI ETHIOPIA)

Degye Goshu
(BSc, MSc, PhD)
Director, Research and Policy Analysis
Ethiopian Economics Association (EEA)
degyeabgos@gmail.com

Mezid Nasir
(PhD)
Senior Researcher
Ethiopian Economics Association (EEA)
mezid2013@gmail.com

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Executive Summary

Digital Public Infrastructure (DPI) is the foundation for digital transformation of economies. The goal of digital transformation in government is to create a more transparent, efficient, and responsive public sector that meets the evolving needs of citizens. Ethiopian government has developed legal and regulatory frameworks and launched several initiatives over the last decade to enhance DPI and digitalization. Accordingly, the strategy for digitalization was launched in July 2020 with four cross-sectoral areas: infrastructure, supporting systems, digital interaction, and digital ecosystem.

This pilot study project is primarily aimed to achieve the three specific objectives: (1) highlight the mechanisms through which DPI could contribute to socio-economic development; (2) identify the socio-economic impact of DPI on disadvantaged and underserved communities; and (3) highlight the potential of DPI to improve governance and public service delivery. This report investigated the state and challenges of DPI in Ethiopia and highlighted the impact of DPI on development and governance using cross-country panel dataset to compare Ethiopia's relative position.

The study used both primary and secondary data. Primary data were collected through key informant interviews (KIIs) with selected institutions more involved in digitalization. Primary data on policy insights and digital initiatives related to the National ID program, Integrated Tax Administration System (ITAS), E-procurement, and Digital Education were collected. To understand the state of digitalization, the associated challenges, and policy insights in Ethiopia, in-depth interviews were conducted with 12 key informants from different digital institutions.

Cross-country secondary data were also collected from national and global official sources to identify the impacts of DPI on development and governance in Ethiopia and beyond. Three DPI indicators were selected to measure their parametric and nonparametric links with development and governance. The indicators of DPI and digitalization used in the study are E-Government Development Index (EGDI) Inclusive Internet Index (3I), and Information and Communication Technology (ICT).

Development was measured by GDP per capita (constant int.$, log), (as a measure of economic progress), Human Development Index (HDI) (as a measure of social progress), and structural change (as a measure of economic transformation arising from the movement of labor and other

productive assets from low productivity sectors to high productivity sectors). On the other hand, overall governance was measured by Worldwide governance Indicators (WGI), Corruption Perception Index (CPI), and Public Service Index (PSI).

Both parametric and nonparametric methods of data analysis were employed. Time series plots and correlation analysis were employed to investigate the dynamic relationship between DPI and socioeconomic progress and governance. Linear panel data models were employed to estimate the spatiotemporal effects of DPI on development and governance.

Ethiopia plans to deliver 1,000 e-government services by 2030, following a systematic and targeted strategy. Currently, around 325 e-government services are available online. However, the key concerns include institutions' ability to implement digital services, infrastructure readiness, institutional preparedness, and the availability of qualified human resource. A Comprehensive effort has been launched to enhance digital skills and literacy, aiming to reach 10 million individuals by 2025. However, Ethiopia's digital literacy confronts with serious challenges related to poor infrastructure, shortage of power, and insufficient digital equipment. By mid-March 2025, a total of 12.7 million National ID registrations were completed, of which 9.4 million (73.6%) were authenticated. This is only 15.5% of the adult population (81.7 million) estimated for 2024. A total of 52 institutions have been integrated, and around 342+ services were offered online. For successful implementation of the National ID program, challenges related to security of the system, general digital literacy of the society, coordination among actors, resistance to digitalization, fees charged to get digital ID, and the other digital divide need to be addressed.

Over the last two and half decades, development of digital infrastructure in Ethiopia has shown substantial progress. However, there is substantial disparity in e-government and e-participation among countries. Ethiopia, with an e-government index of 28.7%, and very low e-participation (19.3%) is among the bottom countries with very low digitalization. Ethiopia was ranked 92nd in inclusiveness with inclusive internet index (3I) of 48.2%. Ethiopia’s relative position in inclusive digital finance is also very low, though significant improvements are observed in recent years. Only 19.7% of the adult population makes/receives digital payments. Gender gap in digital finance is very high where only 15.4% female and 24.3% of male made/received digital payments, indicating a digital finance gap of 8.9%. Only 3.9% of adult women in Ethiopia use mobile phone or the internet to

send money, which is substantially lower than their counterparts in Kenya (66.6%), SSA average (27.9%), and the world average (31.7%).

Both the parametric and nonparametric results are found to be consistent. The parametric results clearly show that the impacts of DPI on development and governance are very strong. Digitization strongly and significantly enhances socioeconomic progress and accelerates structural change around the world. Similarly, digitalization substantially improves governance and public serviced delivery and helps reduce corruption across countries. However, unlike the global trend, digitalization in Ethiopia is not effectively utilized to enhance development and good governance. Despite the substantial progress in DPI and digitalization, socioeconomic progress and structural change in Ethiopia are deteriorating since 2017. The negative association between development and governance and digitalization in Ethiopia is mainly associated with the widespread domestic conflicts adversely affecting DPI and digitalization, eventually leading to loss of welfare and prevalence of poor governance. The results generally imply that Ethiopia requires huge additional investment on inclusive DPI and digitalization across regional states, ensure peace and security to enhancing socioeconomic progress by improving governance.

1. Introduction

1.1. Background

Digital public infrastructure (DPI) is the foundation for digital transformation of economies. The goal of digital transformation in government is to create a more transparent, efficient, and responsive public sector that meets the evolving needs of citizens. To ensure digital transformation in Africa, the African Union (AU) identifies digital industry, digital trade, financial services, digital governance, digital health, and digital agriculture as the six critical sectors driving digital transformation in the African context (AU, 2020). To establish the digital foundations for digital transformation[1] in Ethiopia, the Ethiopian government has as well developed legal and regulatory frameworks and launched several initiatives over the last decade. Ethiopia's Digital Transformation Strategy launched in July 2020 aims to harness technology to drive economic growth, citizen engagement, and improved quality of life. The strategy highlights four cross-sectoral areas: infrastructure, supporting systems, digital interaction, and digital ecosystem. To implement the strategy that is aligned to the AU digital transformation strategy, the government has launched initiatives to enhance digital foundations intended to realize digital transformation in Ethiopia.

The Ethiopia Digital Identification Proclamation no 1284/2023 provides a legal ground for establishing a technologically developed, cross-sectorial foundational Digital Identification System (DIS) to help effectively plan national development, drive economic transformation, ensure good governance, reduce wastage of resources, eliminate redundancy, and ensure inclusiveness when policies are designed and development plans are executed (FDRE, 2023a).

One of the initiatives undertaken by the Ethiopian government is the project known as Digital Ethiopia 2025[2]. The project is generally intended to improve

[1] The common digital transformation expected includes self-service government e-portals for citizens and businesses, electronic document management, open-data platforms, public safety and emergency response alert systems, predictive analytics, citizen and community engagement platforms, e-learning platforms, e-voting, and free online tax-filing system.

[2] Digital Ethiopia initiative identifies four strategic priority sectors as main coordinating and beneficiary institution): Ethiopian Communication Authority (ECA), Ethiopian Education and Research Network (EthERNet), Portal of Finance (MoF) (Ministry of Revenue, and Portal of Innovation and Technology (MInT).

Ethiopia's competitiveness through inclusive and affordable digital services. It specifically aims to lay the building blocks to develop Ethiopia's digital economy in the policy and regulatory environment, infrastructure, and quality digital services. It is generally aimed to catalyzing socio-economic transformation, paving the way for inclusive and sustainable growth.

Through Digital Ethiopia 2025, the government promises to actively embrace the "fourth industrial revolution" led by technologies such as Artificial Intelligence (AI) and Internet of Things (IoT) (UNIDO, 2023). The project is intended to provide new technologies for young people, take advantage of opportunities for digital prosperity, and invest in research and innovation. To use artificial intelligence of things (AIoT) technologies, the government is expected to employ the strategies and contribute to the achievement of these goals. The project is expected to enable pathways for prosperity for Ethiopia, assess Ethiopia's digital readiness (such as infrastructure, enabling systems, digital interactions among government, private sector, and citizens), and the digital ecosystem (Digital Ethiopia 2025, 2024).

One of the digital initiatives in the Digital Ethiopia 2025 project is Fayda, a national digital ID that is integrated with Ethiopia's tax administration systems. Launched in December 2023, Fayda is expected to bring several benefits to Ethiopia, including better quality of tax data and taxpayer experience, broader tax base, stronger monitoring and law enforcement, and better tax governance and management (ICTD, 2024).

1.2. The Research Problem

Digital transformation strategies aim to drive societal and economic change fostering digital integration, promoting inclusive growth, creating jobs, and reducing poverty. However, digital development in Ethiopia, like in other Sub-Saharan African (SSA) countries, faces significant challenges (World Bank, 2024). Ethiopia is characterized by underdeveloped digital infrastructure, lack of accessible and affordable connectivity, substantial digital gender gap, limited skills for digitally enabled industries, and inadequate regulatory and policy environments.

Building inclusive, resilient, and thriving societies in low- and middle-income countries (LMICs) requires the development and adoption of DPI (UNDP, 2022). Recent literature offers rich evidence on the development impact of adopting DPI. While some studies focused on the broader economic development impact of DPI (Calderon and Cantu, 2021; UNDP,

2023), others specifically targeted the tax revenue gains from the adoption of digital technologies in tax administration (Nose and Mengistu, 2023; Varzaru et al. 2023). Governments must implement responsible and people-centered DPI as their mandatory functions mainly because rights-based and inclusive digital transformation should be embedded across technology, governance, and local digital ecosystems (UNDP, 2023). The UNDP's study on the projected impact of DPI by 2030 across finance, climate, and justice sectors in LMICs highlights significant opportunities and benefits.

The other cross-country study on the potential impact of digital technologies on tax collection and compliance shows capacity of digital technologies could enhance tax collection with varying effects by the type of specific digital service or tools introduced (Nose and Mengistu, 2023).

However, despite the scientific evidence generated so far, the development impact of DPI remains largely an under-researched area. The evidence verifies that the potential impacts of DPI on economic and social progress are multiple, including speeding up economic growth, mitigation of carbon dioxide emissions, and increasing efficiency of judicial services. To realize major development objectives of LMICs like Ethiopia, governments are advised to drive the development of DPI by shaping a local digital ecosystem, implement and scale up DPI by strengthening the capacities and capabilities of the public sector, and promote increased knowledge sharing and technology exchange among countries.

Information communication technology (ICT) enables economic growth by creating access to and expanding new technologies, and new methods of production and service provision (Beardsley, et al. 2010). New technologies and their expansion create growth whereby ICT makes it easier to enhance productivity and generate additional benefits. While DPI expansion in Ethiopia has led to significant improvements, it remains constrained by several challenges.

The development impacts of ICT capacities in Ethiopia were very low before 2010. Following the launch of social media since 2010, DPI capacities and other digital capacities have helped enhance socioeconomic progress in Ethiopia.

Achieving inclusive digital transformation in Ethiopia requires overcoming challenges related to DPI usage, availability, affordability, relevance, and overall digital ecosystem readiness. Digital payment in Ethiopia is very limited, where only 20% of adults make or receive digital payments, which is not comparable to other countries in SSA (World Bank, 2022). Around 80% of the population in Kenya and 50% in SSA make or

receive payments with digital methods. About 82% of Ethiopians use cash payments for utility bills, which calls for the need to move a long distance to reach the regional average. Despite increasing bank account ownership, formal financial inclusion in Ethiopia remains significantly lower than in other SSA countries. Gaps in financial inclusion are also high between rural and urban areas, women and men, and among regional states. It is imperative to conclude that the lack of equitable access to financial services disproportionately impacts women and rural populations in Ethiopia.

As the new member of the BRICS from January 2024, Ethiopia aspires to benefit from the development opportunities arising from this economic bloc. Ethiopia is also required to ensure digital transformation both in the private and public sectors. Compared to Ethiopia, digital transformation of the financial system in other member states of the BRICS is by far better. Ethiopia is required to transform its financial system and create a vibrant digital banking system and financial markets comparable to member states of the BRICS. Assessing the state of DPI and its impacts on development and governance is crucial for Ethiopia's effective engagement in the BRICS.

The relevant evidence on digital transformation generated so far strongly verifies the multidimensional impacts of DPI on development and governance. There are also several dimensions of potential impacts of DPI that need further research in Ethiopia and beyond. Existing research gaps highlight the need to assess DPI's impact on development to better plan, implement, and guide digital transformation.

This study was generally aimed to intended to assess the impacts of digital public infrastructure (DPI) and inclusion on socioeconomic progress and governance in Ethiopia. It is a pilot study aimed to examine the state of digital foundations and transformation, their development and governance impacts, and assess Ethiopia’s relative position from the rest of the world. The pilot study is expected to serve as scoping study for a long-term and wider study.

The pilot study is specifically aimed to address the following research questions:

a. How does DPI contribute to economic growth and social development?
b. What are the socio-economic impacts of DPI on marginalized and underserved communities?
c. How can DPI be leveraged to improve governance and public service delivery?

2. Methodology

2.1. Conceptual Framework of DPI

Definition of digital public infrastructure (DPI) as defined by different institutions slightly differ depending on their areas of focus. For comprehensive understating of DPI and digitalization, the major definitions and descriptions are presented below.

UNDP: DPI is a combination of networked open technology standards built for public interest, enabling governance, and a community of innovative and competitive market players working to drive innovation, especially across public programs (UNDP, 2024). DPI is a shared means to many ends and a critical enabler of digital transformation and helps improve public service delivery at scale. Put differently, DPI is a set of foundational digital systems that forms the backbone of modern societies. DPI enables secure and seamless interactions between people, businesses and governments.

OECD (Organization for Economic Co-operation and Development): DPI is defined as shared digital systems that are secure and interoperable and that can support the inclusive delivery of and access to public and private services across society. Governments play a pivotal role in designing, developing and managing DPI, as well as in leveraging DPI systems to increase efficiency and coherence in the implementation of digital government policies. Key components of DPI include digital identity, payments, data sharing, digital post, and core government data registries. DPI can be of four types: Communication and public service interaction (digital and notifications, single digital gateways), data and information sharing (base registries, data sharing systems), security and trust (such as digital identity and digital payments), and other future DPI (like AI). DPI is enabled by safeguards with measures to protect and secure the DPI systems and data, strategic frameworks of governance structure that guide the development and management of DPI, collaboration between non-governmental entities to enhance DPI, and investment models or financial strategies and funding mechanisms to support DPI initiatives.

SDG Digital: DPI is a digital solution emphasizing people-centered and interoperable digital building blocks at a societal scale, allowing local digital ecosystem players to innovate on top of these blocks, and fostering new services for people.

Bill & Melinda Gates Foundation (BMGF): DPI is like roads, which form a physical network essential for people to connect with each other and access a huge range of goods and services. The elements of DPI form a cohesive digital network that enables countries to safely and efficiently open economic opportunities and deliver social services to its residents.

G7and G20: DPI is a set of shared digital systems that should be secure and interoperable, and can be built on open standards and specifications to deliver and provide equitable access to public and or private services at societal scale and are governed by applicable legal frameworks and enabling rules to drive development, inclusion, innovation, trust, and competition and respect human rights and fundamental freedoms.

Harvard Business Review: DPI is rails on which easy-to-use digital products and services can be built to benefit entire populations. DPI can be understood as an intermediate layer in the digital ecosystem. It sits atop of a physical layer (including connectivity, devices, servers, data centers, routers, etc.), and supports an apps layer (information solutions to different verticals, e-commerce, cash transfers, remote education, telehealth, etc.). DPI acts as a connective platform layer, offering registries for the unique ID of people, payments infrastructure, data exchange, consent networks.

Center for Digital Public Infrastructure: DPI is an approach to solving socio-economic problems at scale, by combining minimalist technology interventions, public-private governance, and vibrant market innovation. Common examples include the Internet, mobile networks, GPS, verifiable identity systems, interoperable payments networks, consented data sharing, open loop discovery and fulfillment networks, digital signatures, and beyond.

DPI is considered public because it is designed to be accessible to everyone and is based on a shared set of governance rules. DPI systems are often open source and can be freely shared, ensuring equal access for citizens, entrepreneurs, and consumers (Bandura, et al., 2023). Like roads or electricity in the physical world, DPI aims to serve everyone and helps unlock a host of services. To achieve the goals, DPI is expected to inclusive, foundational, interoperable (have open standards for anyone to use), and publicly accountable. DPI encompasses a comprehensive system of digital services, tools, and technologies provided by governments, organizations, and other stakeholders to support the functioning of a digital society. It is essentially the infrastructure that underpins the entire digital ecosystem, enabling secure, efficient, and user-friendly interactions for individuals, businesses, and governments.

DPI has five main components (OECD, 2025; CSIS, 2023):

1. Digital identity systems
2. Digital payment systems
3. Data exchange system
4. E-government services
5. Cybersecurity.

1. **Digital identity:** A fundamental pillar of DPI, digital identity systems ensure secure and reliable online identification. In Estonia, for example, citizens are issued digital IDs, allowing them to access over 2,000 government services online.
2. **Digital payment systems:** Digital currencies, mobile payment apps, and online banking are critical components of DPI, simplifying financial transactions and boosting financial inclusion.
3. **E-government services:** DPI includes a wide range of government services accessible online, from tax filing to healthcare appointments. This reduces bureaucracy, saves time, and improves transparency.
4. **Open data/Data exchange system:** Governments around the world are increasingly making data available to the public, fostering innovation and transparency. This information enhances research, business development, and informed decision-making.
5. **Cybersecurity:** Ensuring the safety and security of digital infrastructure is paramount. DPI includes cybersecurity measures to protect data, privacy, and critical systems.

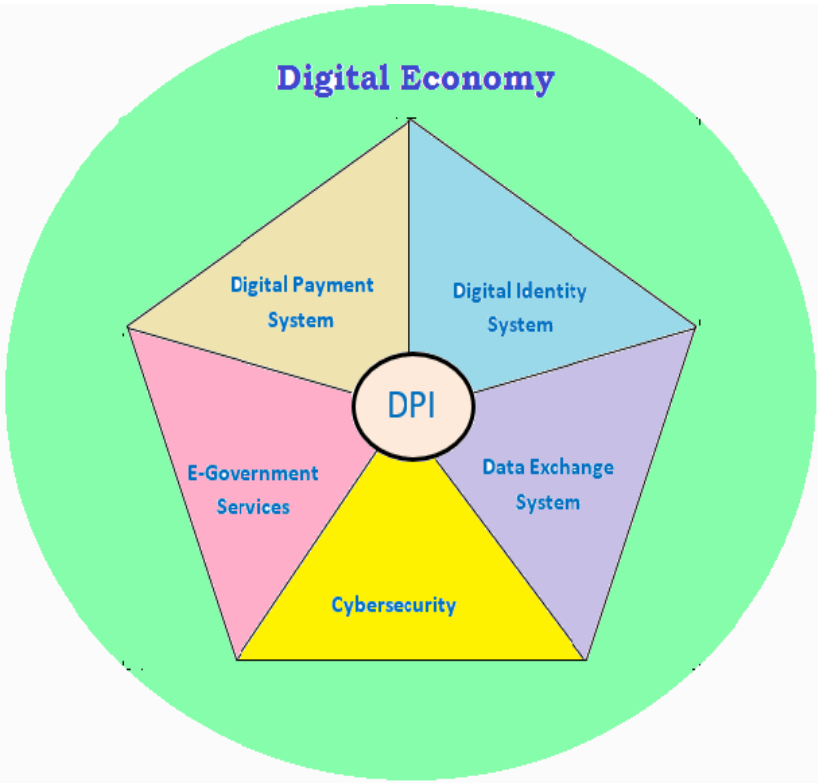
A digital economy is characterized by its five key features that it is digital connected, shared, personalized, and direct as described below (Vendantu, ny).

- **Digital**: Various analogue objects produce digital signals which can be easily measured.
- **Connected**: The workers, assets, suppliers, and stakeholders are linked together by wireless communication
- **Shared**: The digital economy operates on the principle of sharing and reduces costs of services.

- **Personalized:** Customer personalization enables customers to get benefits from their favorite brands whenever and wherever they want.
- **Direct**: The leverage of remote intelligence to monitor, manage, report, and resolve problems throughout the service lifecycle.

