

# Synthesis on the impact of ICT sector on growth and employment in Ethiopia

---

Getachew Ahmed Abegaz  
Seneshaw Tamru Beyene



DIRECTED BY



FUNDED BY



# **Synthesis on the impact of ICT sector on growth and employment in Ethiopia**

Getachew Ahmed Abegaz and Seneshaw Tamru Beyene

Table of Contents

- 1. INTRODUCTION ..... 2
- 2. THE GROWTH LINK..... 4
- 3. EMPLOYMENT AND ICT ..... 6
- 4. AN EXAMPLE: MOBILE MONEY ..... 9
- 5. POLICY CONCERNS FOR ETHIOPIA ..... 13
- 5.1. EXPANSION OF ICT INFRASTRUCTURE ..... 13
- 5.2. CREATING A MORE COMPETITIVE ENVIRONMENT FOR MOBILE MONEY ..... 16
- 5.3. DIGITAL LITERACY AND SKILLS DEVELOPMENT ..... 18
- 5.4. CREATING AN ENABLING SYSTEM FOR TECHNOLOGY HUBS (DIGITAL INCUBATION CENTERS) ..... 19
- 6. CONCLUSIONS AND RECOMMENDATION ..... 20
- REFERENCES ..... 22

**1. Introduction**

Information communication technologies (ICTs)<sup>1</sup> helped spur economic growth, created opportunities, and improved service delivery (World Bank, 2016). The existing theoretical and empirical literature on the link between technology and growth state that technological progress is key to sustained economic growth. Cross-country empirical evidences on both aggregate and firm level evidences have also shown that an increase in ICTs infrastructure helped countries achieve better growth trajectories. Albeit the

---

<sup>1</sup> In this report, ICTs cover all digital technologies that facilitate the creation, storage, analysis, and sharing of data and information. These include, among other things, all communication technologies—computers, the internet, wireless networks, cell phones, software and middleware.

fear of unemployment that is created through automation, adopting digital technologies also helped, countries create new sectors, and occupations and achieve better job opportunities.

The net effect of the progresses in ICTs—spurring growth, creating jobs versus challenges of automation—highly depends on the way countries attempt to capture the opportunities and respond to those challenges. Ethiopia has devised a new strategy to make ICTs at the center of its development agenda. In both the *homegrown economic reform* program and the *ten-year perspective plan*, ICTs took center stage. ICT and the creative industries are one of the areas that the government has given priority in its reform agenda through “efforts that will be geared towards exploring new sources of productivity and job growth, [leveraging] on the rapidly growing educated young labor force” (Office of the Prime Minister, 2019). The government has given the ICT sector priority not as a separate sector to develop but as an enabler of other priority sectors. This has also been consolidated in a strategy through a four-part framework—infrastructure, enabling systems, applications, broader ecosystems (Ministry of Innovation and Technology, 2020). Technological capability and digital economy is also one of the pillars of the ten-year perspective plans of the Ethiopian government (Planning and Development Commission, 2020).

In this document, we attempt to see the role of ICTs to economic growth and employment in Ethiopia using the available literature and the experiences of other countries, taking mobile money as an example. We also draw lessons that the Ethiopian government can learn to maximize the digital dividend from progresses in ICTs. Results of the synthesis suggests that in order to capture the benefits from ICTs sector, the Ethiopian government should give priority to better access to ICT services through improved access to the internet; and create a more competitive environment for mobile money. To make digital transition and substitution of labor smoother, and ameliorate the impact of automation on the labor market, the government should pay attention to re-skilling of the labor force. Creating an enabling technology ecosystem including the development of tech hubs or tech incubation centers is fundamental for developing a conducive environment for entrepreneurship.

The rest of this document is organized as follows. The second section links economic growth with ICTs. The third section looks at the impact of ICTs on employment. Then, the next section provides example of an emerging technology that has the potential to change the payment system platform (i.e. mobile

money). The fifth section will look at the major policy concerns as regards to ICTs in the Ethiopian context while the final section concludes.

## 2. The Growth Link

The importance of technological progress as the ultimate driving force behind sustained growth has been recognized since the modern examination of economic growth. Early works held that sustained growth occurs only in the presence of technological progress; and without technological progress, per capita income ceases to grow as diminishing returns to capital sets in. Technological progress offsets the tendency for marginal product of capital to fall, which would help increase capital. Furthermore, labor productivity increases partly due to efficiency gains that come from technology and to the increase in capital<sup>2</sup>.

Empirically linking growth with any specific technological change is fraught with measurement and endogeneity problems. At aggregate level, tracing back economic growth to a specific technology suffers from measurement problems due to “the limited number of observations relative to the seemingly open-ended list of other potential growth correlates at the country level which makes it almost impossible to reject alternative interpretations of the same macroeconomic correlation” (World Bank, 2016). Other sources of measurement problems come from bias in aggregation (Gullickson & Harper, 2002), and from measurement errors that are correlated with investments in computers and R&D (Siegel, 1977). Nonetheless, to the extent possible, this brief will present potential magnitude of impact and contribution of the ICT sector by using quantitative evidence (building on analysis from other countries). While some of the contribution will be directly in the ICT sectors, most of the impact will be indirectly through a multiplier effect enabling growth in other sectors. This makes the impact potentially more explosive but also more difficult to assess and highly dependent on complementary policy.

Linking ICTs with growth comes from a reduction of (transaction) costs (Brynjolfsson & Hitt, 2000). These reductions of costs lead the way to efficiency and innovation that opens the door for economic growth. Recent empirical evidences show that there is a strong link between ICT infrastructure and economic growth (Niebel, 2014; Czernich, et al., 2009; Koutroumpis, 2009; ITU, 2012). For example, Czernich et al

---

<sup>2</sup> In his seminal work, Solow (Solow, 1956; Solow, 1957) did the early theoretical works that formalized the role of technology on economic growth while a series of research works by Paul Romer (Romer, 1990; Romer, 1986; Romer, 1994) further elaborated how technology is created.

(2009) show that a 10-percentage point increase in the penetration of broadband infrastructure raises annual per capita growth by 0.9–1.5 percentage points. Furthermore, African firms using the internet had on average 3.7 times higher labor productivity than nonusers and 35 percent higher total factor productivity (World Bank, 2016). Similar study also found a significant causal positive link especially when a critical mass of infrastructure is present (Koutroumpis, 2009). Based on a sample of 59 developing, emerging and developed countries for the period 1995–2010, Niebel (2014) show that output elasticity of ICT is larger than the ICT factor compensation share- suggesting excess returns to ICT capital. Earlier works in the US economy showed that computers, software, and communications equipment under typical growth accounting assumptions suggests that productivity growth in the business sector was likely to lie near or above 2.8 percent per year. This pace of productivity growth implied a path for potential GDP growth between 3 and 3.8 percent (Kiley, 2001).

ICTs have also the capacity to increase worker productivity through an increase returns to human capital, overcoming barriers of connecting worker with work and markets through reducing high search costs, long distances, and through making work flexible (World Bank, 2016). Evidences show that better-matched online job seekers are happier with work, and have higher chances of promotion and job security (Mang, 2012). However, while productivity is an important determinant of long-term growth and rising living standards, data in many countries shows that labor productivity has not been growing in the last decade as technology progresses did. There are two strings of thought on explaining this irregularity. First, growth slows temporarily while the economy adopted its factories to the new production techniques associated with information technology and workers learned to take advantage of the new technology. These slowdowns might be due to low returns and could reflect transition costs (Kiley, 2001). This might explain both productivity slowdown after 1973 and the productivity rise in 1995-2000 in the US (Jones & Vollarath, 2013). Productivity gains momentum right after adoption of such a technology. The second explanation is connected with the way we measure technology to account for economic growth as mentioned above.