Based on the available literature on DPI and the digital economy, the conceptual framework of DPI is developed as presented in Figure 2.1. The outcomes of DPI in the digital economy are measured by several indicators, including development and governance indicators investigated in this study.

Figure 2:1: Pentagonal framework of DPI and digital economy



Source: Authors' sketch based on literature.

2.2. Datasets

The study utilizes both primary and secondary data from official sources. Primary data were collected using key informant interview (KIIs)

from selected institutions which are more involved in digitalization in Ethiopia. Qualitative data on policy insights and the state of digitalization in Ethiopia were collected from key informants. 12 Key informants from MInT, Fayda, Ministry of Finance (MoF), Ministry of Education (MoE), Ministry of Revenue (MoR), and Safari.com were selected. Primary data on policy insights and digital initiatives including, but not limited to, the following were collected:

- The national ID program
- Integrated Tax Administration System (ITAS)
- E-procurement.
- Digital education

Secondary data on development, governance and DPI indicators were collected from national and global official sources. Major sources of panel data include the United Nations, United Nations Conference for Trade and Development (UNCTAD), United Nations Development Program (UNDP), World Bank, Transparency International (TI), Economic Impact, and Fund for Peace (FFP).

Development indicators: Panel data on the following three development indicators were collected:

- GDP per capita (constant 2015 int.$, log)
- Human Development Index (HDI) (%)
- Structural change capacity (%).

Governance indicators: Panel data on the following three governance indicators were collected:

- Worldwide Governance Indicators (WGI) (%): A composite index of governance is developed as an arithmetic mean of the following WGI indicators:
  - Voice and accountability
  - Political stability and absence of violence
  - Government effectiveness
  - Regulatory quality
  - Rule of law
  - Corruption control
- Corruption Perception Index (%)
- Public Services Index (PSI) (%).

DPI indicators: Panel data on the following DPI indicators were collected:

- E-Government Development Index (EGDI) (%) and E-Participation Index (EPI) (%)
- Inclusive Internet Index (3I) (%)
- Information and Communication Technology (ICT) Capacity Index (%).

DPI use cases (digital finance): Cross-country data on the following digital use cases (% of adult population) of digital finance were collected for 2021/2022:

- Make/Receive digital payments
- Pay bills using mobile phone or the internet
- Send money using mobile phone or the internet
- Make/Receive digital payment (by gender)
- Send money using mobile phone or the internet (by gender)
- Ownership of debit/credit card.

2.3. Methods of Data Analysis

Both parametric and nonparametric methods were employed to investigate the systematic link and causality between DPI and socioeconomic development and governance outcomes. For informed planning and implementation of digital transformation, Ethiopia's relative position was assessed, and gaps were identified.

Methods

The following nonparametric methods were employed to investigate the dynamics of DPI and the systematic link between development, governance, and DPI.

- Timeseries line plots to measure the dynamics of DPI in Ethiopia
- Panel plots to measure the global dynamics of DPI
- Scatterplots and correlation analysis to measure the systematic link between development and DPI and to identify Ethiopia's relative status.

The effects of DPI on development and governance are estimated using linear panel data estimators. The basic framework for panel data analysis is a regression model of the form (Wooldridge, 2022):

$$y_{it} = \boldsymbol{x}_{it}'\boldsymbol{\beta} + \boldsymbol{z}_i'\boldsymbol{\alpha} + \varepsilon_{it}$$

The dependent variable, y_{it} is the value of development or governance indicator for country i in year t with DPI indicators (regressors) in $\mathbf{x_{it}}$, not including the constant term with coefficient of (β). The heterogeneity, or the country effect in this case is $\mathbf{z_i'\alpha}$ where $\mathbf{z}_i$ contains a constant term and a set of country or group specific variable which may be observed or unobserved (constant over time). If $\mathbf{z_i}$ is observed for all countries, then the entire model can be treated as an ordinary linear model and fit by least squares.

There are four estimators of linear panel data: fixed-effects (FE), first-differences (FD), random-effects (RE), between-effects (BE), and population-averaged (PA).

The following tests[3] will provide guidance at to which model to employ for the data under investigation (Table 2.1):

- Testing for non-zero correlation between the unobserved effect and the regressors: FE versus RE.
- Testing for the presence of an unobserved effect: RE versus pooled OLS

[3] An estimator is consistent if the (transformed) explanatory variables are uncorrelated with the residual, and inconsistent if it is correlated with the residual. In cases where the residuals are correlated with the explanatory variables, the population averaged (PA) and pooled OLS (POLS) can be employed to estimate consistent parameters.

Table 2.1: Key properties of basic panel data estimators

Model	Assumptions			
	(1)	(2)	(3)	(4)
Tests	i) Zero correlation between $\mathbf{x_{it}}$ and α_i; ii) Zero correlation between $\mathbf{x_{it}}$ and u_{it} for ll values of s (strict exogeneity) $corr(\alpha_i, \mathbf{x_{it}}) = 0$ $corr(u_{it}, x_{it}) = 0$ $s = 1,2,..t,..T$	i) Non-zero correlation between $\mathbf{x_{it}}$ and α_i; ii) Zero correlation between $\mathbf{x_{it}}$ and u_{is} for all values of s (strict exogeneity) $corr(\alpha_i, \mathbf{x_{it}}) \neq 0$ $corr(u_{it}, x_{it}) = 0$ $s = 1,2,..t,..T$	i) Zero correlation between $\mathbf{x_{it}}$ and α_i; ii) Zero correlation between $\mathbf{x_{it}}$ and u_{is} only for values of s equal to or larger than t (sequential exogeneity); otherwise, non-zero $corr(\alpha_i, \mathbf{x_{it}}) = 0$ $corr(u_{it}, x_{it}) = 0$ $s = t, t+1,\ldots,T;$ $corr(\mathbf{u_{it}}, \mathbf{x_{it}}) \neq 0,$ $s = 1,2,\ldots,t-1$	i) Non-Zero correlation between $\mathbf{x_{it}}$ and α_i; ii)) Zero correlation between $\mathbf{x_{it}}$ and u_{is} only for values of s equal to or larger than t (sequential exogeneity); otherwise, non-zero $corr(\alpha_i, \mathbf{x_{it}}) \neq 0$ $corr(u_{it}, x_{it}) = 0$ $s = t, t+1,\ldots,T;$ $corr(\mathbf{u_{it}}, \mathbf{x_{it}}) \neq 0,$ $s = 1,2,\ldots,t-1$
RE	Consistent & efficient	Inconsistent	Inconsistent	Inconsistent
POLS	Consistent, inefficient	Inconsistent	Consistent	Inconsistent
FE	Consistent, inefficient	Consistent	Inconsistent	Inconsistent
FD	Consistent, inefficient	Consistent	Inconsistent	Inconsistent

RE (GLS) estimator: $y_{it} - \bar{y}_i \lambda = (x_{it} - \bar{x}_i \lambda) + (v_{it}^{RE} - v_{it}^{-RE} \lambda)$

PA estimator: $\mathbf{y_{it}} = \mathbf{x_{it}}\boldsymbol{\beta} + (\alpha_i + u_{it})$

FE (Within') estimator: $\mathbf{y_{it}} - \bar{\mathbf{y}}_i = (\mathbf{x_{it}} - \bar{\mathbf{x}}_i)\boldsymbol{\beta} + \mathbf{u_{it}} - \bar{\mathbf{u}}_i$

FD estimator: $\mathbf{y_{it}} - \mathbf{y_{i,t-1}} = (\mathbf{x_{it}} - \mathbf{x_{i,t-1}})\boldsymbol{\beta} + (\alpha_i - \alpha_i + \mathbf{u_{it}} - \mathbf{u_{i,t-1}})$

$= (\mathbf{x_{it}} - \mathbf{x_{i,t-1}})\boldsymbol{\beta} + (\mathbf{u_{it}} - \mathbf{u_{i,t-1}})$

2.4. Definitions and Working Hypothesis

2.4.1. Development indicators

The following five development indicators are selected to measure the effects of DPI on socioeconomic progress.

GDP per Capita (log, constant 2015 US$): It measures the economic output of a nation per person and seeks to determine the prosperity of a nation by economic growth per person per year in that nation. In this study, it is measured in the 2015 constant US$. The World Development Indicators (WDI) of the World Bank covering 23 years (2001-2023) were utilized in the analysis.

Structural Change (SC) (%): It is one component of productive capacities reported by the United Notations Conference for Trade and Development (UNCTAD) to measure the movement of labor and other productive inputs from low productivity sectors to high productivity sectors. This shift is captured by the sophistication and variety of exports, the intensity of fixed capital and the weight of industry and services on total GDP. The data covering 22 years (2001-2022) were utilized in the analysis.

Human Development Index (HDI) (%): The HDI, developed by the UNDP, is an aggregate index of development measuring health, education and economic growth. It has been used to measure the multidimensional measure of development of nations worldwide. Data covering 22 years (2001-2022) were utilized.

2.4.2. Governance indicators

Three governance indicators are used to measure the effects of DPI on governance.

Worldwide Governance Indicators (WGI) (%): The WGI is a set of six indicators reported by the World Bank covering 21 years (2001-2021). The following six governance indicators are aggregated into a single composite index of governance using their arithmetic mean.

- **Voice and accountability:** Voice and accountability is an indicator of governance measuring perceptions on participation of citizens in government elections, as well as freedom of expression, association, and a free media.
- **Political stability and absence of violence:** Political stability and absence of violence/terrorism is one indicator of governance

used to capture the likelihood of a government to be destabilized or overthrown by unconstitutional means.

- **Government effectiveness:** It is used to capture the quality of public services, the quality of the civil service and its independence from political interference, the quality of policy formulation and implementation, and credibility of government and its commitment to such policies.
- **Regulatory quality:** It is used to capture the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.
- **Rule of law:** It is used to capture the extent of confidence of agents in and abide by the rules of society, including the quality of contract enforcement, property rights, the police, and the courts.
- **Control of corruption:** It captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.

Corruption Perception Index (PCI) (%): The CPI is a measure of public sector corruption reported by Transparency International (TI) since 2012. Higher values (closer to 100%) indicate lower corruption, while lower values (closer to 1%) indicate higher corruption. The CPI covering 13 years (2012-2024) were utilized.

Public Services Index (PSI): The PSI is a component of FSI measuring the presence of basic state functions that serve the people. This includes the provision of essential services, such as health, education, water and sanitation, transport infrastructure, electricity and power, and internet and connectivity. It also includes the state's ability to protect its citizens, such as from terrorism and violence, through perceived effective policing; whether the state narrowly serves the ruling elites while failing to provide comparable levels of service to the general populace; and the level and maintenance of general infrastructure. The data from the Fund for Pease (FFP) covering 18 years (2007-2024) were utilized.

2.4.3. DPI indicators (Covariates)

Five DPI indicators or covariates are identified to measure their effects on socioeconomic progress and governance.

Information Communication Technology (ICT) capacity (%): ICT estimates the accessibility and integration of communication systems including fixed line and mobile phones users, internet accessibility and server security. The data from the UNCTAD on ICT covering 22 years (2001-2022) were utilized.

E-Government Development Index (EGDI) (%): Along with an assessment of the website development patterns in a country, the EGDI incorporates the access characteristics, such as the infrastructure and educational levels, to reflect how a country is using information technologies to promote access and inclusion of its people. The EGDI is a composite measure of three important dimensions of e-government, namely: provision of online services (OSI), telecommunication connectivity (TII) and human capacity (HCI). The data on EGDI of the United Nations (UN) covering 24 years (2003-2024) were utilized.

- **Telecommunication Infrastructure Index (TII) (%)**: This sub-index is a composite weighted average index of six primary indices based on basic infrastructural indicators, defining a country's ICT infrastructure capacity. These are: personal computers per 1000 persons; Internet users/1000 persons; Telephone Lines/1000 persons; Online population; Mobile phones per 1000 persons; and TV's per 000 persons.
- **Online Service Index (OSI) (%):** This sub-index measures a government's capability and willingness to provide services and communicate with its citizens electronically.
- **Human Capital Index (HCI) (%):** The HCI sub-index consists of four components, namely: adult literacy rate; the combined primary, secondary and tertiary gross enrolment ratio; expected years of schooling; and average years of schooling.

E-Participation Index (EPI) (%): The EPI is derived as a supplementary index to the UN E-Government Survey. The EPI is a multifaceted framework, composed of three core components: e-information, e-consultation and e-decision-making.

- **E-information:** Enabling participation by providing citizens with public information and access to information without or upon demand.
- **E-consultation:** Engaging citizens in contributions to and deliberation on public policies and services.

- **E-decision-making:** Empowering citizens through co-design of policy option and co-production of service components and delivery modalities.

Inclusive Internet Index (3I) (%): This index measures[4] whether the internet is accessible and affordable, and how much it enables social and economic mobility (Meta, 2022). It can be used to plan or advocate for connectivity investments. The overall index score is based on the scores of the four components with different weights, availability (40%), affordability (30%), relevance (20%), and readiness (10%). The purpose of this index is to give policymakers and influencers a clearer understanding of the factors that contribute to wide and sustainable inclusion and to provide a comparison across countries of the enabling environment for adoption and productive use of the internet. The data on 3I by reported by the Economic Impact (Meta) covering five years (2017-2022) were utilized.

- **Availability (%):** The Availability category in the 3II index examines the quality and breadth of available infrastructure required for access and levels of internet usage.
- **Affordability (%):** Affordability examines the cost of access relative to income and the level of competition in the internet marketplace.
- **Relevance (%):** Relevance examines the existence and extent of local language content and relevant content.
- **Readiness (%):** Readiness examines the capacity to access the internet, including skills, cultural acceptance, and supporting policy.

Digital Finance: DPI indicators in digital finance measure the extent of inclusion/exclusion of different population groups in accessing and using DPI. Selected DPI use cases from the World Bank's Findex dataset measure their effects on development and governance.

[4] The 3I for 2022 represents 97% of global GDP and 99% of global population.

Table 2.2: Expected effects of DPI on development and governance

DPI indicators	Expected effect on					
	Development			Governance		
	GDP per capita	HDI	Structural change	WGI	CPI	PSI
EGDI	**+**	**+**	**+**	**+**	**-**	**+**
Telecom infrastructure	+	+	+	+	-	+
Online services	+	+	+	+	-	+
Human capital	+	+	+	+	-	+
EPI	+	+	+	+	-	+
Inclusive internet	**+**	**+**	**+**	**+**	**-**	**+**
Availability	+	+	+	+	-	+
Affordability	+	+	+	+	-	+
Relevance	+	+	+	+	-	+
Readiness	+	+	+	+	-	+
ICT	**+**	**+**	**+**	**+**	**-**	**+**

3. Policy Insights and Digital Initiatives in Ethiopia

3.1. The State of Digitalization

The terms digitization and digitalization are often confused and sometimes considered as synonymous. It is helpful to make a clear distinction between these two terms before stepping to the discission on the state of digitalization in Ethiopia. *Digitalization* is the process of leveraging digital technologies to transform a business model by integrating digital tools and systems into various business operations (Walk Me, 2025). Digitalization refers to the broader transformation of business processes and activities to take advantage of digital technologies and data. It is a digital transformation process that involves the integration of digital technologies into all areas of a business, leading to fundamental changes. *Digitization*, on the other hand, refers to the process of converting information into a digital format, which is a step in digitalization.

The legal framework of government digital transformation and government service strategy in Ethiopia is seen from personal data privacy and digital governance perspectives and pre-requisite works have been one of in these aspects of the legal framework. Previously, the government of Ethiopia, for example, launched e-services system, now the second digital government system has been launching in all regional states.

It was necessary to coordinate the organizational and legal structures, and the current system was established once the necessary proclamations were approved. To establish a unique identity for each person, all citizens must provide biometric information, including fingerprints and eye scans, at the national level. This will make it possible to track personal data, including job, housing, and other crucial information, all of which will be kept in a single database.

A key identification like a National ID number is necessary to guarantee successful integration. Multiple databases can be linked by this key identification, which facilitates information access across different systems. The National ID number serves as the key for accessing and exchanging all relevant data across many industries. Through this single identifier, the digital ID would make it possible to trace an individual's movements, criminal history, education, employment history, and involvement in the trading system, among others.

The digital efforts are guided by a strategic plan and a transformation framework. The digital policy is integrated into the broader strategic framework with a focus on technological solutions. For example, digital payment systems and transaction services are required to operate through approved platforms that facilitate these services. The legal framework for digital transformation focuses on digital literacy, e-governance, and secure digital services. It contains e-commerce and data protection legislation and a strong cybersecurity framework. Government services are made available online under a set of digitalization requirements. These rules are designed to guide implementation processes while ensuring compliance with financial and privacy regulations.

During implementation, the platform's transactions are integrated with digital payment systems such as Telebirr and CBE Birr. This connection enables unified transactions while adhering to recognized financial and privacy regulations. The main purpose is to provide efficient, safe, and easily available digital services across institutions.

Strategically, the Ethiopia's digital transformation is progressing well, with promising results in both accessibility and market growth. Ethiopia's digital transformation reflects a strong commitment to integrating digital technologies for improved services, governance, and economic growth. The government has established plans to build a strong digital economy. Key areas of progress include improving technology infrastructure, increasing e-government services, and supporting digital payment methods.

3.2. Streamlining E-Government Services

The government is updating e-Government service portals to create a unified, efficient, and user-friendly platform for accessing government services. By combining services under a single digital interface, this effort is expected to decrease bureaucracy, shorten wait times, and improve accessibility. By improving functionality, ensuring multi-device accessibility, and implementing online elements, the government hopes to improve service delivery.

Ethiopia plans to deliver 1,000 e-government services by 2030, following a systematic and targeted strategy. Given the large number of institutions, the government intends to start by digitizing selected government institutions before implementing digitalization across all the sectors. The prioritization process will be guided by research-based

criteria with an emphasis on impact and practicality. Key concerns are institutions' ability to implement digital services. Infrastructure readiness, institutional preparedness, and the availability of qualified human resources all have a significant impact on the implementation timeline.

The Ministry of Innovation and Technology (MInT) has identified transactional and informational applications to improve service provision and avoids the expected challenges that may arise when apps are developed individually by different sectors. The MInT is accountable for issuing certificates. To streamline this process, the government is developing an application to manage services of license to be used by the concerned ministry and will be linked to a centralized database. With this method, trade registration would be done using a unique identification using the National ID. As a result, members of the trade community would be able access their registration information online immediately, eliminating the need for in-person visits to the concerned offices. Users can easily access and manage their data online by providing their National ID. This strategy is essential from the standpoint of e-government to guarantee smooth access to informational services (like browsing data via websites or portals) as well as transactional services (like issuing licenses). To accomplish this, the necessary infrastructures and preconditions are already performed. Currently, about 342 services are offered online by over 26 government organizations. These services align with the legal framework for digital transformation. At present, e-government services are available completely at the federal level covering federal institutions.

In the future, there are plans to expand e-government services to cities and regional governments. By 2030, the government intends to greatly increase its digitalization efforts, with 1,000 services to be made available online. This expansion will include connections with certain private companies, as well as all government agencies for improving service accessibility and efficiency.

The following are current priority e-government services for digitalization:

- Skills certificate: It is a vital online service provided through the www.eservices.gov.et website. Users can upload important documents and register on this portal. After submission, the system generates a tracking number and forwards it to MInT for processing and review. When it is finalized, the system automatically notifies the user by SMS so take the certificate.

- Digital identity: The country is also developing e-government services that include secure digital identities.
- Taxation for faster tax payment,
- Digital payment.
- E-procurement to make easy public sector procurement,
- Education platforms for e-learning.

The success of these projects depends on robust infrastructure, capacity building, inclusivity, and supportive legislation. Users of this platform can access a variety of e-services from multiple organizations in a one-stop shop setting.

Now the e-services in most cases are service-focused and are related to license providers, including ID registration and renewal, driving licenses and trade licenses. Those e-services that are related to licensing are top priority areas. The government has shifted its approach to conducting assessments to prioritize key areas for digitalization. These assessments inform the development of a comprehensive service catalog, ensuring a more strategic focus on critical government services.

Online access to services like licenses, competency certifications, and registrations are expected to greatly increase efficiency and convenience. People can now complete all required procedures remotely from any location with an internet connection, avoiding the need to physically visit government offices. Specialized support centers are provided to help users who need assistance with the process. These centers offer direct support, such as providing step-by-step instructions to ensure activities are completed smoothly and sharing links to pertinent websites. This method accommodates people who are not familiar with digital platforms and promotes inclusivity while also saving time and money.