The macroeconomic evidences—the surge in productivity we just saw above— comes from computer-enabled organizational investments at the firm level. ICTs help firms enable complementary organizational investments such as business process and work practices and lead productivity increases through cost reduction that comes from the application of ICTs (Brynjolfsson & Hitt, 2000). Measuring ICT using an index combining the total annual costs per worker of information communications services for a firm with capabilities of firms in terms of using email communication and ownership of a website,

Lou and Bu finds that ICT adds more value to firms' productivity. This improvement in firms' productivity was, however, contingent on a number of other factors such as the development level of the economy in which the firm operates, exposure of firms to the international market, and the quality of products they produce (Luo & Bu, 2015). The study found that the less economically developed a country is the stronger positive impact of the firm's ICT on its productivity— ICT enables firms in less developed countries to catch up with their counterparts in more developed countries through improving efficiency and competitiveness. The impact of ICT was also stronger for firms who export their products to the international markets than those who sell products in domestic markets. Quality of firms is another important factor in capturing the benefits of ICT—the better the quality of the firms, the stronger the positive impact of the firm's ICT on its productivity (Luo & Bu, 2015)

Firms that are highly proficient in their use of data-driven decision making have been found to have productivity levels up to 6 per cent higher than firms making minimal to no use of data for decision-making (Brynjolfsson, et al., 2011). This includes the utilization of multi-source, fast-growing data called big data that helps firms attain their marketing vision (ITU, 2014)<sup>1</sup>.

### **3. Employment and ICT**

There link between digital technologies in general, and ICTs in particular, on employment is not clear. On one hand, ICTs have the capacity to disrupt other sectors leading to unemployment, automating occupations that can easily be 'codifiable', while on the other, these technologies have created new emerging sectors through innovation, created new jobs, and helped other sectors that use these technologies to create more jobs. On balance, however, benefits appear to outweigh costs (World Bank, 2019; World Bank, 2016). This section looks at some of the existing empirical evidences on both sides of the impact of ICTs on employment and earnings.

Evidences abound on the role of digital technologies on employment and earnings in the labor market. For example, Klöner & Nolen (2010) show that mobile phone coverage increased (wage) employment by 15 percentage points in South Africa, mostly due to increased employment among women, especially those without significant child care responsibilities. Among men, it induced a shift from agricultural employment to other sectors. A similar study indicates that use of laptops and internet also led to a 33-percent increase in hourly labor income among households below the median income in Uruguay (Marandino & Wunnava, 2014). In Peru, internet adoption was associated with labor income gains of

between 13 and 19 percent although no effect was found on the probability of finding employment (De los Rios, 2010). Access to internet and mobile phones increased wage employment, the production of processed goods, and the prices farmers received for their products. Mobile phones were the main driver for agricultural activity, while internet access was the main driver for employment outside agriculture (Ritter & Guerrero, 2014). Furthermore, broadband expansion was associated with local population and employment growth in the United States. Localities with broadband became more attractive, and the supply of workers responded to job opportunities (Kolko, 2012). Integrating mobile phones into traditional public intermediation services increased employment among job seekers by 8 percentage points in the short term in Peru (Dammert, et al., 2014).

Job creation by ICTs emanates from the ICT sector itself, from companies in other sectors that use ICT as their input in the production process, and from self-employment (i.e. entrepreneurship). In terms of the absolute number of employment created, the role of ICT sector is very limited, contributing way below 3 percent of total employment. A World Bank estimate shows that the ICT sector employs, on average, 1 percent of the workers in developing countries with a minimum of 0.1 in Cambodia and maximum of 2.7 percent in Costa Rica (World Bank, 2016). This is partly because of the low labor intensiveness of the ICT sector. Generally, few people employed in high-tech companies tend to produce higher values than several employees in non-tech companies do and get higher earnings. Earnings in ICTs sector were found to be 1.5 times higher than in urban non-ICT sectors or non-ICT occupations in developing countries. This probably reflects the relatively higher average level of education of the workforce in ICTs sector, and the relative scarcity of ICT workers in some countries, driving up the skill premium (World Bank, 2016). Another study shows that a 10-percentage-point increase in broadband availability in a municipality raised wages of skilled workers by about 0.2 percent, while lowering wages for low-skilled workers (Akerman, et al., 2015). Furthermore, there is also a large gender gap in the ICT sector. The sector is male dominated—men are 2.7 times more likely to work in the sector and 7.6 times more likely to be in ICT occupations (World Bank, 2016).