Ethiopia has implemented various e-government services to improve efficiency and accessibility. Key accomplishments include digitizing taxpayer registration, enabling online tax filing and payment, and implementing e-invoicing systems. These services allow businesses and individuals to manage their tax responsibilities electronically, avoiding the need for physical visits to revenue offices.

Sectors such as construction, trade, and customs have successfully accepted e-government systems, demonstrating their practical use and utility of these digital services. Efforts are ongoing to collect and analyze data

to improve service delivery and expand the scope of e-government initiatives.

The e-service platform guarantees unified service delivery and facilitates service accessibility by integrating both administrative and user-facing tasks into a single effective system. However, this ease of access comes with risks, as fraud may pose challenges to the system if users are not cautious.

E-government services and electronic currency transfers have considerably improved efficiency and convenience in Ethiopia. Individual users gain greatly from these services because it eliminates the need to visit banks or institutions in person. Mobile banking and other digital payment systems allow consumers to conduct financial transactions and exchange money in a secure and fast manner. The electronic marketplace has also gained more confidence than traditional cash markets due to its reliability and transparency. With the integration of mobile payment systems, citizens and businesses can now make payments and complete transactions online with minimal in-person visits. As a result, digital payment systems play an important role in streamlining transactions, improving accessibility, and increasing efficiency across e-government platforms.

3.3. Digital Literacy

Digital literacy levels in Ethiopia remain relatively low, posing challenges to digital transformation efforts. Comprehensive efforts have been launched to enhance digital skills and literacy, aiming to reach 10 million individuals by 2025. To date, these initiatives have benefited an estimated 2 to 3 million individuals. One important focus is on developing digital financial skills. To this end, educational brochures have been prepared, and outreach programs are being conducted in schools, universities, and various institutions, with a particular emphasis on engaging women, employees, and other key groups. These efforts are raising awareness about the importance of digital financial literacy. As a result, a growing number of people are using online and mobile banking services. They receive information about the advantages of these services, detailed instructions on how to use them, and a summary of the broad range of services that are available through educational initiatives. Users are also receiving education on how to borrow money, including how to use collateral and what requirements must be met to obtain financial services. In addition to

increasing digital competency, these programs are strengthening different populations and promoting a culture of financial inclusivity.

Digital literacy is a broad term that begins with fundamental skills such as controlling a basic phone. Because literacy rates are generally low in Ethiopia, the concept of digital literacy necessitates three prerequisites. For people to gain digital literacy, the three elements of digitalization must coexist connectivity, device access, and basic literacy. These services, including access to finance, must be coordinated and integrated to be effective, particularly in remote communities. Microfinance institutions, for example, already use mobile phones to provide credit to their members.

However, Ethiopia's digital literacy confronts serious challenges related to poor infrastructure, shortage of power, and insufficient digital equipment. Basic literacy skills are essential for effectively using digital products. To use a mobile phone for digital banking, individuals must understand numbers and basic text input. Furthermore, given Ethiopia's multilingual and multicultural landscape, digital information must be localized in major languages such as Amharic, Afan Oromo, and Tigrinya to ensure accessibility for all.

Currently, there are initiatives such as the digital content development project, which is intended to create content in **ten** primary languages spoken by a significant portion of the population. This project covers a variety of issues, including agriculture, health, and computer literacy. Expanding and growing the number of such projects is critical for boosting digital literacy in Ethiopia, ensuring that the material is understandable in local languages, and, ultimately, making digital literacy accessible to all.

E-services are mainly provided at the federal level in Ethiopia, where digital literacy has grown due to extensive smartphone and internet access. Most people in cities and at the federal level are connected via cellphones, making it simple to access and use e-services. The platforms are meant to be user-friendly, with no additional technical knowledge or skills required, ensuring that the bulk of users in these areas can access the service.

Looking ahead, plans include the establishment of service centers to address literacy challenges, particularly for regions where digital literacy is relatively more limited. These centers will support individuals with literacy or technology skill gaps, helping bridge the digital divide and expand e-service accessibility nationwide.

While technology skills may not pose an immediate challenge in urban areas, expanding digital literacy to regional and national levels requires strong coordination. Education and outreach should be prioritized to ensure equitable access to e-services, promoting inclusivity in the digital transformation process.

3.4. The National ID Program

A strategic document titled Digital Ethiopia 2025 was produced to guide the country's ICT and digital development. It is organized around a five-year strategic framework. The MInT manages and supervises the implementation of the digital strategy using annual plans and goals. *Fayda* project is generally aimed to establish a digital identity, increase citizen access to government services, and facilitate institutional integration. The plan focuses on integrating ICT and digital activities across all sectors. This calls for collaboration amongst different groups while implementing appropriate regulations and strategies. The plan's activities and milestones are designed to be implemented gradually, building on previous achievements and advancing towards future objectives.

The National ID or Fayda helps an individual user or digital identity owner uniquely and easily identify as a citizen or even a foreigner who lives in Ethiopia. It connects the holder to get/access different e-service platforms in the digital economy. The Digital ID serves as an individual's unique identifier, minimizing account duplication and streamlining identification processes across multiple platforms.

Individuals could previously register for services online using smart phones without undergoing severe identification verification, resulting in concerns such as duplicate applications. To solve this, the Fayda ID is now required at registration centers to avoid repetition and verify validity. The strategic plan is focused on solving the issues of people with multiple accounts.

The relevant sector is expected to manage and carry out the Digital ID program, which is an essential part of the strategic plan. The strategic document contains several important pillars, each of which has several initiatives. These projects are organized into yearly events and given priority.

The first two years of the strategic plan were labeled as experimental years when small initiatives to build into the full projects. These projects are extended into more programs and are progressively implemented. Fayda is

one of these projects, programs, or initiatives. The role of the Digital ID initiative is crucial, and its implementation has been delayed. Moreover, there are concerns about potential mismanagement of the system, as with any technology, there are individuals who may seek to exploit it inappropriately.

3.4.1. Status of the national ID program

By mid-March 2025, a total of 12.7 million National ID registrations had been completed, of which 9.4 million (73.6%) are authenticated. A total of 52 agencies or institutions have been integrated. About 342+ services are offered online. These institutions use centralized digital platforms to give citizens easy access to numerous government services and information.

The National ID program, known as Fayda ID, is now in development, with sections dedicated to its implementation and integration. Currently, some components of the ID are used in existing platforms and services, but the program is evolving to become a requirement for e-government service platforms. When online or e-commerce starts, Fayda ID will be a mandatory requirement to get any services.

Moving ahead, the objective is to make the National ID a mandatory prerequisite for accessing electronic services. Individuals without a National ID will be unable to apply for or use e-services. Now, the ID is an optional input in many e-services, but it is gradually being integrated into the system to improve its function in enabling secure and efficient service delivery.

Ethiopia has set 2030 as deadline for full digital registration of citizens (aged 18+). It has advanced this project significantly, frequently ahead of the regional timeframe, in comparison to other African countries. The target of this Fayda ID registration by 2030 is to reach all the population aged 18+ and literate, guarantee complete nationwide coverage. By doing this, the government seeks to enhance data management and shorten service. The government tries to greatly improve digital infrastructure and accessibility by 2030 with intermediate goals for increasing internet adoption, digital literacy, and e-government services. These initiatives include fostering digital financial inclusion, enhancing connection in areas of disadvantage, and putting in place strong digital ID systems.

By giving residents digital identity, this ambitious plan hopes to improve governance, promote socioeconomic inclusion nationwide, and advance access to necessary services. However, the targets seem less achievable, given that the current Fayda ID registration stands at 12.7 million,

covering only 15.5% of the estimated adult population of 81.7 million in 2024.

Until the Digital ID system is fully implemented nationwide, it is critical to increase its reach and utilization. Expanding the use of the Digital ID will not only improve accuracy and efficiency but will also provide a solid platform for integrated digital services.

Ethiopia's National Digital ID system is gradually extending its regional reach, with efforts being made to guarantee accessibility in every corner of the nation. Plans to expand the system to rural and underserved areas are still in progress, but initial placement has concentrated on urban areas and administrative centers where DPI infrastructure is relatively more developed. The goal of this step-by-step strategy is to attain equal access to all citizens, regardless of where they live.

The regional coverage of the National Digital ID system is improving, with a specialized ICT center established in each kebele. Many agents including, telecom companies and commercial banks, are involved in the role out of the Fayda ID and help in creating digital access by distributing mobile cards to help the local community access the e-services with their ID. This coordinated effort ensures that the community may access digital services through these centers. To improve this system, it is critical to expand the network by constructing one ICT center in each kebele, allowing for greater regional coverage. However, this expansion necessitates considerable attention and additional resources, notably in terms of DPI infrastructure and human resource. Ensuring that implementers are properly trained and skilled is critical to the success of this effort. Without enough training and resources, scaling up to meet the demands of all regions would be difficult.

3.4.2. Challenges in the national ID system

To successfully implement the National ID system in Ethiopia, a number of major challenges must be addressed.

- **Security concerns**: There are security challenges in several regional states (e.g. Amhara, Oromia, and Tigray) where major concerns about the smooth operation of registration for Fayda ID.
- **Low digital illiteracy:** Many people in rural areas, particularly elderly people, are unfamiliar with digital tools. Awareness campaigns that educate the public on the advantages of the National ID system using mass media (radio, television, and mobile platforms) can help address the challenge. Schools, local

community centers, and collaborations with banks, telecom companies, and microfinance institutions can contribute to enhancing digital literacy and promoting participation.

- **Lack of resources.** Resource constraints make the procedure even more difficult, especially when it comes to rural areas. Access to biometric data gathering technology like fingerprint and eye print scanners are limiting factors. The challenges also include inadequate infrastructure, poor connectivity, and intermittent internet access. Many rural and urban areas have inconsistent internet connectivity, making it difficult for inhabitants to use digital services. To address this, the government can work with nearby organizations, banks, and telecom providers to set up temporary registration facilities and investing in mobile registration units. To avoid delays and guarantee coverage, the registration process must be decentralized, and adequate resources must be allocated for the collection of biometric data.
- **Weak coordination actors**: Successful implementation of the Fayda project requires different stakeholders working together effectively. Government agencies, service providers, and community groups must collaborate. Organizations like banks, telecoms, and microfinance institutions can help with resource mobilization, awareness campaigns, and service facilitation.
- **Digital divide:** Lack of inclusiveness due to income and gender are important challenges. The difference between women and men, including inclusivity, disability, senior people, and immigrants require inclusive digital strategy. Data cost is expensive in Ethiopia call for the need reduce the data cost so that Fayda ID could be accessible to all citizens. Device cost is also the other challenge. For a marginalized segment of the community cost should be minimized or if alternative cost is available to encourage them. Device subsidies may be one of the means to address this challenge. Initiatives to produce and supply low-cost devices should be launched.
- **Resistance to digitalization:** There are people who face difficulty trusting digital devices and the associated digital benefits. Aged and illiterate people may particularly resist the implementation of the Fayda ID program. When new technologies are implemented, the public often encounters the issue of moving

from traditional means to digital solutions. However, this transition is critical to effective national resource management.

- **Lack of commitment by the leadership:** The e-service program has been underway for more than 10 years, but it has frequently encountered obstacles due to inadequate system transitions and lack of committed national leadership. To overcome these difficulties, there must be a long-term commitment to digitization that ensures consistency and the integration of new systems with current ones. Effective leadership and ongoing attempts are essential to overcome these problems and develop trust in the community.
- **Lack of expertise:** There is serious shortage of skilled manpower that can implement the digital initiatives in Ethiopia. The need for trained professionals with a deep understanding of the digital processes and principles became increasingly apparent as the system was rolled out, emphasizing the importance of building capacity and fostering a culture of professionalism to ensure successful implementation.
- **Payment for the digital ID system:** There is payment for the national ID. The more pressing issue in this case is who will cover the administrative costs. It is undeniable that fees have a significant impact on acceptance rates and inclusion in Ethiopia's Digital ID transformation. The costs include the expenses associated with registration facilities, fingerprint and eye print capture, and the delivery of the Fayda ID. Currently, the cost of registration, ranges from ETB 300-400, which may be difficult for those with low incomes. For individuals who cannot afford, this creates a significant barrier. It is crucial for the government to find solutions either to subsidize the service or fully cover the costs to ensure that everyone, regardless of income, can obtain the Fayda ID. Introducing a payment mechanism for certain services can increase their value and sustainability, while also encouraging accountability among those with the means to pay. To ensure inclusion, the government should develop alternate solutions, such as subsidies or exemptions, for people who cannot afford even the most basic payments. As a digital ID is increasingly required to access a variety of services, their adoption promotes streamlined service delivery, efficiency, and integration, making

them a cornerstone of the country's digital transformation efforts. Digital ID is critical because the government's return on investment extends beyond financial rewards. It lies in the ability to precisely identify every individual. Widespread use of digital ID can result in significant cost reductions because the primary goal is resource efficiency. While the notion of digital ID was presented several years ago, roughly a decade ago, their implementation has been difficult, particularly in making them mandatory and guaranteeing smooth uptake. Once the government makes it essential for everyone to have a digital ID to access services, widespread adoption will be required. This will have a big impact as people receive digital ID. It is also critical to build a revenue-generating mechanism once the digital ID system is fully operational.

3.5. Integrated Tax Administration System (ITAS)

3.5.1. The state of ITAS

One of the major digital use cases in Ethiopia is the Integrated Tax Administration System (ITAS). It is a significant step in modernizing tax administration and collection. It highlights the responsibilities of taxpayers, including registration, reporting, and payment compliance. To improve the effectiveness and accessibility of tax services, the government has made investments in digital technologies.

The intention of ITAS is to streamline and speed up taxpayer responsibilities, including registration, information sharing, reporting, and payment obligations. Accessibility and convenience for taxpayers are crucial for the services that support these responsibilities to encourage compliance to tax regulations. Ethiopia has so taken great steps to digitize these services to increase productivity and reduce manual procedures.

The ITAS includes a taxpayer registering procedure that incorporates biometric data and the issuance of a Taxpayer Identification Number (TIN). Additionally, the system allows for e-filing, enabling upper and middle level taxpayers to file taxes electronically without the need to visit the revenue office. This functionality supports unified submission of tax related data to the institutions' data centers.

The digitization of payment procedures is one of ITAS's main features. Nowadays, digital platforms manage all payments, enabling smooth and

effective transactions for taxpayers. Additionally, notices and correspondence are delivered online, allowing taxpayers to obtain essential data about their tax responsibilities without having to meet in person. The ITAS system enables e-payment, which reduces the need for taxpayers to physically visit institutions and allows them to make payments through integrated bank systems and other payment platforms. Additionally, the system is working to automate the previously manual tax refund procedure. Refunds will be processed electronically to streamline the procedure and reduce the burden on taxpayer compliance.

These functionalities have already undergone pilot testing, and the system is now prepared for full implementation. To guarantee smooth operation and improve tax compliance, this will involve educating taxpayers and specialists. The ITAS strives to increase efficiency, reduce errors, and ensure taxpayers may accurately and quickly use their rights by automating the payment and refund processes.

In Ethiopia, the ITAS has been in use for over ten years, facilitating various tax-related processes from registration to calculation and decision-making. Taxpayers utilize this system from the initial registration phase, supported by related application software, to comply with the country's tax administration regulations. The manual registration system has now been replaced by digital registration, allowing institutions and individuals to register online. The taxpayer's registration serves as the core of the tax base, and the data collected during registration is used for calculations, decision-making, and even for economic studies, such as assessing the number of taxpayers in the country. Over the years, amendments and improvements have been made to enhance the system's functionality.

In the 2023, the tax registration system has been further developed with biometric information. Starting in November 2024, the introduction of the national ID, or digital ID (Fayda) has integrated with the tax system. After registering for a Fayda number, individuals can now use it to obtain a TIN. Previously, fingerprint registration and the national ID were separate processes, but now, the 12-digit Fayda ID serves as the official taxpayer ID. This integration of the ITAS system with Fayda ID allows for more accurate identification of taxpayers, reducing errors and improving tax administration. The system is currently under implementation, ensuring smoother identification and better management of taxpayer data.

Following taxpayer registration, taxpayers can report their status on a monthly, quarterly, or annual basis via filing. The system and online

platforms are connected to the filing system. Those outside of the tax authority, institutions or doing business at other banks can continue access the system, even if VAT is currently only operative within the tax authority. By connecting the filing procedure to VAT, the system makes it easier. Furthermore, a variety of online payment methods are available to taxpayers, and these are noted in the institution's database. This facilitates the monitoring of tax payments on a monthly, quarterly, or annual basis, giving tax administrations transparent information and aiding in the modernization of the tax system.

In order to create a fully digitalized and efficient tax administration process, attempts are also being made to incorporate other tax services into the digital system. The tax administration attempts to improve service delivery, increase compliance, and fill up any gaps in the current system by consistently reviewing and improving these digital services.

3.5.2. Digital elements of ITAS

Ethiopia has made great progress in 2024 in digitizing important parts of the ITAS, with an emphasis on federal tax payments, income tax, and e-invoicing. The system was widely adopted in 2024, especially by large federal taxpayers, which are primarily massive institutions.

Through digital technologies, these developments attempt to improve taxpayer services and increase the effectiveness of tax administration. The ITAS system incorporates a number of digital processes such as registration, e-invoicing and filing.

- Electronic invoicing system: One of the most significant changes is the implementation of the e-invoicing. This system permits businesses to create, send, and store invoices by electronic means, ensuring the sales and purchases are accurately tracked. For the purposes of monitoring and tax collection, the data from these transactions is automatically moved to the data center of the tax authorities. The e-invoice system streamlines the entire invoicing process and lowers reporting errors by doing away with the necessity for manual invoicing.
- Income tax: Another crucial area of digitization is income tax. Taxpayers may now electronically file and pay their income taxes thanks using the digital system. Both individual and corporate taxpayers now find it easier to comply with tax laws without having to go to tax offices. Taxpayers may file their income tax

returns and make payments more easily due to the digital platform's simple design.

- E-payment of tax: The e-payment system has been expanded to include business taxes and VAT payments. This enables direct payments from taxpayers via electronic channels, including banks and other online marketplaces. The shift to digital payments ensures faster and more effective tax collection, which lowers administrative costs for both tax authorities and taxpayers. Online resources and the already fully functional Telebirr system is utilized to implement e-payment and e-invoice systems. These digital solutions are crucial for increasing efficiency, simplifying the procedure, and improving taxpayer compliance. The ITAS has the following digital elements:
- Improving taxpayer services: It is another aspect of the digitization initiatives. Through the digital system, taxpayers can now file complaints or queries, receive refunds, and obtain clearing certificates. Through this platform, they can check the progress of their requests and get timely answers, which speeds up communications with the tax office and enhances service quality. To provide effective services, taxpayers are categorized based on a number of factors, such as annual turnover, trade activity, and tax law compliance. Based on their financial activities and regulatory compliance, this classification helps customize services to match the requirements of various taxpayer groups, ensuring everyone gets the right amount of support and supervision. Taxpayers are further categorized into small, medium, and large categories, and services are tailored accordingly to better serve them.

3.5.3. Challenges of the ITAS system

- Lack of preparedness and ability: Taxpayers have limited understanding and ability of using the digital tax system, which is the major challenge in the digital tax system.
- Integration of tax data. Interatom of tax-related data across multiple organizations is the other major challenge. The effective sharing and compatibility of data from different institutions are quite challenging. The digital tax system's smooth functioning is

disrupted by delays and inefficiencies caused by this lack of connection.

- Complaints: Taxpayers have complaints related to the digital tax system, specifically on its complexity and convenience of use. Many taxpayers have had difficulty utilizing the site or have reported challenges with data accuracy and access. These comments indicate that the system requires constant enhancements in user experience and functionality to better fulfill the needs of taxpayers while also ensuring that the platform is intuitive and reliable.
- Early-stage digital tax system: Ethiopia's digital tax system is currently in early stages of adoption. This early stage of implementation presents problems related to system instability, user adaption, and full integration of tax-related activities. Addressing data integration, accuracy, and accessibility is critical to the success of the digital tax system. The requirement for a national ID to use digital tax system is currently a problem. Many problems may be resolved once this system is fully implemented, allowing for safer and more efficient operations.
- Inadequate internet connection: The existing internet systems are inadequate. Taxpayers find it challenging to depend on continuous internet connection because of these interruptions, which cause delays and interruptions in service. The digital tax system's reliability is severely impacted by inconsistent internet services, which upset users and make it more difficult for tax-related transactions to go smoothly. As a result of ongoing capacity concerns, payment validation mechanisms are still undergoing testing. A better integrated system is necessary for efficient online access in all regions, especially when it comes to cooperation between revenue institutions and trade offices for required licensing and renewals.
- Resistance to change: Resistance to change among taxpayers who are accustomed to traditional, in-person methods of payment. Is the other challenge This resistance is often compounded by the segmentation of taxpayers, where larger businesses or more established taxpayers are treated differently from smaller or newly registered ones.

- Lack of expertise: Lack of technological expertise and capability makes it impossible for many taxpayers to use the digital system. Due to their potential inability to use the technology, new taxpayers are challenged to board into the digital system. To close this knowledge gap, assistance and training are crucial, but the procedure is still difficult and time consuming.

3.6. E-Procurement

The Advanced Government Procurement (AGP) program has now included universities that have successfully rolled out and integrated them with the Integrated Financial Management Information System (IFMIS)[5]. Consequently, all purchasing requests, bids, reviews, acknowledgments, and technical evaluations are now conducted online, with the rankings announced directly by the system under these conditions.

3.6.1. The state of e-procurement

The government launched a technological project in 2017, named E-Office adopted by several institutions. Customers can apply online to the MInT. Applications are sent to the appropriate officials, who can respond to them right away. Customers can use the system to monitor the progress of their submissions.

At present, IFMIS is working powerfully and effectively, with no informed challenges. When departments require assistance, they can call support directly over the MInT. The MInT has later taken over the management of IFMIS. When they access the system, they can review, identify and resolve any issues as required.

For comprehensive digitization and increased overall efficacy, IFMIS, Integrated International Public Sector Accounting Standards (IPSAS) and audit technologies must be fully connected. Under the Ministry of Finance (MoF), the procurement process is especially effective. Additionally, Ethiopian government agencies, non-governmental organizations, and private companies use IFRS (International Financial Reporting Standards),

[5] For the past 13 years, the Ministry of Finance (MoF) has been working to digitize its financial system, starting with the country's adoption of the Integrated Financial Management Information System (IFMIS). About 180 budgeted organizations are registered with IFMIS by 2024, moving from manual cash flow, planning, transportation, and reporting procedures to an online platform that enables real-time financial reporting.

which is enforced by the MoF, as their accounting and auditing standard. Despite advancements and expansions over time, the system has not yet attained complete maturity. Until every part is integrated and allows for communication with the Ministry of Revenue MoR), the customs agency, and banks, it cannot be considered completely functioning. For financial statements to remain consistent, this integration is necessary.

In 2021, nine universities were initially selected for the e-procurement system. The government selected these organizations mainly because they were thought to act as representatives for others and managed substantial finances. They are essential to the project since they have been shown to be major allocators of government funds, mainly the treasury budget. Construction, service, consultancy, and property procurement are the four basic categories into which procurement operations within these institutions can be divided. These categories highlight a broad range of activities and the difficulty of efficiently managing significant financial resources.

Since construction procurement mostly deals with building materials and projects, it was given to the Road Authority. On the other hand, Addis Ababa University and Addis Ababa Science and Technology University (AASTU) were the main representatives of universities in procurement concerning property and related demands.

Additionally, the Federal Public Procurement and Property Administration (FPPPA) represented organizations with large budgets, especially those engaged in item purchases. The procurement mechanism was formally launched in 2021 by selecting the nine representatives. A more consolidated and effective method of coordinating procurement across multiple sectors was made possible by this framework.

To test its functionality and make sure it operated efficiently, the computerized E-Service government procurement system started out as a pilot project. Given how crucial it is to ensure security, this process was conducted in cooperation with INSA (Information Network Security Administration). Another essential requirement was integration; for example, it was necessary to identify the product categories, list the things that were required, and permit integration for product delivery. Coordination with several stakeholders was required for this, including the MoR for matters pertaining to taxes and revenue and the Ministry of Trade and Regional Integration (MoTRI) for trade and registration. The pilot testing included verifying whether the system could handle these integrations seamlessly.

Around 66 items selected for annual purchase in the early stages were made public and added to the system. Around nine bids were put out, and all procedures from contract agreement to demand assessment were performed effectively. Beginning in 2021 and continued until early 2024, around 69 budgetary institutions had made the complete switch to the e-procurement system. This number increased gradually and included, and by 2024 116 institutions had finished their online procurements. The system expanded further to include around 65 university branches and eventually included 216 institutions that had fully implemented the online procurement system. The e-procurement within this framework includes the entire process from announcing purchasing needs to signing contract agreements.

This public announcement of procurement plan allows merchants and suppliers to align their schedules with institutional needs. When a bid is announced, it is made accessible to bidders through the designated portal, allowing them to register and participate actively. The portal facilitates equal access for all, ensuring a transparent and competitive process. From the initial announcement of the bid to the finalization of the contract agreement, the entire process is managed systematically.

As of 2024, the procurement system has matured significantly, functioning in this structured and digitalized manner. It represents a streamlined approach to handling bids and contract agreements while minimizing manual interventions and promoting accountability. This digital system reflects a step forward in achieving efficiency and accessibility in public procurement.

3.6.2. Challenges of e-procurement

The digital procurement system has faced several challenges, including the following:

- Resistance and lack of commitment: Being a system-driven approach, its implementation initially faced significant resistance, particularly at the institutional and individual levels. Many institutions showed a lack of commitment to adopting the new system, largely due to apprehension and a reluctance to shift from traditional methods. On the supply side, there was an expectation of resistance; however, the reaction turned out to be quite the opposite. The challenges stemmed primarily from the expertise gap within purchasing and procurement departments. The resistance by users at all levels hindered wider acceptance and

application of the system. A wide range of stakeholders, including government agencies, domestic suppliers, and foreign bidders, required intensive training and capacity building to adapt to the new system. It required a lot of work and resources to provide sufficient training because there were about 80,000 suppliers nationally alone.

- Lack of adequate infrastructure: This challenge ranges from basic equipment like computers to more extensive systems. To fill the gaps in infrastructure, prioritizing resource allocation and efficiently meeting the required infrastructure and technology requirements are required.
- Weak network: The system was designed to function using the WoredaNet[6] network. The WoredNet was not properly installed and functioning. In many areas, they have posed a considerable obstacle. This lack of connectivity has particularly hindered institutions at the supply side, making it difficult to ensure smooth implementation and integration. Without the necessary technology, the full potential of the digital system remains unrealized, underscoring the urgent need for investment in infrastructure and capacity-building to bridge these gaps and support the system to successfully operate.
- Lack of integration: The is limited complete integration among key stakeholders. While initial efforts were made with the MoR, MoTRI, INSA, MInT, as well as with banks and insurance institutions, the integration process remains incomplete.
- Lack of expertise and high staff turnover: This challenge disrupts institutional knowledge and continuity in the implementation of the digital procurement system. Extensive training programs have been started in recognition of the critical role that skilled manpower plays to guarantee effectiveness the system. In order to promote adoption, evaluation indicators were also created.
- Resource constraints: Another major issue was the demand for huge resources. It took a significant investment to balance the capacity requirements of stakeholders with the availability of people and financial resources.

[6] WoredaNet is an e-government project funded by the Federal Government of Ethiopia which was initiated and was governed by the Ministry of Capacity Building.

3.7. Digital Payments

3.7.1. Development of digital payments

Digital financial transactions have been growing rapidly in Ethiopia since 2019 in terms of both volume and value of transactions across all channels, including ATM, POS, mobile banking, and internet banking (Africa Nenda Foundation (2024). As of June 2023, end users in Ethiopia had made digital payments worth more than ETB 4.7 trillion (equivalent of US $82 billion), which is three times the value made in 2022. The number of digital transactions reached 1.2 trillion. Person-to-Person (P2P) transactions have seen the most explosive growth. As of June 2020, there were no digital P2P transactions, By June 2023, there were over 14 million transactions worth ETB 113.3 billion (US $2 billion). Mobile money has shown substantial growth in number of transactions, with a six-fold increase within a year (from 48 million transactions in 2022 to 298 million transactions in 2023).

As of March 2023., Ethiopia has 22 million mobile banking users, 4.8 million internet banking users, and 35 million debit card holders (Shega, 2023). By Ethio telecom alone, there were over 51.3 million Telebirr users. Around six million people use M-Pesa until 2024.

Serval commercial banks in Ethiopia have launched mobile banking services. There are 30 million users of Commercial Bank of Ethiopia (CBE) mobile money service known as CBE birr. A total of nine million customers are utilizing mobile banking services of the CBE. About 910 million transactions were processed through the bank's digital services within six months of the 2023/2024 budget year. The CBE's digital transactions have seen a 90% increase compared to the same period last year, signaling a strong shift towards digital banking among in Ethiopia.

By April 2023, Telebirr had gained 31.3 million users from Ethio telecom's total subscriber base of 70 million. Transactions made via Telebirr in the first half of the Ethiopian in 2022/23 accounted for about 3% of Ethiopia's annual GDP. The progress in mobile banking service initiated by Safaricom (M-Pesa) is also rapidly growing.

Ethiopia is embarking on a digital transformation journey that it hopes will enable it to achieve its development goals and drive inclusive prosperity.

3.7.2. Challenges of digital payments

The major challenges facing digital payment include the following (Africa Nenda Foundation (2024):

- Limited connectivity: There is very limited connectivity in rural settings of Ethiopia that made it difficult for vast majority of people to access digital payments
- Low levels of digital literacy: Digital literacy, particularly financial literacy is very low among most of the population in Ethiopia.
- Limited public trust in digital payment systems. Related to data security issues and financial frauds commercial banks prevailing the country, Ethiopian have very little trust on financial institutions and their digit payments initiatives.
- Lack of policy and regulatory frameworks: There is lack of the necessary policy and regulatory framework that enable growth and expansion in digital payments. To address the problem, the government has imitated serval interventions, including the following (Africa Nenda Foundation, 2024):
    - The endorsement of the payments instrument issuers directive of 2020, which paved way for the introduction of mobile money, digital wallets and similar digital financial services in Ethiopia.
    - New directive for payment operators, allowing for payment switching (ATM and POS operation), and online payment gateway services.
    - National transaction switch (Eth-Switch) that enabled interoperability between and among different types of financial service providers.
    - The opening of the Ethiopian financial sector to
    - Opening of mobile network operators (MNOs) and fintech's.
    - The opening of the MNO and mobile money market to foreign companies such as Safaricom with its M-PESA mobile money service.
    - A government-wide initiative to expand the
    - The use of person-to-government (P2G) and government-to-person (G2P) digital payments for fuel purchases, utility bills, and cash transfer programs.
    - The roll-out of Ethiopia’s National ID program (Fayda) with several financial sector use cases.

- The opening-up of the financial sector to international financial service providers.

3.8. Digital Education/E-Learning

3.8.1. Policies and strategies for digital education

The implementation of digital education in Ethiopia, starting with higher education has nine strategic objectives organized in four major pillars (MoE, 2023).

1. Infrastructure and Connectivity: addresses challenges linked to the physical and technological frameworks of DPI, including power supply, user devices, and other important assets required for digital education.
2. Digital Skills focuses on providing instructors and students with the required competences to effectively navigate and use digital education technologies.
3. Enabling Environment, emphasizes the need of developing supportive policies, strategies, and guidelines to provide a favorable environment for conducting digital education projects.
4. Platforms and Digital Content: focuses on digitizing educational systems using diverse modalities to ensure accessibility and inclusion for all learners.

These pillars form a comprehensive framework for developing digital education in Ethiopia (2023-2028). The nine strategic objectives have been identified to steer the transformation process within the above four pillars.

1. Ensure an Enabling ICT for Education and e-Learning Policy
2. Create an enabling infrastructure and connectivity for digital education in Ethiopia
3. Promote EdTech innovation and encourage Public-Private-Partnership (PPP)
4. Promote the development of curriculum-aligned digital content
5. Advance digital literacy and skills for teachers and other staff
6. Advance digital literacy and skills for students and adults
7. Promote effective data governance and analytics for education
8. Facilitate Research, Cooperation, and Learning
9. Foster digitally inclusive education for all

Efforts to enhance this project include developing ICT education policies and digital e-learning standards. Previously Ethiopia had only a broad

national ICT policy, with no specialized policy for ICT in education. This gap was seen as a significant challenge. An ICT education policy was launched last 2023 to address these concerns. Digital e-learning guidelines have been developed explicitly for higher education to improve online learning and efficiently utilize digital educational practices.

3.8.2. Progress of digital education

Last 2024, the Ethiopian General Secondary Education Certificate Examination used a mixture of online and paper-based testing modalities. This approach is intended to find and solve current infrastructure problems while minimizing risks to students' experiences and performance.

An initial evaluation and monitoring phase examined the digital infrastructure in Addis Abeba to identify potential problems, such as power failures and internet blackouts, that could have a negative impact on students' performance and mental well-being during exams. Based on these findings, preparatory steps were taken to ensure a smooth examination process. Flexible exam rooms were created to accommodate students, and backup power supplies, high-performance computers, and stable internet access were given. Students also received computer skills instruction, which helped them adapt to the digital examination format.

The online test system also included strategies for dealing with unexpected challenges, such as power disruptions. When power was temporarily lost, the technology enabled the recovery of lost time maintaining fairness. These system-based improvements dramatically improved the exam's reliability and accessibility.

Students' feedback indicated a strong preference for the online format particularly among those in Addis Abeba. Urban students who are more comfortable with digital technology than some teachers found the online approach more interesting and user friendly than traditional printed tests. Looking ahead, the Ministry of Education (MoE) intends to shift from direct implementation to facilitation. Capable schools and students will completely accept the online system after taking model exams and pilot tests to familiarize themselves with the framework and ensure preparation. Schools will report on their infrastructure status, and based on these findings, the system will be gradually scaled. The online exam process will remain basic and user-friendly, with straightforward tasks such as entering usernames and passwords and answering multiple-choice questions, reducing ambiguity for students. The Ministry hopes to increase the use of online tests by addressing major

challenges and incorporating feedback, providing inclusivity, efficiency, and reliability for all students.

In 2024, over 30,000 students took online tests at different schools nationwide. Ethiopia wants to attain broad digital coverage of online examinations during the next five years. This goal poses considerable financial challenges due to the huge resource required for nationwide implementation. The platform required for online assessments is already in place, and with adequate financing, complete coverage can be achieved. Reliable power backup systems, ICT infrastructure, and collaboration among many entities are all critical criteria for the success. Despite the hurdles, the strategic plan emphasizes the importance of resource mobilization and collaborations in achieving this goal within the stated schedule.

3.8.3. Challenges of digital education

The ever-increasing demand from learners, educators, and educational system management and administration presents challenges to inclusion, cost, and quality of education. These challenges can be summarized into quality, access, resilience, and affordability. The following are key challenges (MoE, 2023):

1. Financial constraint: Lack of adequate funding for setting up affordable, resilient, and secured infrastructure for digital education. Funding is significantly dependent on foreign or external sources.
2. Insufficient digital content: Insufficient open digital content with an appropriate pedagogical approach guided by privacy, ethical, and security standards.
3. Lack of digital literacy: Insufficient competency-based digital literacy and skills of students and teachers.
4. Lack of expertise: Shortage and limited capability of ICT staff at schools and universities.
5. Low compensation for teaching staff: Economic challenges of teaching staff at all levels, forcing them to work per dime.
6. Limited access to internet connection: Lack of reliable access to internet in almost all schools and colleges of teachers education.
7. Limited access to digital devices: Access and affordability of digital devices.

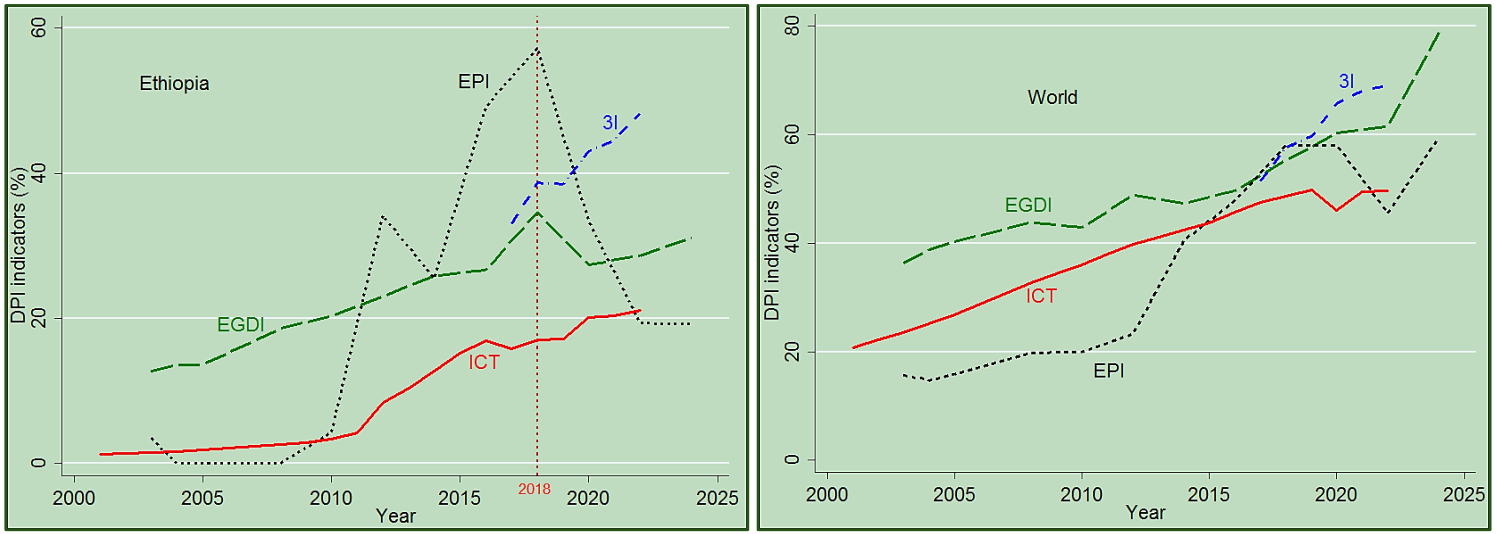
4. The Dynamics of Digitalization

4.1. E-Government

Over the last two and half decades, development of digital infrastructure in Ethiopia has shown substantial progress (left panel of Figure 4.1). Digitalization of government services and participation of the public in government activities and services are substantially improved. However, public participation in accessing government information, participation in consultation and decision making has shown a drastic fall since 2018, indicating the role of the public in their government is deteriorating. E-government also shows deterioration since this year. This deteriorating trend is likely associated with the state of emergency laws frequently initiated and implemented. Almost all states of emergency were proclaimed to combat domestic conflicts widely prevailed in the country. Access to internet services was interrupted in regions and localities where conflicts were supposed to be worse.

Ethiopia has been increasingly affected by these conflicts and the associated states of emergency, leading to slowdown of overall socioeconomic activities. Overall, the patterns of website development, access to telecommunication infrastructure, capability of the government and its willingness to provide services and communicate with its citizens electronically, human capital, the use of information technologies, and inclusion of EGDI and EPI have been adversely affected by the domestic conflicts and the associated state of emergency in Ethiopia. However, unlike Ethiopia, participation of the public in government is increasing except for the latest couple of years (right panel of Figure 4.1).