A more promising source of employment is from companies in non-ICTs sectors using ICTs as their input for their production process. Using ICT technologies in these firms tend to associate with more employment. This was the case in China—the increase in internet domains and users per capita had a positive impact on firms' employment in ICT-intensive industries (Fernandes, et al., 2015). Firms in Brazil intensive in the use of ICTs had higher wage increases across skill levels than the rest of the economy, although they did not experience faster employment growth; and wage growth was especially

high for workers moving across firms (Dutz, 2015). In addition to the “on-premise” employment creation by these non-ICT sectors, business process outsourcing is also an important source of employment in many parts of the world (Blinder & Krueger, 2013; Kennedy, et al., 2013; Jenson, 2012; Agrawal, et al., 2013).

In Ethiopia, the ICT sector contributed less than 1 percent— 0.1 percent overall and 0.9 percent in urban areas in 2013. According to reports by Central Statistical Agency and Jobs Creation Commission, about 60,000 people were employed across ICT fields in 2013 the level growing to an estimated 78,000 in 2018 (Central Statistics Agency, 2013; JCC, 2019). This employment ranges from software publishing to radio and television broadcasting to wired and wireless telecom activities and computer consultancy and management activities. The Ethiopian government has planned to create more than 48 thousand new ICT jobs and about 242 thousand new indirect (i.e. ICT enabled) jobs for 2025 (JCC, 2019)<sup>3</sup>. Although it is beyond the scope of this review to judge on the feasibility of these numbers, the government is cognizant of the significance of the ICT sector by its own right and as an enabler for other sectors through its multiplier effects.

The other side of ICTs on employment is automation and the resulting unemployment. The fear of unemployment created by progresses in technology termed by Keynes as technological unemployment was felt as a policy concern since the 1930's. According to Keynes, this form of unemployment was understood to occur due to mismatch between the pace of technological advancements (i.e., discovery of means of economizing the use of labor) and the pace of finding new uses for labor (Keynes, 1930). Digital technology has the potential to create unemployment in occupations that can easily be “codifiable”, i.e. “ routine intensive occupations—mainly consisting of tasks following well-defined procedures that can easily be performed by sophisticated algorithms” (Frey & Osborne, 2013). These include machine operators and clerical support workers who perform many “routine” tasks that can easily be automated. World Bank estimates show that the share of routine employment in total employment has fallen by 8 and 12 percentage points in developing and developed countries, respectively (World Bank, 2016). On the other hand, jobs that utilize emotion and context understanding— both of which are key ingredients of critical thinking, creative problem solving and effective communication—do not seem to be replaceable in the near future (Kosslyn, 2019). This

---

<sup>3</sup> These estimates were made using NPC GDP forecasts per sector and employment elasticity from World Bank calculations. Where data is unavailable at the sub-industry level, projections for the industry or sector have been used as proxy. Multiplier for the ICT industry is 5.0 indirect jobs for every direct job (benchmark from US) (JCC, 2019)

suggests that the Ethiopian government should consider these soft skills into consideration in designing the education system of the country.

#### **4. An Example: Mobile Money**

In countries with low level of financial inclusion, where traditional banking services are not reachable to many, mobile money is considered an essential channel for making and receiving payments, storing digital savings, and transferring money using mobile phone. This service can easily be available to the unbanked—i.e., people who do not have access to a formal account at a financial institution (Aron, 2018; Nan, et al., 2020). Although mobile money is a new innovation, global adoption of this technology has been growing fast. In 2020, the number of registered mobile money accounts grew by 12.7 per cent globally with the total number of registered accounts of 1.2 billion. More than half a billion mobile money registered accounts existed in Sub-Saharan Africa in 2020, over 150 million of which were active on a monthly basis. Apart from a change in consumer behavior, adoption has been high due to changes in regulations (GSMA, 2021).