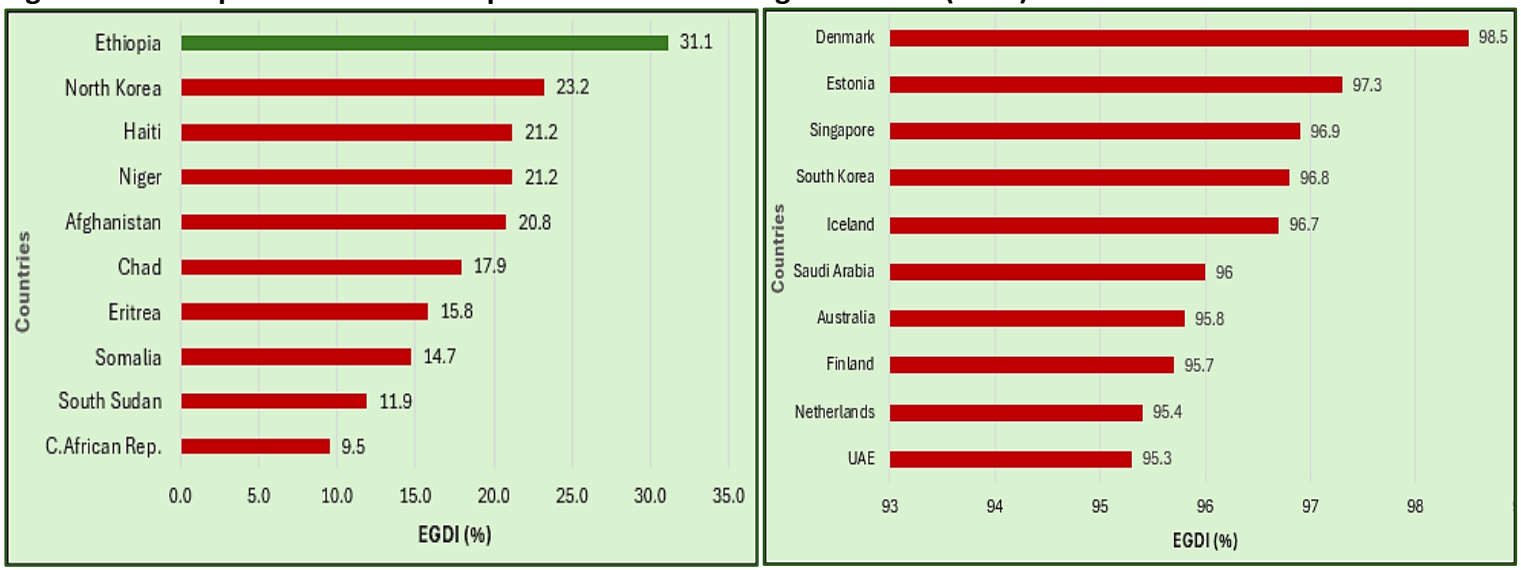
Figure 4.1: DPI developments in Ethiopia and the world (2001-2024)



Source: Computed from data in UN, UNDP, and Economic Impact (2001-2024).

There is substantial disparity of e-government among countries. Most of the bottom 10 countries with e-government index are fragile states in Africa, including Central African Republic (9.5%), South Sudan (11.9%), Somalia (14.7%), and Eritrea (15.8%) (left panel of Figure 4.2). Ethiopia with 31.1% index of e-government was ranked 169th (out of 193 countries) in 2024. On the other hand, the top 10 countries with very high digital government include Ukraine (100%), Denmark (98.6%), and Japan (98.6%) (right panel of Figure 4.2).

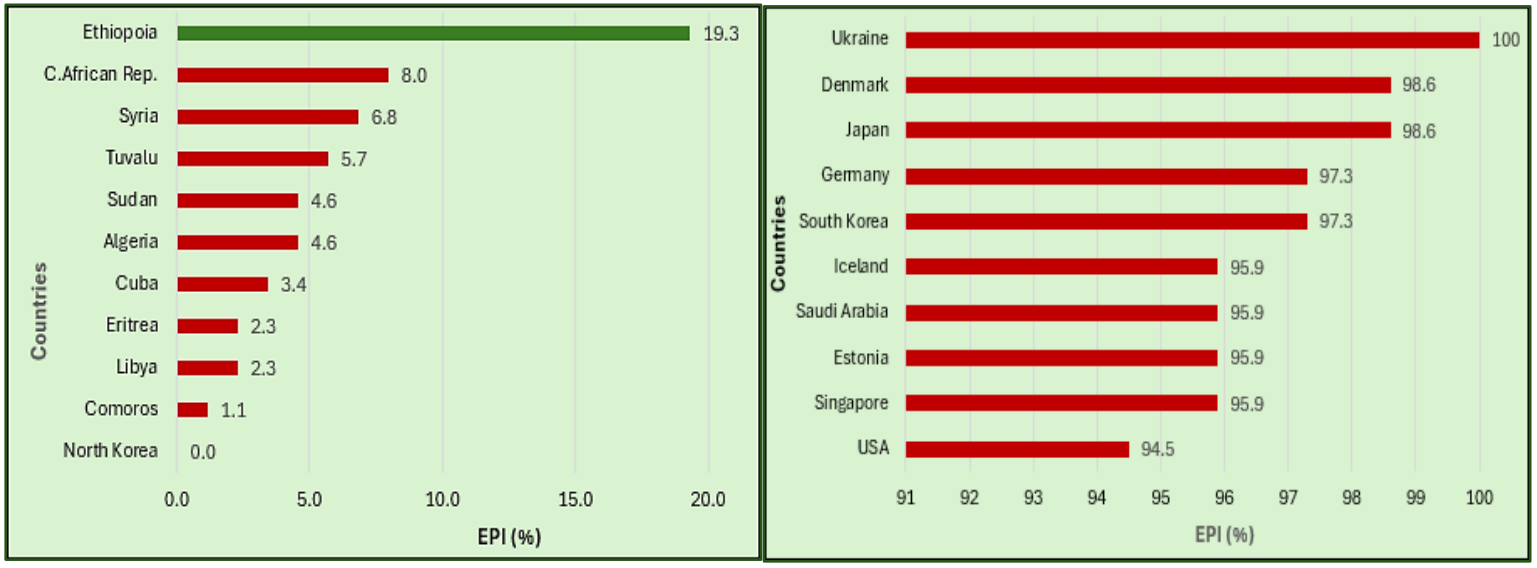
Figure 4.2: Ethiopia and bottom & top 10 countries with e-government (2024)



Source: Computed from data in the UN (2001-2024).

Countries with very low e-participation are also those in Sub-Saharan African (SSA) and fragile Arab states (left panel of Figure 4.3). Ethiopia has very low e-participation (16.4%), compared to other countries with very high and full participation such as Japan (100%), Australia 98.9%), and Estonia (97.7%) (right panel of Figure 4.3). Ethiopia is expected to enhance investment in digital infrastructure and improve digitalization of the government and participation of the public.

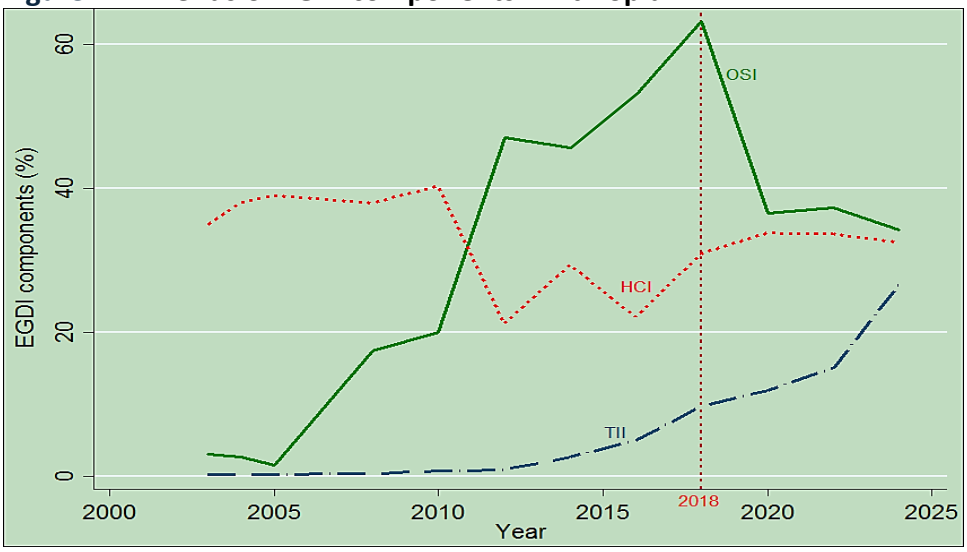
Figure 4.3: Ethiopia and bottom & top 10 countries with e-participation (2022)



Source: Computed from data in the UN (2001-2024).

Further analysis shows the relative importance of EGDI components in developments of digitalization in Ethiopia (Figure 4.4). Despite the deterioration since 2018, the most impactful development in digitalization was attributed to online services (OSI). Telecom infrastructure (TII) is very low and but has shown drastic progress over the last couple of years. However, Homan capital (HCI) has moderate contribution with negligible developments over the last two and half decades.

Figure 4.4: Trends of EGDI components in Ethiopia



Source: Computed from data in the UN (2001-2024).

4.2. Inclusive Internet

In 2022, Ethiopia was ranked 92nd in internet inclusiveness with inclusive internet index (3I) of 48.2% (Table 4.1). However, there was substantial progress of 156.1% within five years since 2017, an annual progress of 3I by about 3%. Internet availability significantly increased to 58.7%, mainly due to improvements in internet quality (21.6%), electricity (18%) and digital infrastructure (11.5%). Between 2017 and 2022, the quality and breadth of DPI infrastructure required for access and levels of internet usage in Ethiopia increased from 58.2% to 27.2%.

Between the two periods, the cost of access to internet, relative to income and the level of competition in the internet marketplace in Ethiopia has shown little improvement, a change of only 4 percentage points. The internet marketplace is particularly constrained by the noncompetitive

environment where the government-owned Ethiotelecom was the only internet provider. Ethiopia is the third country where internet is unaffordable, which is by far lower compared to the top counties with very cheap internet

Table 4.1: The dynamics of internet inclusiveness in Ethiopia (between 2017 & 2022)

Variable	3I (%)		
	2022	2017	Change (%)
Overall 3I	**48.2**	**33.1**	**15.1**
1. Availability	***58.7***	***27.2***	***11.5***
Usage	32.8	28	4.8
Quality	33.5	21.9	21.6
Infrastructure	24.4	12.9	11.5
Electricity	64.2	46.2	18.0
2. Affordability	***55.2***	***51.2***	***4.0***
Price	73.2	67.1	6.1
Competitive environment	19.3	19.4	-0.1
3. Relevance	***57.9***	***28.0***	***21.2***
Local content	66.7	40	26.7
Relevant content	49.2	16	33.2
4. Readiness	***46.0***	***12.7***	***33.3***
Literacy	48	38.1	9.9
Trust and safety	26.5	0	26.5
Policy	63.4	0	63.4

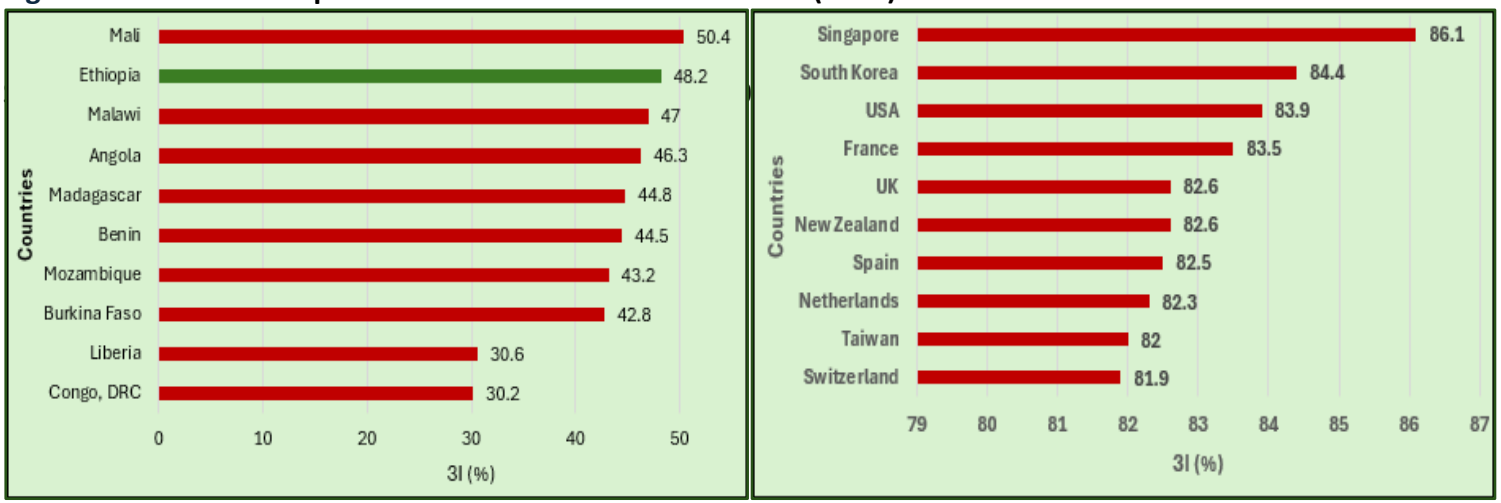
Source: Compiled from data in Economic Impact (2017-2022)

In 2022, Ethiopia was among the bottom 32 countries with low internet availability, which is by far lower than the top countries with 3I of over 80%. Relevance of internet, measured by the existence and extent of local language content and relevant content, has undergone significant improvement. Between the two periods, relevance of the internet in Ethiopia increased from 28% to 57.9%, an improvement by about twofold. However, Ethiopia is still among the bottom 25 countries with relevance compared to the top countries with very high internet relevance.

The capacity to access the internet, including skills, cultural acceptance, and supporting policy in Ethiopia are rapidly improving. Readiness increased from 12.7% in 2017 to 46.2% in 2022, 3.5 times improvement within five years. However, Ethiopia in the 11th country with very low capacity to use the internet, compared to those with very high capacity. Ethiopia is expected to work more on capacity strengthening related to digital literacy, trust and safety, and digital policy.

With 46.2% internet inclusive index (3I), Ethiopia is one of the bottom 10 countries with low inclusiveness of internet (left panel of Figure 4.5). Most countries in SSA have low inclusiveness of the internet. The usage, quality, internet infrastructure and electricity are important digital elements of improving internet availability in Ethiopia. On the other hand, the top 10 countries with very high inclusive internet include Singapore (86.4%), South Korea (84.4%), USA (83.9%), France (83.5%), and UK (82.6%) (right panel of Figure 4.5).

Figure 4.5: Bottom & top 10 countries with inclusive internet (2022)

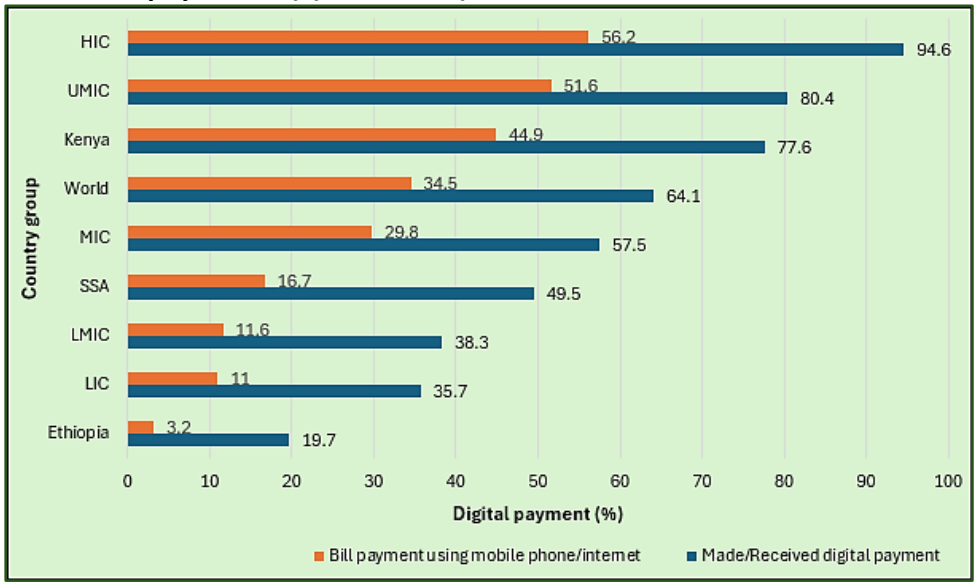


4.3. Digital Finance

4.3.1. Digital payments

Ethiopia's relative position in inclusive digital finance is very low, though significant improvements are observed in recent years. Only 19.7% of the adult population makes/receives digital payments. This reflects a very low level of digitalization, compared to SSA average (49.5%), low-income countries (LIC) (36.7%), middle income countries (MIC) (57.5%), the world average (64.1%) and high-income countries (HIC) (94.6%) (Figure 4.6). Bill payments (3.2%) using mobile phone or the internet is similarly very low, suggesting the need to improve the digital foundations required for digital payments.

Figure 4.6: Ethiopia's relative position in digital payments (% of adult population) (2021-2022)

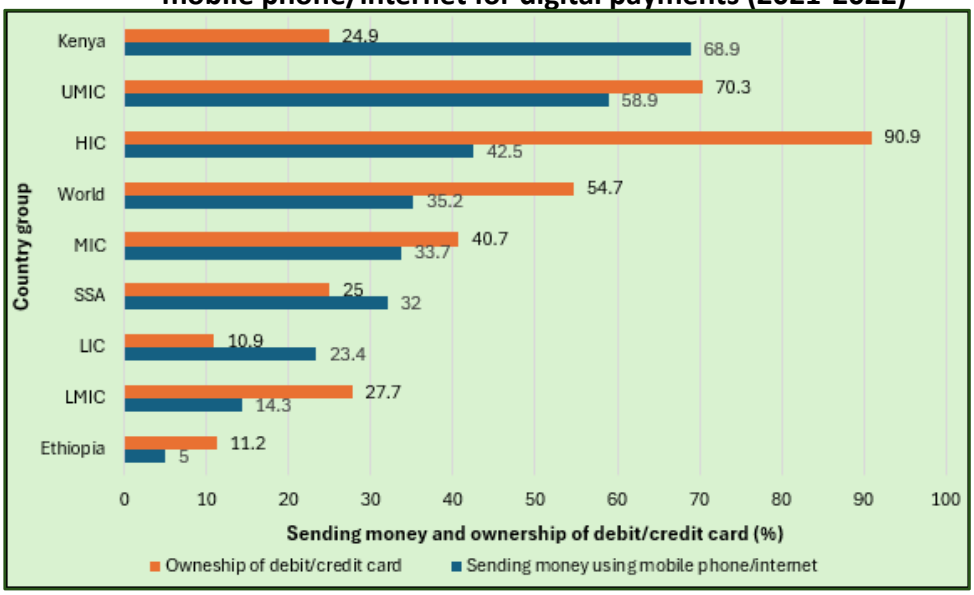


Source: Computed from World Bank Findex database (2021-2022)

Ownership of debit/credit cards to make digital payments is also substantially lower compared to other countries, regions and income groups (Figure 4.7). Ethiopia, with 11.2% of adult population owning debit/credit cards is by far lower than Kenya (68.9%), SSA average (25%), and the world average (54.7%). Only 5% of the adult population in Ethiopia sends money

using mobile phone or the internet, which is not comparable to Kenya (68.9%), SSA (32%), and the world average (35.2%).

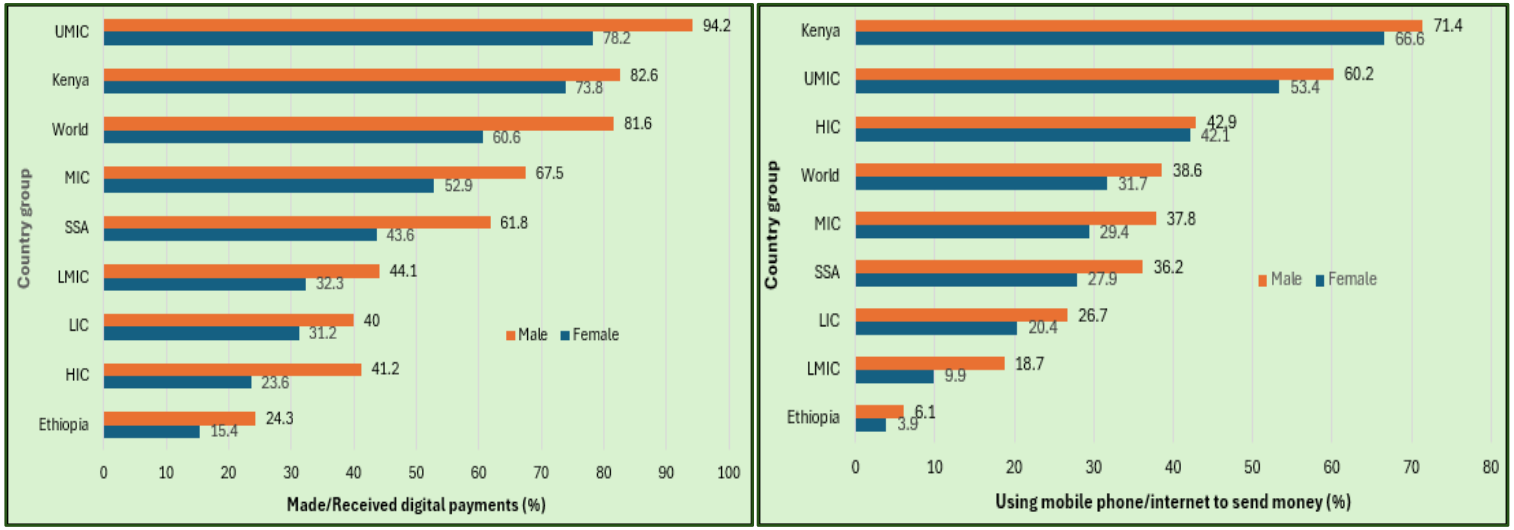
Figure 4. 7: Ethiopia's relative position in using debit/credit card and mobile phone/internet for digital payments (2021-2022)



4.3.2. Gender inclusion

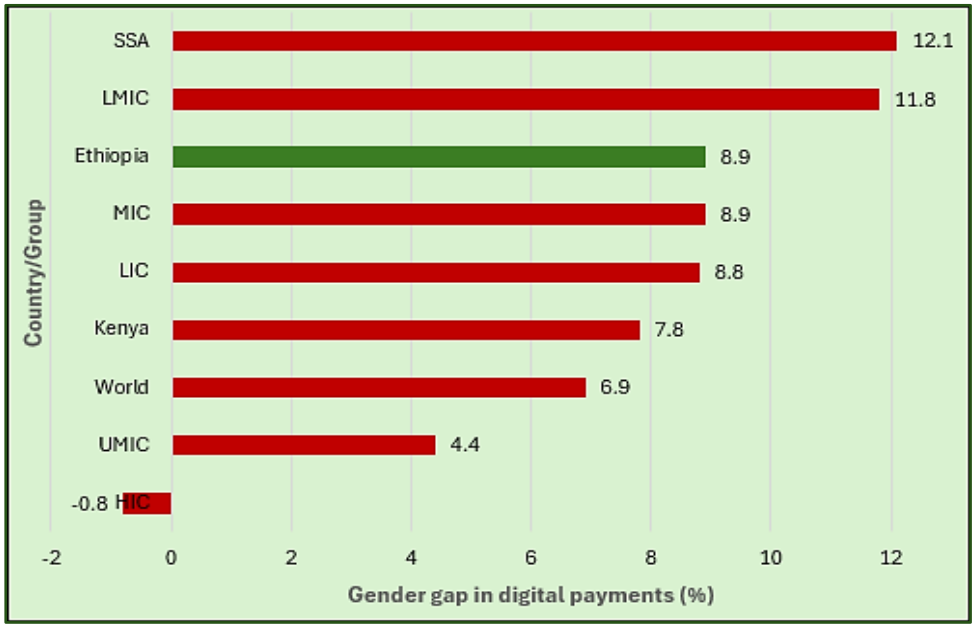
The gender gap in digital finance in Ethiopia is very high where only 15.4% female and 24.3% of male make/receive digital payments, indicating a digital finance gap of 8.9% (left panel of Figure 4.8). Digital payments made/received by female in Kenya (73.8%), SSA (95.7%), and the world (60.6%) are relatively higher. Only 3.9% of adult women in Ethiopia use mobile phone or the internet to send money, substantially lower than their counterparts in Kenya (66.6%), SSA (27.9%), and the world (31.7%) (right panel of Figure 4.8).

Figure 4.8: Gender gap in digital payments, case 1&2 (2021-2022)



The gender gap in digital finance in Ethiopia (8.9%) is below the LMIC (11.8%) and the SSA average (12.1%) (Figure 4.9). Ethiopia is relatively in a better position in inclusive digital finance, though there is substantial gap it should fill when compared to the rest of the world, including Kenya (7.8%), UMIC (4.4%) and HIC (-0.8%).

Figure 4.9: Gender gap in digital payments (2021/2022)

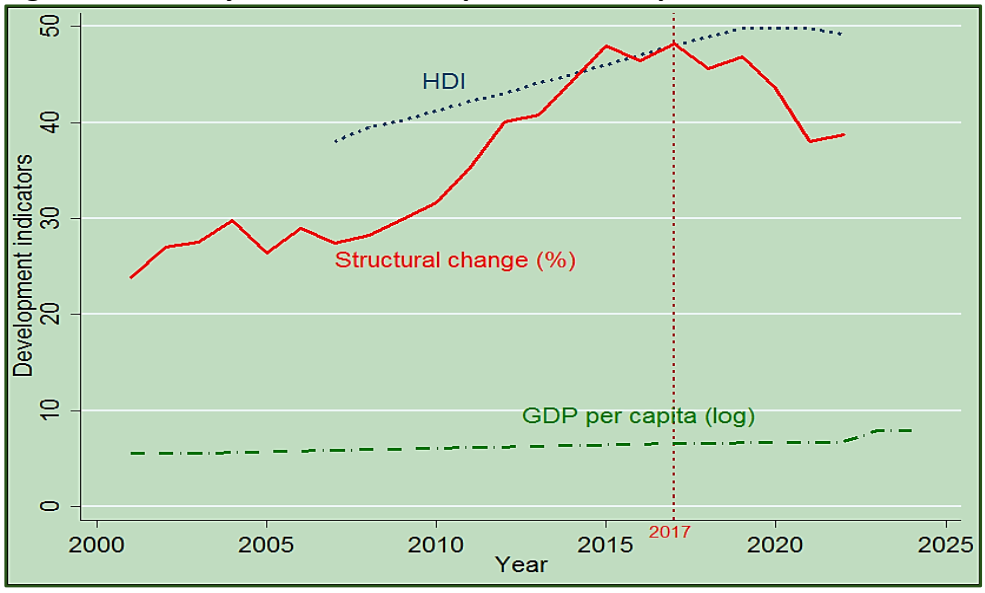


5. Impacts of DPI

5.1. Development and Governance in Ethiopia

Development in Ethiopia, proxied by three indicators (GDP per capita, HDI, and structural change), shows significant improvements until 2017 (Figure 5.1). However, the development indicators show contractionary trends since 2017, verifying the rapid deterioration of economic and social progress. In 2022, Ethiopia was ranked 176th (out of 193 economies) with 49.2% HDI (very high status) (UNDP, 2022). The movement of labor and other productive assets from low productivity sectors (such as agriculture) to high productivity sectors (such as manufacturing and services) was drastically reversed, likely leading to overall economic recession. Ethiopia is required to reverse this contractionary process by ensuring macroeconomic stability and enhancing production and supply of goods and services through mobilizing all productive capacities constrained by the current domestic conflicts widely prevailed in the country. Mobilization of productive capacities requires digitalization of the government services through development of DPI that has been adversely affected by these conflicts.

Figure 5.1: The dynamics of development in Ethiopia

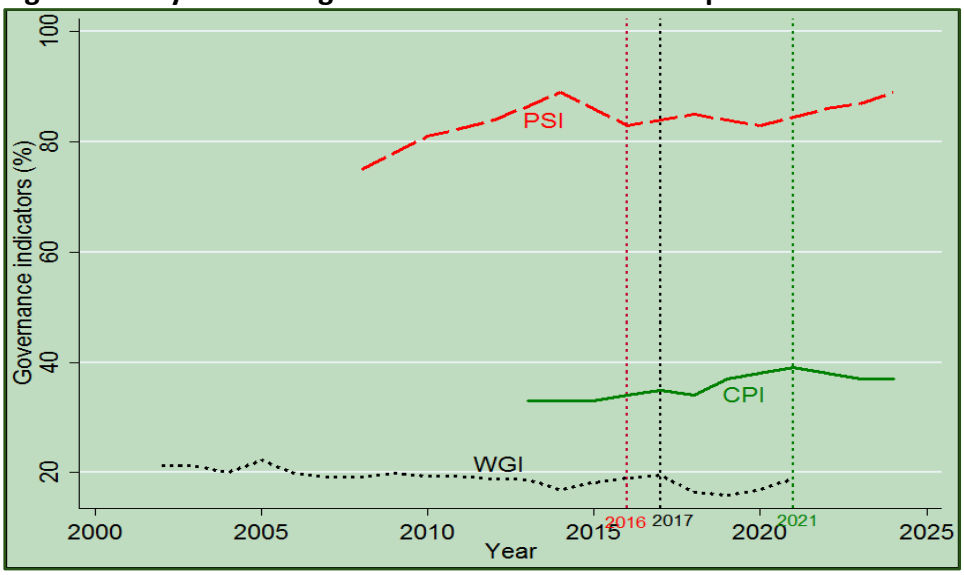


Source: Computed from data in UNDP, UNCTAD, and the World Bank

Overall governance, proxied by three indicators (WGI, CPI and PSI), shows either deteriorating or unchanging trends over the years (Figure 5.2). Governance, measured by Worldwide Governance indicators (WGI) remained significantly unchanged over the years; it was rather deteriorating since 2017. Instability of public service delivery measured by Public Services Index (PSI) shows significant deterioration since 2016. In 2024, Ethiopia was among the bottom 12 countries (ranked 12th out of 189 countries) with 81.8% of fragile states index (FSI), reflecting the highest fragility of public service delivery (FFP, 2024). Public sector corruption measured by Corruption Perception Index (CPI) remained consistently increasing since 2021. In 2024, Ethiopia was ranked 99th with CPI of 37% (TI, 2024).

Trends of the three governance indicators are likely associated with the underlying factors such as domestic conflicts and socioeconomic uncertainties. The prevalence of domestic conflicts adversely affected governance and public service delivery by creating socioeconomic environment conducive for public sector corruption in Ethiopia. Domestic conflicts and the several states of emergency likely eroded the rule of law, political stability, voice and accountability, regulatory quality, governance effectiveness, and aggravated violence, eventually leading to weak control of corruption and bad governance. Very poor public service delivery and high corruption are associated with bad governance (FDRE, 2016, 2018, 2023b).

Figure 5.2: Dynamics of governance situation in Ethiopia



Source: Computed from data in the World Bank, TI and FFP.

Several studies reveal that the negative association between development and digitalization in the latest years is primarily associated with the domestic conflicts and political unrest widely prevailed in Ethiopia. The study on the northern conflict reveals the destruction of infrastructure, disruption of production, and the displacement of more than 4.2 million people, causing considerable social trauma. Crucial economic facilities, such as airports, roads and bridges, health and education facilities, power stations, telecom lines, factories and production facilities, farms, processing plants, and other key infrastructures have been damaged by the conflict (CIPE, 2022), This has led to closure of businesses, inability of businesses to access inputs, shortage of cash, unemployment, and displacement. Real sectors of the economy have been significantly and adversely affected by the conflict.

The other study coving the period 2019-2020 estimated the value of direct costs of the domestic conflicts and violent political unrest in other parts of the country was estimated to be ETB 8.8 billion (in 2020 prices), which could require a recovery budge of USD 44 billion in five years (Atlaw *et al.,* 2023). The magnitude of indirect costs expands with the time taken to rehabilitate the households and businesses. Since November 2020, the bloody war in northern Ethiopia has left the Ethiopia's economy battered, devastated its infrastructure (including DPI), and left thousands dead and many displaced. Overall, the cost of war in northern Ethiopia runs into billions of dollars arising from vast destruction of social and economic infrastructure (Addis & Wasike, 2022).

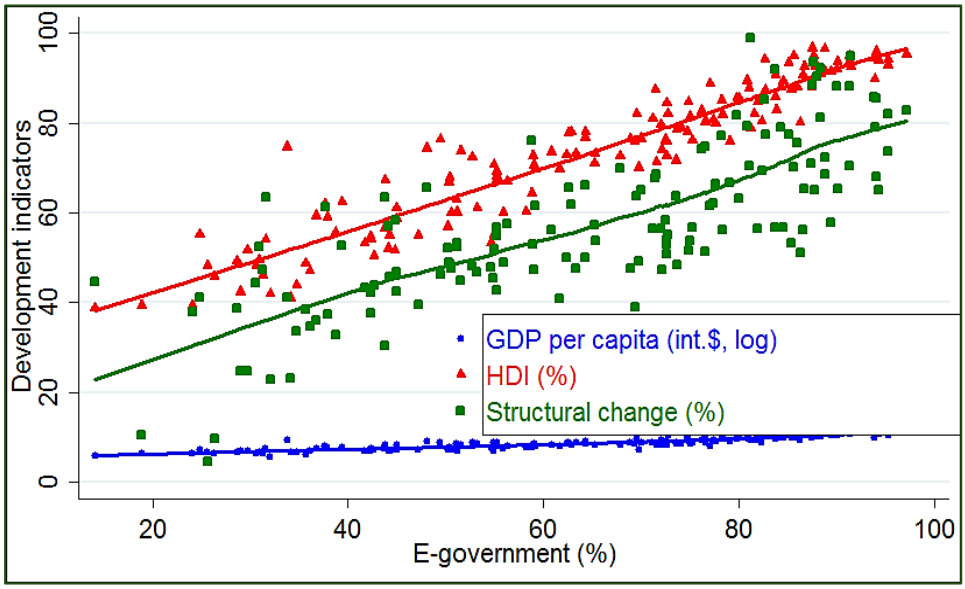
5.2. Development Impacts

The impacts of e-government on the three redevelopment indicators were investigated using correlation and parametric methods. There is strong positive association between e-government[7] and the three measures of development (Figure 5.1). Human development (r=0.994) shows the strongest association with digital government followed by GDP per capita (r=0.873), and structural change (r=0.779), the movement of labor and other productive resources from low productivity to higher productivity sectors. Developments in digital government strongly enhance the process of

[7] Because of its comprehensive nature and time coverage, the EGDI is used to assess the association with and the impacts of DPI on development and governance. Compared to EGDI, the 3I covers very short period (2017-2022) and the ICT is relatively less comprehensive measure of DPI.

structural change, leading to social progress and increased income of citizens around the world.

Figure 5.3: Development is strongly associated with digitalization of government services

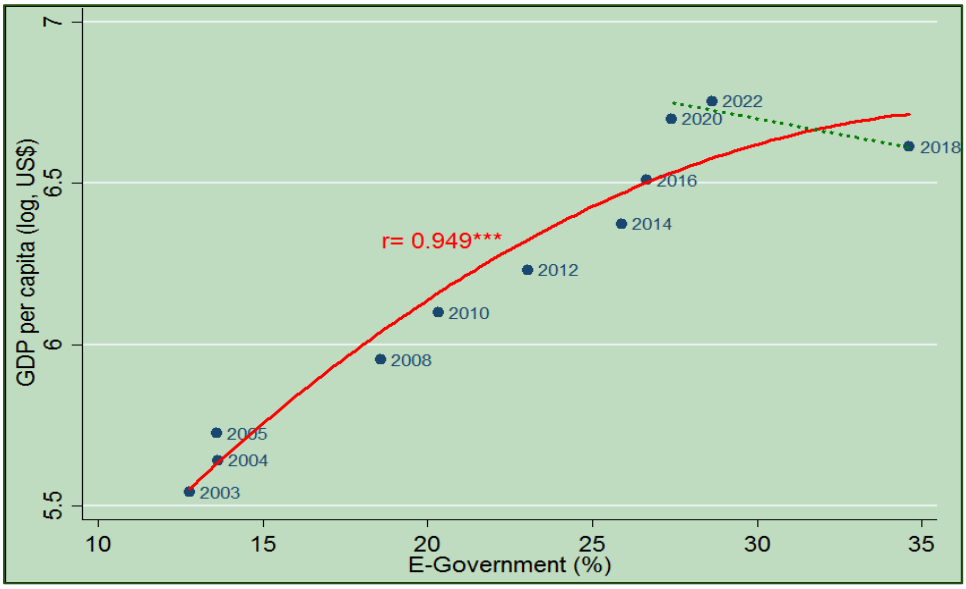


Source: Computed from data in UN, UNCTAD, and World Bank

5.2.1. Economic progress

Economic progress in Ethiopia, measured by GDP per capita, shows a strong positive association with e-government (with linear correlation coefficient, r=0.949), suggesting that economic progress of citizens observed over the period was strongly associated with the digital initiatives (Figure 5.2). However, since 2018, the dynamic link between e-government and economic progress shows a reversal trend, likely linked with the domestic conflicts and the state of emergency that interrupted internet connections and other digital facilities in several regions of the country, including Tigray, Amhara, Afar, and Oromia. Economic progress of countries around the world is also strongly enhanced with e-government (r=0.873). However, Ethiopia with e-government index of 28.7%, is among the bottom countries with very low digitalization and economic progress.

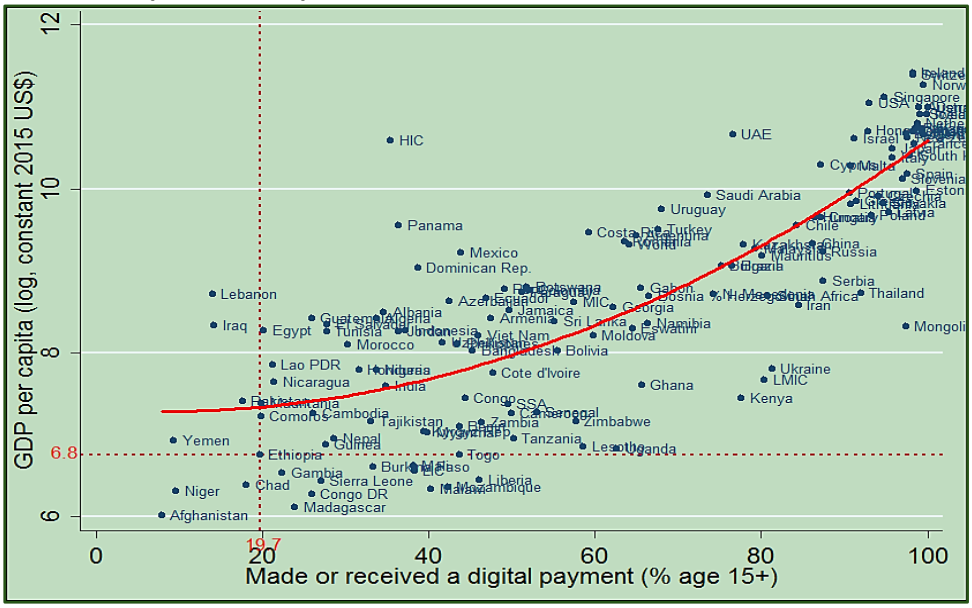
Figure 5.4: GDP per capita grows with digitalization of government services



Source: Computed from data in the UN and the World Bank.

The dynamic link between GDP per capita and three digital use cases is measured to assess the role of DPI on global development. Digital payments made/received by adult population in countries around the world is strongly associated with the state of development of digital payment systems (Figure 5.3). Economic progress of countries was strongly and nonlinearly associated with their digital payment system(r=0.797), verifying the role of digital finance in enhancing economic progress. Ethiopia with 19.7% of adults making/receiving digital payments, is among the bottom countries with least digital payment systems.

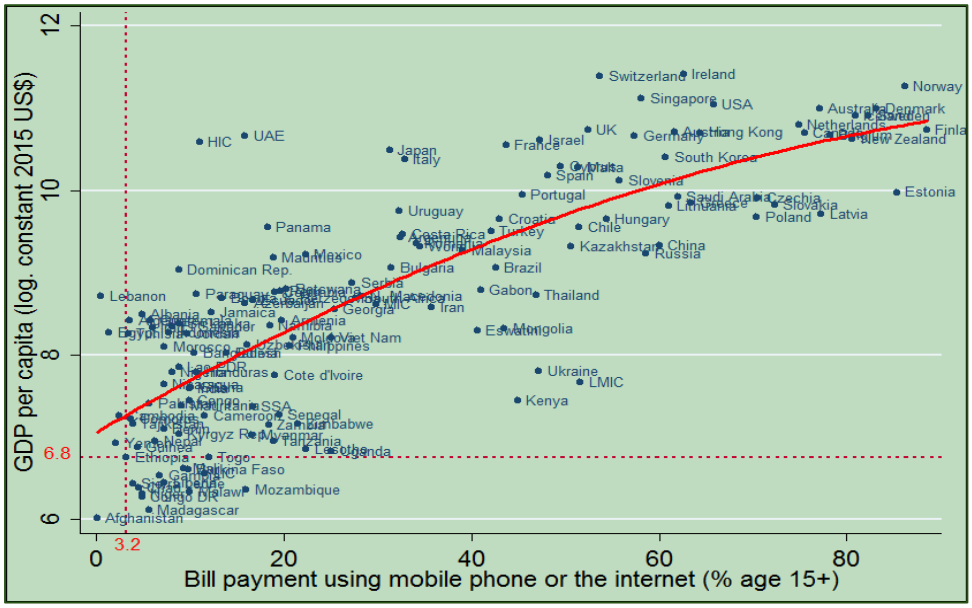
Figure 5.5: GDP per capita income grows with digital finance (use case 1) (2021/2022)



Source: Computed from data in the World Bank.