Mobile money, a form of digital finance, includes transferring money, making and receiving payments using the mobile phone. It represents a new payment system, with money stored as credits on a smart card or a system-provider's 'bank books', but continue to use national currencies (Bank of England, 2014; World Bank, 2014). Unlike other mobile payment systems, such as mobile banking and payment services (such as Apple Pay and Google Pay) that offer the mobile phone as just another channel to access a traditional banking product, mobile money works outside of bank branch and automatic teller machines (ATMs) networks (GSMA, 2021)<sup>4</sup>.

---

<sup>4</sup> The innovation on digital payments, in general, and mobile payments, in particular, is evolving. One can identify three forms of innovations in this area. (1) Some innovations are used as "wrappers" to the traditional banking system, creating digital interface with traditional payment systems such as bank accounts. These include electronic money (in both hardware computer chips-e.g. ATM cards and software web and mobile applications-e.g. mobile wallets), electronic payments, and mobile banking. These are bank centric payment models- i.e. they require users to have bank accounts before engaging with the services. (2) On the other hand, mobile money systems "store money in the national currency as credit on smart cards or a system provider's books, and enable payments online or through mobile phones". These second group of innovations do not require users to have a bank account, and can be either mobile operator-centered or peer-to-peer payment systems. A notable example is M-PESA in Kenya. (3) A completely different payment scheme, called digital currencies, are a new and decentralized payment scheme with crypto currencies (Bank of England, 2014; World Bank, 2016; GSMA, 2021). The emphasis in this document is in the second form of mobile payment systems: mobile money.

Digital finance and mobile money, in particular, promote financial inclusion, increase efficiency, and spur innovation (World Bank, 2016; World Bank, 2014). The micro-view of the economics of mobile money can be seen in terms of reducing transaction costs, reducing asymmetric information, improving transparency, changing the nature of saving and increasing savings through digital means, using as an insurance to idiosyncratic shocks and improving economic efficiency (Aron, 2018). The transaction costs problem, that mobile money innovation solves, include the transport costs of travel, the travel time and the waiting time in long queues, the coordination costs, and the costs of delays through corruption or intermediaries. These costs can be substantial in developing countries, where financial systems and infrastructure are underdeveloped. In fact, these poor infrastructures can be catalysts for mobile money developments as these payment schemes have been found to be more likely to succeed in poorer countries that lack basic infrastructure (Evans & Pirchio, 2015).

Reducing these transaction costs is not limited only to mobile money—it is a characteristics of mobile payments in general. A study on payment schemes of a social transfer program in Niger has shown that the variable cost of administering social transfer is 20 percent lower for mobile transfer than for manual cash distribution (Aker, et al., 2016). Using data from one of the largest banks in China (which uses Alipay as mobile payment channel), Xu et.al., (2018) show that mobile payment systems act as a substitute for the offline channel, and as a complement for the personal computer payment channel. They show that compared to physical card channel, adoption of mobile payment channel reduces total transaction amount by about 4 percent (Xu, et al., 2018). Mobile payment services have the potential to cut travel costs to a bank, utility company, or government office. However, unlike other mobile payment systems such as mobile banking, where users should have access to banks (hence, a need for travel to nearby banks at times), mobile money has the added advantage of avoiding the requirement for contacting such banks. This is particularly important for people who are widely disbursed across large geographic areas and where the share of the unbanked society is significantly high.

In Ethiopian, financial inclusion is low. Only 35 percent of the population has a bank account in 2017 compared to 43 percent Sub-Saharan average. This is even worse in rural areas where 32 percent have bank accounts compared with 39 percent Sub-Saharan average (Demirguc-Kunt, 2018). Low penetration of financial institutions is among the major reason for such a low level of access to financial services. For a population of more than 102 million, there were only 6,511 bank branches in Ethiopia with bank to

population ratio standing at 1 to 15,702 people in 2020. Furthermore, penetration rate in rural areas is very low with about 34 percent of the bank branches located in Addis Ababa. Microfinance coverage is also low with main branch to population of 1:58,655 (NBE, 2020). In 2017, 13 percent of people in Ethiopia do not have bank account because financial institutions were too far away (Demirguc-Kunt, 2018). Mobile money has the potential to change this situation in Ethiopia.

The benefits that accrue to mobile money users, from reduced transaction costs and improved asymmetric information, better transparency, and new forms of saving & insurance, can easily be translated into household and individual wellbeing and improved firm efficiency. Nan, et.al., (2020) in their systematic review of 82 empirical academic studies on the socioeconomic impacts of mobile money in Sub-Saharan Africa illustrate that mobile money use can lead to considerably larger socio-economic gains. They show that mobile money, when widely used in Sub-Saharan African countries, have enabled a wide range of socioeconomic benefits at multiple levels including household welfare, business benefits, community development, financial development, and country well-being (Nan, et al., 2020).

As evidenced by different literature provided in the remaining part of this section, many Sub-Saharan Africa countries registered positive economic growth amid expansion of mobile money. For example, in Uganda, adopting mobile money increases household per capita consumption by 72 percent through the facilitation of remittances by making money transfers easier and with minimal cost (Munyegera & Matsumoto, 2014). These high rates of consumption change due to mobile money might have come from the fact that people shifted to these cost saving mobile money transfer channels, and abandoned other costly international money transfers. Similar results were also found in Kenya where use of mobile money was found to have a large positive net impact on household income through increased remittances (Kikulwe, et al., 2013) and in Ghana where users receive significantly higher domestic remittances and consequently spend, on average, higher on consumption than non-users (Baffour, et al., 2020). The mechanism for this increased income and consumption is such that users of mobile money are more likely to receive remittances, receive remittances more frequently and the total value received is significantly higher than that of non-user households. These findings have important implications for Ethiopia. International remittances are both an important source of foreign exchange earnings and a big source of financing of Ethiopian household consumption expenditure. In 2018/19, values of inflows of international remittances were USD 5.7 billion, higher than the value of earnings from exports of

services, the second largest source of foreign exchange earnings during the year (NBE, 2020). Furthermore, on average 25 percent of total consumption expenditure is financed by international remittances for urban residents. This figure in rural areas was 18 percent (CSA, 2016). This suggests that facilitation of international remittances through the adoption of mobile money can significantly improve foreign exchange earnings and increase per capita consumption.

Use of the mobile money system in Kenya (M-PESA) increased per capita consumption levels and lifted 194,000 households—i.e., 2% of households—out of poverty. The impacts were more pronounced for female-headed households, and appear to be driven by changes in financial behavior—in particular, increased financial resilience and saving—and labor market outcomes, such as occupational choice, especially for women, who moved out of agriculture and into business (Suri & Jack, 2016). This is also true of other mobile payment systems. They have the potential to increase household consumption through increased transactions. Xu et al. (2018) show that total transaction amount of users increased in China by around 2.4% after mobile payment adoption, and the total transaction frequency increases by around 23.5%.

Mobile money use increases the resilience to shocks by dampening the impact of rainfall shocks on nightlights-based economic activity and household consumption (Patnam & Yao, 2020; Batista & Vicente, 2021; Afawubo, et al., 2019). In Kenya, while shocks reduce consumption by 7 percent for nonusers, the consumption of user households is unaffected (Jack & Suri, 2014). A different study indicates that 16 percent of mobile money users had health insurance coverage as compared with 2 percent of nonusers in Kenya and mobile money use increased the probability of being enrolled in the same insurance scheme by 5 percent (Obadha, et al., 2019).