The use of digital payment methods such as mobile phones or the internet are also investigated for their association with economic progress of countries (Figure 5.4). Digital payments using mobile phones or the internet are found to have a strong, positive, but nonlinear (exponential) association with economic progress (r=0.785). Economic progress around the world is strongly enhanced by the development of digital payments using digital technologies. Ethiopia, with only 3.2% of adults making bill payments using a mobile phone or the internet, is among the bottom countries where digital payment of bills is very low.

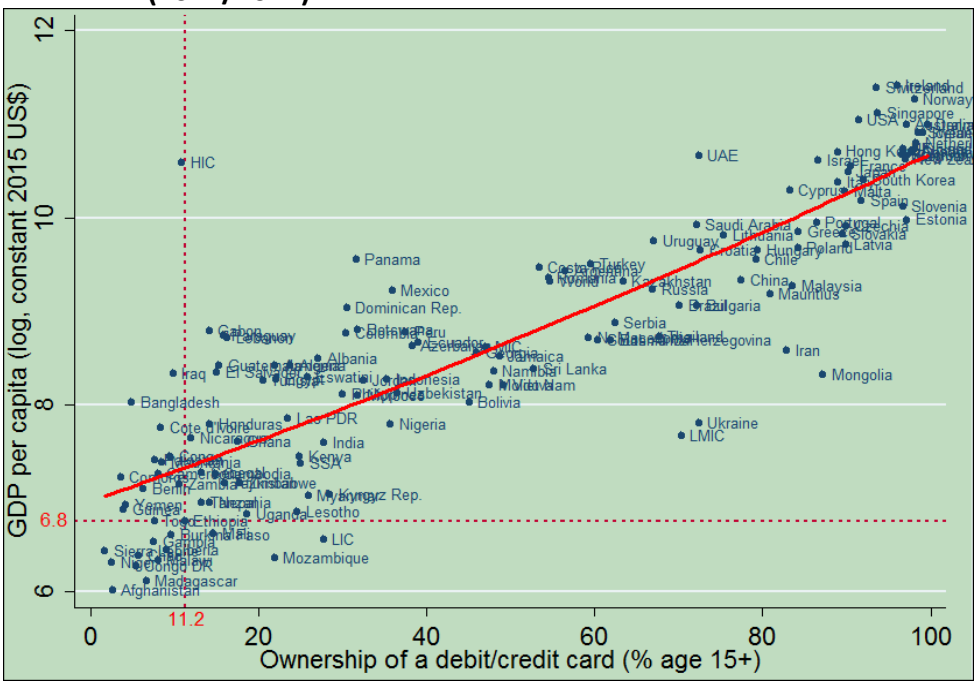
Figure 5.6: GDP per capita income grows with digital finance (use case 2) (2021/2022)



Source: Computed from data in the World Bank.

The other digital case used to assess the link between economic progress and DPI is ownership of debit/credit cards. Economic progress is strongly and positively linked (r=0.872) with the use of debit/credit card as means of digital payment (Figure 5.5). Only 11.2% of the adult population in Ethiopia owns debit/credit cards for digital payment, which is by far lower than its counterparts in Africa and the rest of the world.

Figure 5.7: GDP per capita income grows with digital finance (use case 3) (2021/2022)



Source: Computed from data in the World Bank.

The results of the parametric method, linear panel data model population-averaged[8], supports the results found from the nonparametric methods discussed above. GDP per capita of countries is significantly and positively impacted by the three elements of e-government (Table 5.1). The three elements of e-government have nearly comparable effects on GDP per capita with more pronounced effect by human capital (32.3%), followed by online services (31.8%) and telecom infrastructure (22.2%). Online services, human capital, and telecom infrastructure are the three important digital elements of e-government enhancing economic progress of countries. The effect of other factors on economic progress captured by the constant term is also huge.

[8] An estimator is consistent if the (transformed) explanatory variables are uncorrelated with the residual, and inconsistent if correlated with the residual. In all cases of the RE model, the residuals are correlated with the explanatory variables. In this case, the PA was selected to estimate consistent parameters.

Table 5.1: Impacts of E-Government on GDP per capita

DPI indicators	Coefficient	Standard errors
Online services	31.83***	6.123
Human capital	32.34***	11.527
Telecom infrastructure	22.18***	6.011
Constant	8957.22***	1706.725
Wald chi2	101.54***	
Observations	1,077	
Panels	154	
Years	7	

Note: *** denotes 1% level of statistical significance of the coefficient.
Source: Computed from data in the World Bank.

The impacts of e-government on economic progress obtained from the parametric model can be summarized as follows:

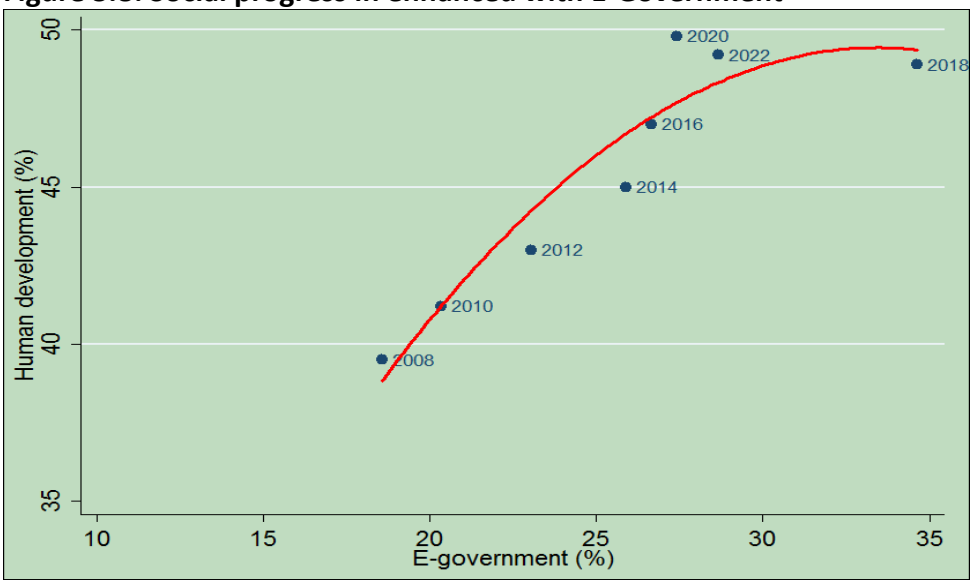
- As online services increase by a unit percentage, GDP per capita (log of int.$) between countries over the years will increase by 31.8%.
- As human capital increases by a unit percentage, GDP per capita between countries over the years will increase by 32.3%.
- As telecom infrastructure grows by a unit percentage, GDP per capita between countries over the years will increase by 22.2%.
- As indicated by the strongly significant model fitness test (Wald chi2=101.54), the panel data model adequately explains the spatiotemporal link between e-government and economic progress.
- The results from the pool of 1077 observations or datapoints (154 countries/economies over seven years) can be considered as the global average.
- There are other unobserved factors significantly explaining the link between economic progress and e-government, though they could not be measured and modelled in this case.

5.2.2. Social progress

Social progress is the capacity of a society to meet the basic human needs of its citizens, establish the building blocks that allow citizens and communities to enhance and sustain the quality of their lives, and create the conditions for all individuals to reach their full potential (Harvard Business School, 2016).

The Human development index (HDI) a summary measure of human development covering three dimensions of human development: education healthy, and gross national income (GNI) measuring a descent standard of living. The dynamic association between e-government and human development in Ethiopia is strongly enhanced with e-government (r=0.885) (Figure 5.6). However, as depicted in the figure, the link between human development and e-government shows a reversal trend since 2018. As described before, the likely reason is the domestic conflicts and the associated state of emergency adversely affecting e-government and digital initiatives in Ethiopia. Over the years before 2018, e-government in Ethiopia strongly enhanced social progress. Social progress and digitalization around the world are strongly and directly associated (r=0.944).

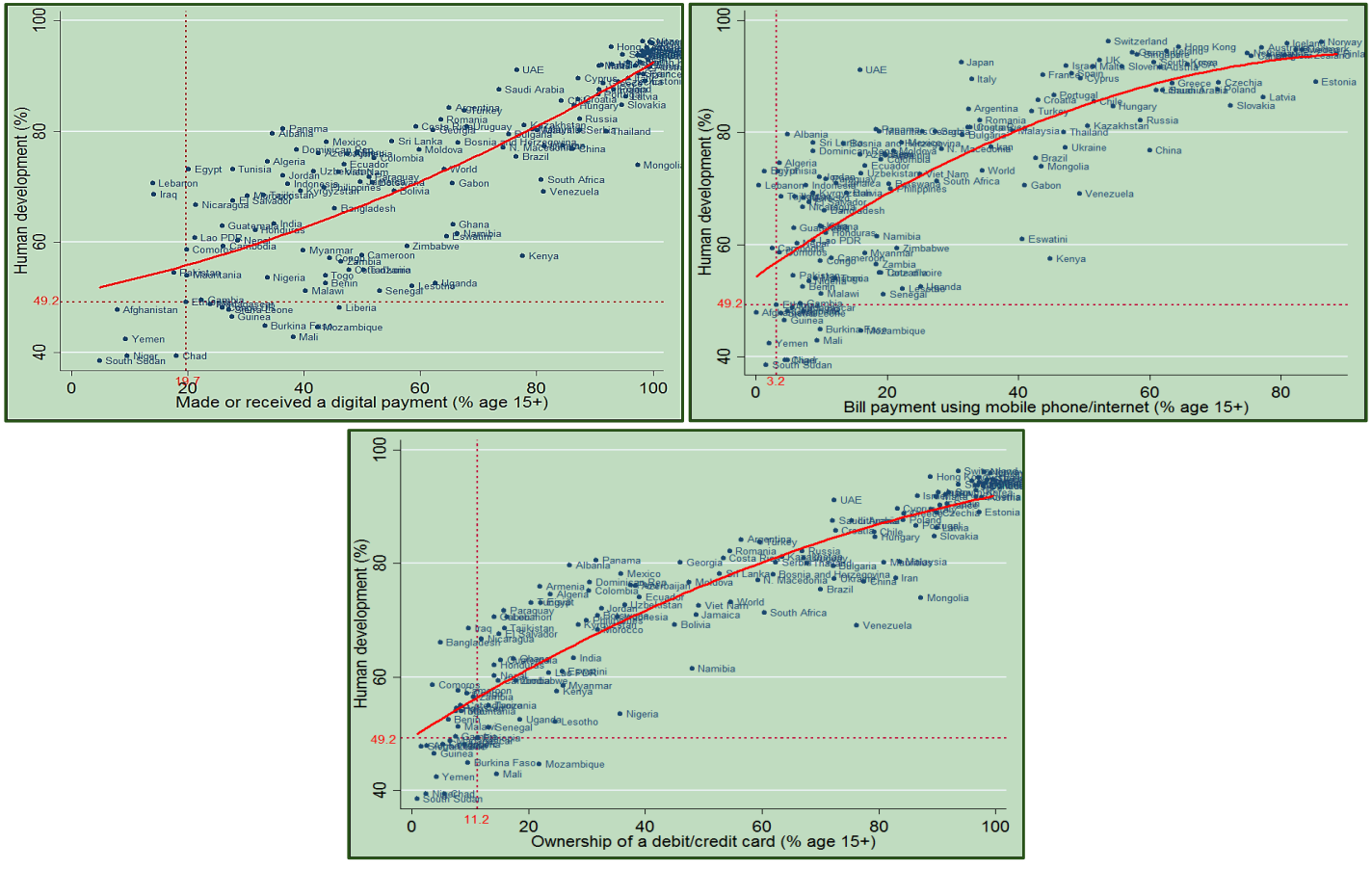
Figure 5.8: Social progress in enhanced with E-Government



Source: Computed from data in the UN and the UNDP.

Other digital use cases are also strongly associated with social progress around the world (Figure 5.7). Social progress around the world is strongly enhanced with digital payments made/received by adult population (r=0.818) (top panel of Figure 5.7). The strong exponential link between digital payments and social progress suggests the role of digital payment systems in enhancing human development. Ethiopia is among the bottom countries with very low digital payments and benefiting the least from digital initiatives. Social progress is also strongly enhanced with bill payment using mobile phone or the internet (r=0.775) (middle panel of Figure 5.7) and ownership of debit/credit cards (r=0.897) (bottom panel of Figure 5.7). Ethiopia is among the least benefited from such digital payment systems.

Figure 5.9: Social progress enhanced with digital finance (digital use cases 1, 2 & 3) (2021/2022)



Source: Computed from data in the UNDP and the World Bank.

The impacts of e-government on social progress are estimated and reported below (Table 5.2). Social progress around the world is strongly and positively impacted by e-government. The model outputs have several implications as outlined below.

- As online services increase by a unit percentage, human development between countries over the years will increase by 0.04%.
- As telecom infrastructure grows by a unit percentage, human development between countries over the years will increase by 0.06%.
- The panel model adequately explains the parametric link between e-government and social progress.
- The results from 1,161 data points (166 countries/economies and 7 years) can be considered as the global average.
- There are other unobserved factors significantly explaining the link between social progress and e-government. They could not be measured and modelled in this case.

Table 5.2: Impacts of E-Government on Social progress

E-Government	Coefficient	Standard errors
Online services	0.04***	0.004
Telecom infrastructure	0.06***	0.004
Constant	66.71***	1.07
Wald chi2	767.4***	
Observations	1,161	
Countries (Panels)	166	
Years	7	

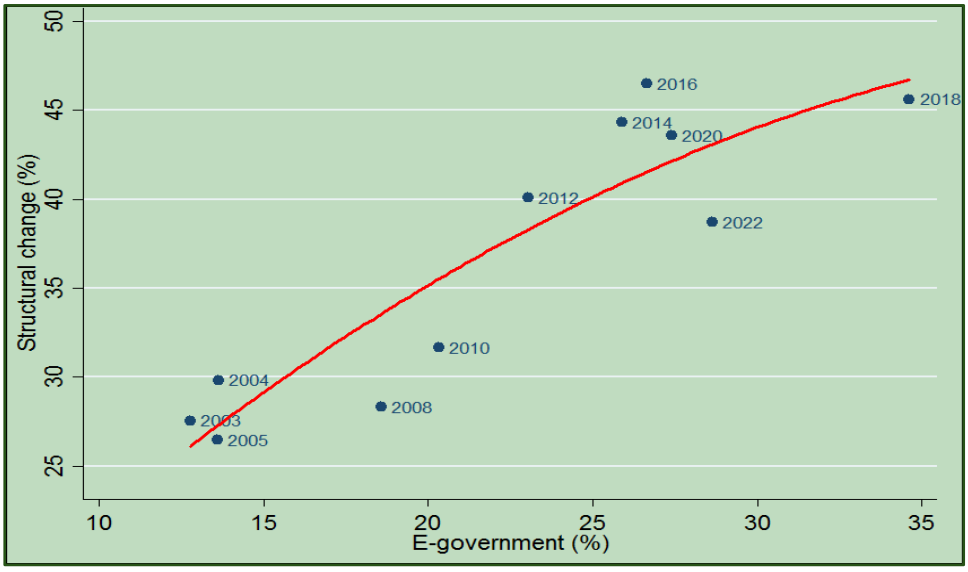
Note: *** denotes 1% level of statistical significance of the coefficient.
Source: Computed from data in the UN and the UNDP.

5.2.3. Structural change

Structural change in Ethiopia was strongly enhanced with e-government over the years (Figure 5.8). There is a very strong association between structural change and e-government (r=0.897). As discussed above, the dynamic link between structural change and e-government shows

reversal trend since 2018 with similar reasons associated with the state of emergency constraining DPI. The reallocation of productive resources from low productivity to high productive sectors in countries around the world was improved with development of digital infrastructure. Structural change is found to be strongly linked with digital governments (r=0.779). Ethiopia is one of the bottom countries with very low structural change.

Figure 5.10: Structural change in Ethiopia increasing with E-Government



Source: Computed from data in the UN and the UNCTAD.

The parametric model outputs support the descriptive results discussed above. Structural change is weakly impacted by e-government (Table 5.3). The impacts of e-government on structural change are generally low, below 1%. The following are the specific implications:

- As online services increase by a unit percentage, structural change between countries over the years will increase by 0.03%.
- As human capital rises by a unit percentage, structural change between countries over the years will increase by 0.09%.
- As telecom infrastructure increase by a unit percentage, structural change between countries over the years will increase by 0.01%.
- The panel model adequately explains the parametric link between e-government and structural change.

- The results from a pool of 1,222 data points (175 countries/economies and 7 years) can be considered as the global average.
- There are other unobserved factors significantly explaining the link between structural change and e-government.

Table 5.3: Impacts of E-Government on structural change

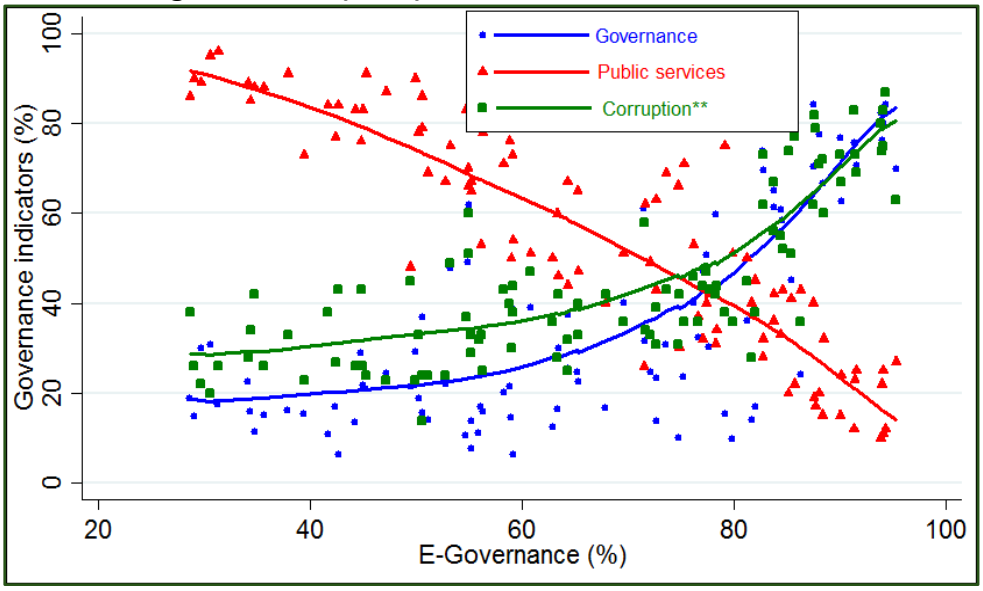
E-Government	Coefficient	Standard errors
Online services	0.029***	0.012
Human capital	0.09***	0.018
Telecom infrastructure	0.01	0.012
Constant	47.38***	1.809
Wald chi2	33.99	
Observations	1,222	
Countries	175	
Years	7	

Note: *** denotes 1% level of statistical significance of the coefficient.
Source: Computed from data in the UN and the UNCTAD.

5.3. Governance Impacts

The empirical link between e-government and the three aspects of governance has consistent implications. Improvements in digitalization of government services are associated with improved governance, good public service delivery, and reduced corruption (Figure 5.9). The aggregate index of worldwide governance indicators used to measure the overall governance of countries is exponentially and positively associated with e-government (r=0.620). Corruption perception decreases with improved digitalization of governments (r=0.763). Countries with high digitalization are characterized by low public sector corruption. Fragility of public service delivery decreases with improved digitalization (r=-0.903).