Mobile money affects the performance of firms. Use of mobile money helps reduce risk and liquidity constraints, promotes agricultural commercialization because users apply more purchased inputs and market a larger proportion of their output, and have higher farm profits (Kikulwe, et al., 2013). In the same vein, analysis using firm-level data in Kenya, Tanzania, and Uganda showed a positive relationship between mobile money use and the probability of a firm's purchase of fixed assets which is mainly attributed to reduced transaction costs (Islam, et al., 2016). Firms adopting mobile payments improved their sales after six-months of use, compared to other firms, and had lower subjective uncertainty and greater sales optimism (Patnam & Yao, 2020).

Mobile money has the potential to affect the labor market. In a study based on data from developing countries, relative to non-users, individuals who use mobile money were found to be more likely to become self-employed and to receive a regular wage (Gasperin, et al., 2019). Furthermore, availability of mobile money increases migration out of rural areas—which lowers agricultural activity and investment— and accelerate urbanization and structural change while improving welfare in rural areas in Africa (Batista & Vicente, 2021). Using mobile money services helped spur innovation and entrepreneurship (hence employment) and have the potential to improve the micro or small business trade supply chain process in terms of reduced operational costs, higher profit margins and higher market access opportunities (Vong, et al., 2012).

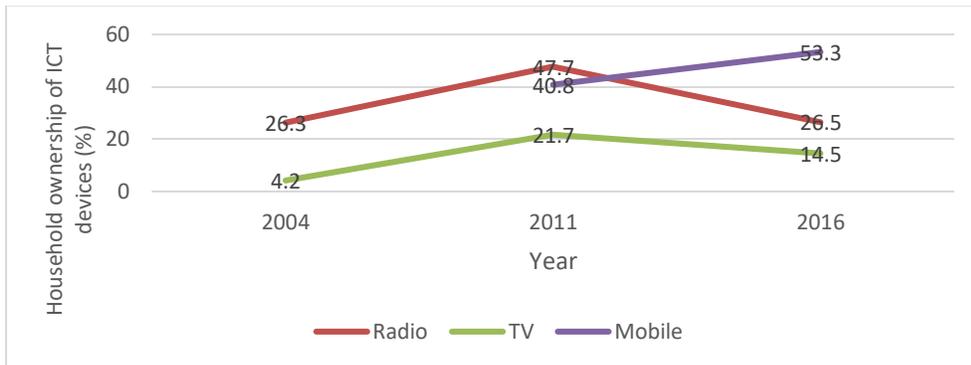
## 5. Policy Concerns for Ethiopia

### 5.1. Expansion of ICT Infrastructure

As discussed in Section 2 (“The Growth Link”), reduction of transaction costs by firms due to the adoption of ICTs helped these firms improve efficiency and increased productivity. More specifically, the penetration of broadband infrastructure raised annual per capita growth. Furthermore, African firms using the internet had on average 3.7 times higher labor productivity than non-users and 35 percent higher total factor productivity (World Bank, 2016). Ethiopia’s large and medium scale manufacturing firms registered ETB 150 billion in gross value added in 2017 with gross value added per employee of ETB 579, 836 (CSA, 2018). If we assume 25 percent of firms use internet in Ethiopia, and 10 percent cost of labor ratio to total gross value added, a rough estimate shows that using internet adds 0.4 percent more to total gross value added, suggesting that expansion of ICT infrastructure is vital to economic growth in the country.

Up until recently, landline telephone device has been an important means of communication in Ethiopia especially in major urban areas of the country. With the emergence of mobile phones, which have become more and more widespread in Ethiopia and improved communication and access to information both in rural and urban areas, the share of other communication devices (such as landline telephone devices, TVs and radios) has been declining. Close to 41 percent of households owned mobile telephone devices in 2011 which increased to 53 percent in 2016 replacing (See **Error! Reference source not found.**).