Figure 5.11: Governance around the world strongly enhanced with e-government (2022)



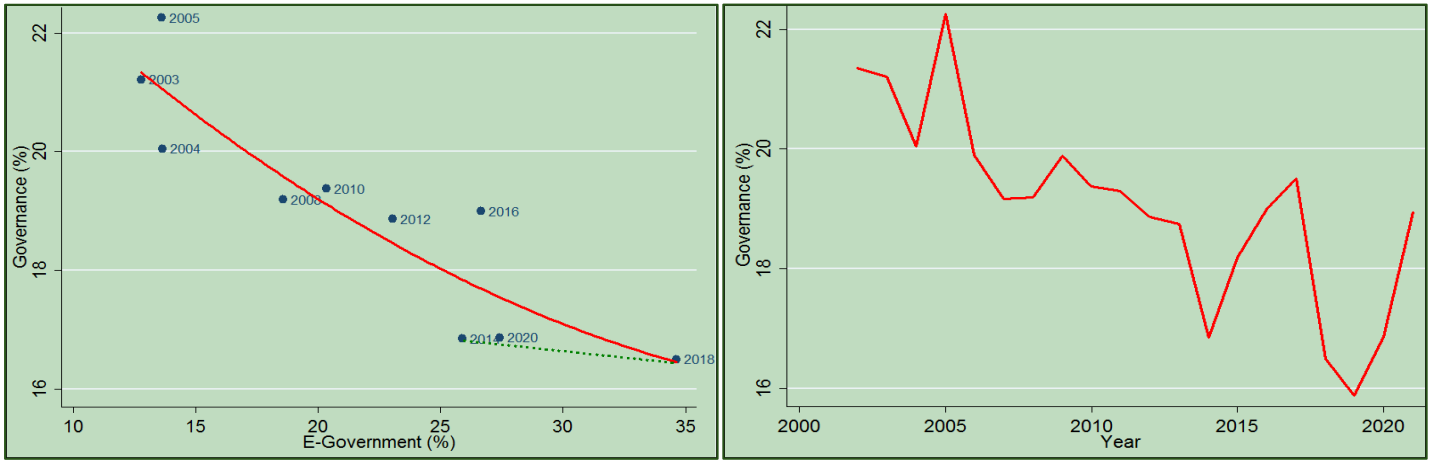
Source: Computed from data in the UN, the World Bank, TI, FFP.
Notes: High values of CPI and PSI, respectively, indicate low corruption and highly fragile public services.

5.3.1. Overall governance

Governance and digitalization are expected to have a positive association. However, over the last two decades, governance in Ethiopia was drastically deteriorating despite the improvements in digitalization (left panel of Figure 5.10). This negative association is more illustrated by the time trend of governance over the period (right panel of Figure 5.10). The positive role of digitalization in improving overall governance is not reflected in Ethiopia. This is likely associated with the domestic conflicts and state of emergency adversely affecting internet connections and digital uses. Due to conflicts and their adverse consequences, governance (including, voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption) is deteriorating in Ethiopia.

However, unlike the case in Ethiopia, governance around the world is strongly associated with e-government (r=0.620). Developments in digitalization are associated with improved governance.

Figure 5.12: Governance in Ethiopia deteriorating despite the rising E-Government



Source: Computed from data in the UN and the World Bank.

The panel data model outputs estimated from a pool of 180 countries over six years have consistent implications with the results reported above (Table 5.4).

- As online services increase by 1%, governance between countries over the years will increase by 0.02%.
- As human capital rises by 1%, governance between countries over the years will increase by 0.07%.
- The impact of e-government on governance is significant but generally low.
- There is no adequate evidence indicating the effects of telecom infrastructure on governance.
- The panel model adequately explains the parametric link between e-government and governance and can be considered as an estimator of the global average.
- There are other unobserved factors significantly explaining the link between governance and e-government. They could not be measured and modelled in this case.

Table 5.4: Governance impacts of E-Government

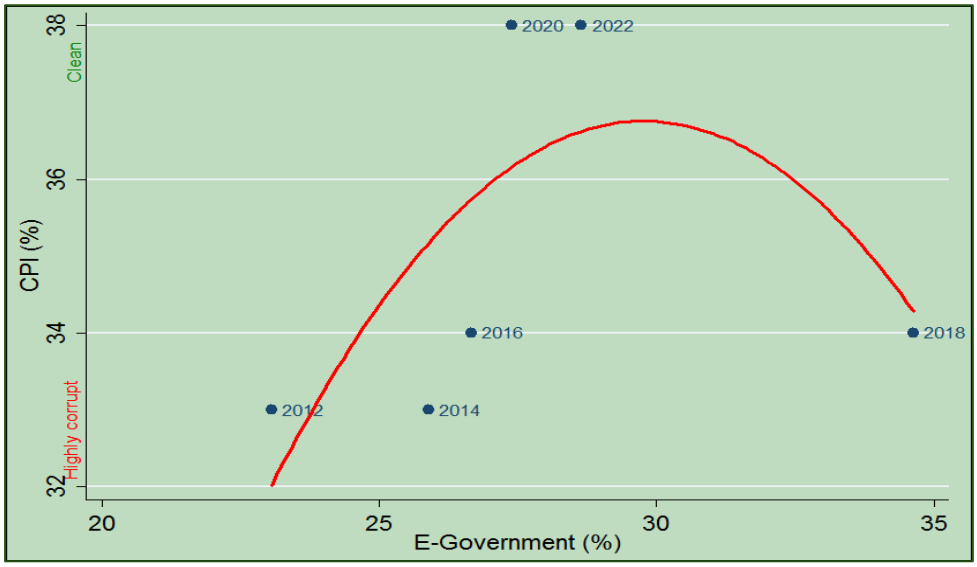
E-Government	Coefficient	Standard errors
Online services	0.02***	0.014
Human capital	0.07***	0.02
Telcom infrastructure	0.02	0.016
Constant	31.05***	2.332
Wald chi2	17.38***	
Observations	1,080	
Countries (Panels)	180	
Years	6	

Note: *** denotes 1% level of statistical significance of the coefficient.
Source: Computed from data in the UN, and the World Bank.

5.3.2. Corruption

The dynamic link between corruption and digitalization in Ethiopia is nonlinear (Figure 5.11). However, in 2018, corruption was very high, likely associated with the political instability when the incumbent regime came into power. After 2018, corruption was again reducing, though digitalization was strongly constrained due to domestic conflicts and state of emergency. Globally, unlike Ethiopia, e-government is strongly and exponentially linked with corruption (r=0.763). Ethiopia, with CPI of 28% in 2022, is among the top countries where corruption is perceived to be very high.

Figure 5.13: Corruption reduces with e-government worldwide but in Ethiopia



Source: Computed from data in the TI the UN, and Economic Impact.

The parametric link between corruption and digitalization is found to be strongly significant (Table 5.5). Reducing corruption is driven by improvements in digitalization. The impact of e-government on corruption is summarized as follows.

- As online services increase by one percentage point, corruption between countries over the years will reduce by 0.02%.
- As human capital index rises by one percentage point, corruption between countries over the years will increase by 0.07%.
- The impact of e-government on corruption is significant but generally low.
- There is no adequate evidence indicating the effects of telecom infrastructure on corruption.
- The panel model adequately explains the parametric link between e-government and corruption which can be considered as an estimator of the global average.
- There are other unobserved factors significantly explaining the link between corruption and e-government. They could not be measured and modelled in this case.

Table 5.5: Corruption impacts of E-Government

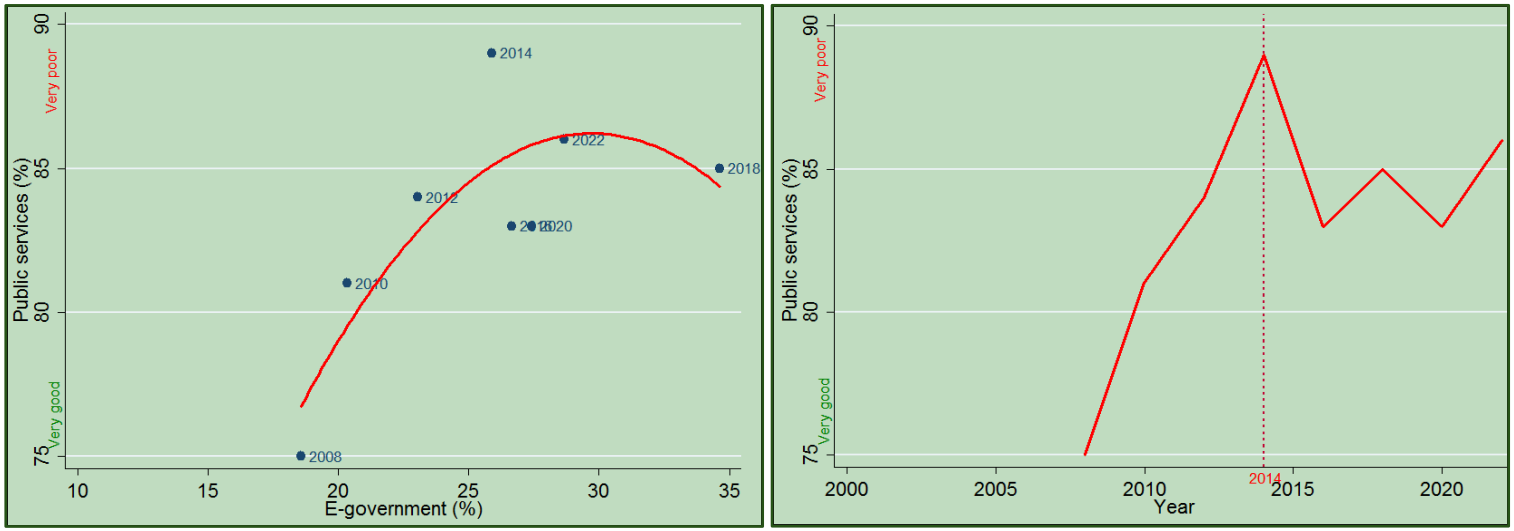
E-Government	Coefficient	Standard error
Online services	0.02***	0.010
Human capital	0.07***	0.0218
Telecom infrastructure	0.00	0.010
Constant	36.32***	1.985
Wald chi2	25.93***	
Observations	996	
Countries (Panels)	166	
Years	6	

Note: *** denotes 1% level of statistical significance of the coefficient.
Source: Computed from data in the UN and TI.

5.3.3. Public services

Digitalization is expected to strengthen public service delivery, improved access, inclusion and efficiency. The presence of basic state functions generally improves with digitalization. Digitalization is expected to enhance the provision of essential services, such as health, education, water and sanitation, transport infrastructure, and electricity and power. The association between e-government and public service delivery in Ethiopia is unexpected (r=0.642) (left panel of Figure 5.12). Despite the positive developments in digitalization, public service delivery has been increasingly fragile (right panel of Figure 5.12). The rapid improvements in public service delivery registered until 2014 were deteriorating and fragile. However, as expected, public service delivery in countries around the world is strongly associated with digitalization (r=0.903). Public services are significantly improving with digitalization.

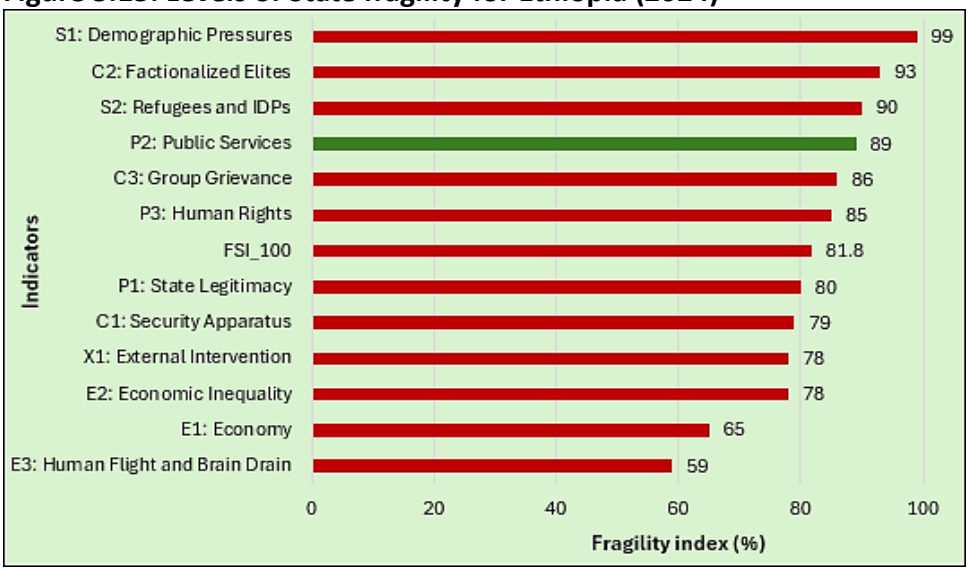
Figure 5.14: Public services in Ethiopia deteriorating with rising E-Government



Source: Computed from data in the UN and FFP.

Using the 12 indicators of state fragility, the overall state fragility index for Ethiopia in 2024 was 81.8% (Figure 5.15). The top five sources of state fragility in Ethiopia are demographic pressures (99%), factionalized elites (93%), refugees and internally displaced persons (IDPs) (90%), public services (89%), and group grievance (86%). Fragility of public services is one of the major factors likely affected by the domestic conflicts. Other sources of fragility such as factualized elites, refugees and IDPs, and group grievance also adversely affect public services, leading to highly fragile public service delivery. The evidence generally shows that, despite the positive developments in DPI, Ethiopia is one of the most fragile states in the world.

Figure 5.15: Levels of State fragility for Ethiopia (2024)



Source: Computed from data in the FFP (2024).

Based on the the state fragility index in 2024, Ethiopia could be characterized by following fragilities adversely affecting its development and governance (FFP, 2024):

1. **Demographic pressures (99%):** Demographic pressures upon the Ethiopian government deriving from the population to produce and supply more goods and services is very high.
2. **Factionalized elites (93%):** The fragmentation of government institutions along ethnic, class, clan, racial or religious lines is very high.
3. **Refugees and IDPs (90%):** The pressure upon the government caused by the forced displacement of large communities because of social, political, and environmental causes is very high,
4. **Public services (89%):** Basic state functions that serve the people (including essential services such as health, education, water and sanitation, transport infrastructure, electricity and power, and internet and connectivity) are very poor.
5. **Group grievance (86%):** The divisions and schisms between different groups in society– particularly divisions based on social or political characteristics – and their role in access to services or resources, and inclusion in the political process is very high.

6. **Human rights and rule of law (85%):** The protection of fundamental human rights and the rule of law are very poor, adversely affecting the relationship between the government and the population.
7. **State legitimacy (80%):** The representativeness and openness of the government and its relationship with its citizenry is very poor.
8. **Security apparatus (79%):** The security threats to the government is high.
9. **External intervention (78%):** The influence and impact of external actors in the functioning of the government is high.
10. **Uneven economic development (or economic inequality) (78%)**: Inequality within the economy, irrespective of the actual performance of the economy, is high.
11. **Economic decline and poverty (65%):** Ther is progressive economic decline (measured by per capita income) within the country.
12. **Humna flight and brain drain (59%)**: The economic impact of human displacement (for economic or political reasons) and the consequences this may have on the country's development is significant.

The model outputs show that public services are significantly impacted by digitalization (Table 5.6). The results show the following insights.

- As online services increase by one percentage point, public services between countries over the years will improve by 0.09%.
- As human capital index rises by one percentage point, public services between countries over the years will improve by 0.15%.
- As telecom infrastructure rises by one percentage point, public services between countries over the years will improve by 0.14%.
- The panel model adequately explains the parametric link between e-government and public service delivery.
- The model can be considered as the estimator of the global average link between public service and e-governance.
- There are other unobserved factors significantly explaining the link between corruption and e-government. They could not be measured and modelled in this case.

Table 5.6: Impacts of E-Government on public services

E-Government	Coefficient	Standard error
Online services	-0.09***	0.015
Human capital	-0.15***	0.022
Telecom infrastructure	-0.14***	0.014
Constant	76.01***	2.194
Wald chi2	381.83***	
Observations	1,335	
Countries (Panels)	167	
Years	8	

Note: *** denotes 1% level of statistical significance of the coefficient.
Source: Computed from data in the UN and FFP.

6. Recommendation

Development and governance have shown strong positive association with DPI and level of digitalization in Ethiopia and beyond. Digitalization and integration of of institutions are found to be the most important drivers of development and good governance. However, there is a wider global gap among countries and economies in their stage of DPI development and digitalization affecting their development and governance situation.

The findings of this pilot study particularly highlight to the following concluding remarks and specific recommendations.

1. The impacts of DPI on development in Ethiopia are not as expected. Over the last 5-6 years (2017-2024), unlike the global trend, socioeconomic progress and structural change in Ethiopia was negatively associated with DPI. This was mainly attributable to the domestic conflicts and political instabilities widely prevailed in the country. Productive capacities are strongly constrained by the domestic conflicts, political instabilities, and the associated states of emergency proclaimed several times since 2016. To exploit the benefits of DPI and digitalization and accelerate socioeconomic progress, Ethiopia should ensure peace and security and enhance socioeconomic progress through the effective implementation and use of DPI and digitalization.
2. Governance in Ethiopia remains very poor for years. Unlike the rest of the world, overall governance is not enhanced with DPI and digitalization. Governance is unchanged or deteriorating over the past two decades. Public sector corruption is increasing over the years. Public service delivery is deteriorating since 2016. Ethiopia should improve its overall governance through additional investment on DPI and the effective use of DPI and digitalization. Additional investment and use of DPI calls for the urgent need for addressing the challenges of domestic conflicts and the associated investment risks.
3. Ethiopia is among the bottom countries in inclusive DPI and digitalization. Wider gaps in gender, location (or rural-urban settings) and income are the major factors adversely affecting inclusive DPI and digitalization. One of the key barriers to the effective utilization of Digital Public Infrastructure (DPI) is the

relatively low level of digital literacy, which is often linked to broader general literacy rates. Without adequate digital literacy, individuals are unable to fully leverage the benefits of DPI which limit the potential impact DPI on development and governance. To address this issue, the government of Ethiopia, development partners, and various stakeholders in DPI Ethiopia need prioritize the integration of digital literacy into their strategies. The promotion of digital literacy should be viewed not just as an educational effort, but as a fundamental component of ensuring that the benefits of DPI are accessible and impactful across all segments of society.

4. The national ID program in Ethiopia is the foundational and the essential initiative for digitalization. However, the progress of the rollout of the national ID is very sluggish, seems less likely to reach significant proportion of the adult population by 2030. Digitalization of the government services and integration of important institutions will be less likely. Inclusive and accelerated rollout of the national ID requires addressing major challenges of digital divide such as gender, remote location, income, digital literacy, and attitude towards digitalization. These challenges are interconnected, stemming from the limited accessibility of services to disadvantaged groups in society. To tackle this issue, the government of Ethiopia needs collaborate with development partners and the private sector to make a dramatic shift in the accessibility of Internet of Things (IoT) services and financial services nationwide. For example, the government could grant permits to fintech companies, enabling them to invest in network infrastructure in rural areas along with offering mobile devices to individuals on subsidized prices on a loan basis, without requiring collateral. This takes time and requires formulation of appropriate digital policy and legal frameworks. The other critical yet often overlooked issue concerning the National ID program is the public's trust, particularly in relation to data security and personal privacy. This concern arises from fears about how personal information will be stored, accessed, and protected. Given the Ethiopia’s government limited experience and expertise in managing such sensitive data, it is necessary to develop a pool of qualified professionals who possess the necessary skills to

safeguard the integrity and sustainability of the initiative. The government should focus on effectively managing this sensitive data by developing a skilled workforce. This will, in turn, help boost public confidence in the digitization process. Furthermore, Ethiopia can greatly benefit from learning from the experiences of other countries that have successfully implemented similar programs. Engaging in experience-sharing initiatives, seeking technical support, and adapting global best practices can significantly enhance the effectiveness of the National ID program.

5. There is a wider disparity among countries and economies in DPI and digitalization. This global digital divide constrains the global integration of economies and institutions for inclusive global development and good governance. Stakeholders should invest and fill the digital gap among economies around the world.

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or write to communications@gdn.int for more information.

GDN Global Development Network

INDIA: 2nd Floor, West Wing ISID Complex, 4,
Vasant Kunj Institutional Area, New Delhi-110070, India

EUROPE: 63 Boulevard François Mitterrand - CS 50320,
63009 Clermont-Ferrand Cedex, France

US: Clifton Larson Allen LLP, 901 N. Glebe Road,
Suite 200, Arlington, VA 22203, USA