Figure 1: Ownership of ICT devices in Ethiopia\*

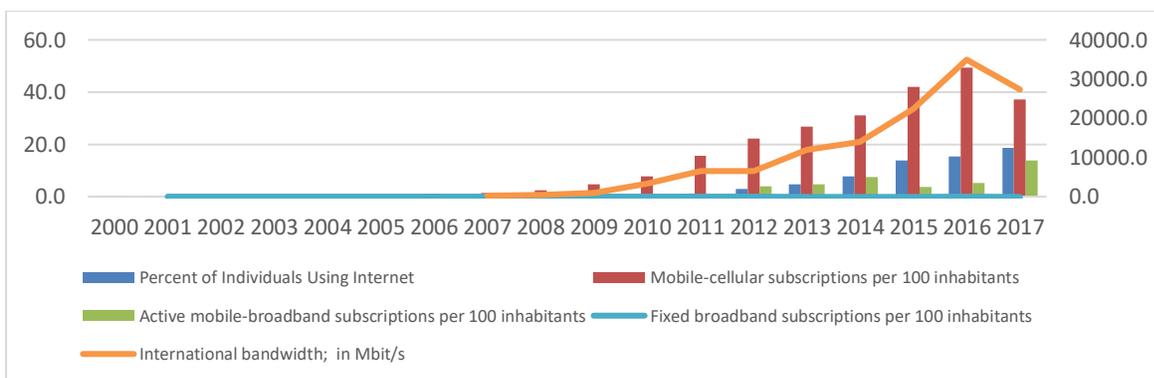


\*The y-axis is shares of owners of devices

Source: Planning and Development Commission, 2018

According to data from the International Telecommunications Union, mobile-cellular telephone subscriptions, which refers to the number of subscriptions to a public mobile-telephone service that provide access to public switched telephone network (PSTN) using cellular technology, has been increasing over the last 13 years in Ethiopia. Subscriptions per hundred inhabitants was close to zero 2006. In 2018, this has increased to 49.4 percent. Similarly, both fixed and mobile-broadband subscriptions per 100 inhabitants also increased (See Figure 2).

Figure 2: Mobile, fixed telephone and broad bank subscriptions and use of internet



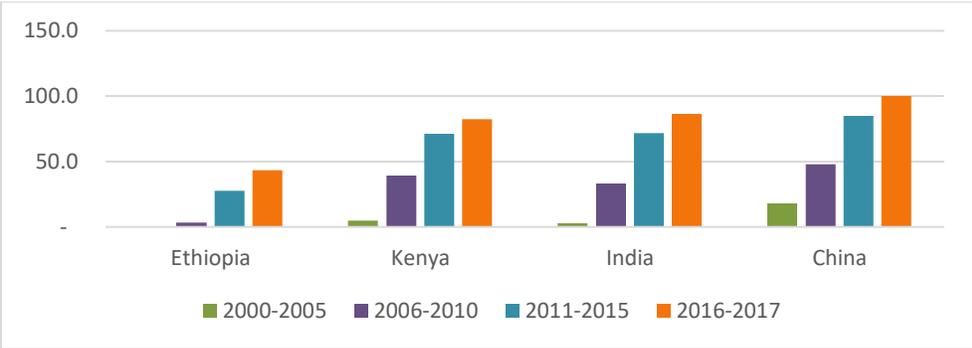
Source: International Telecommunication Union

\*Note: Data for 2017 is not complete

Given the small base in the telephone network infrastructure 13 years ago, there has been a good progress in mobile-cellular subscriptions and use in Ethiopia. However, Ethiopia still lags behind other

countries. Figure 3 shows the low level of penetration of mobile-cellular subscriptions per 100 inhabitants for Ethiopia, Kenya, China and India. In the early 2000s, there was no mobile-cellular subscriptions in Ethiopia while in Kenya 5 out of 100 inhabitants had mobile subscriptions. In the second half of that decade, marginal improvements were made—there were, for example, 4 out of 100 inhabitants with mobile subscriptions in Ethiopia. It is only in the first and second half of 2010s that the country could see a good progress. By the end of 2017, 43 out of 100 inhabitants had mobile-cellular subscriptions. Looking at the same period, these developments in Kenya, India and China were much higher than what happened in Ethiopia. This suggests that there is a need to develop enough mobile-cellular infrastructure in order to make mobile phones more accessible.

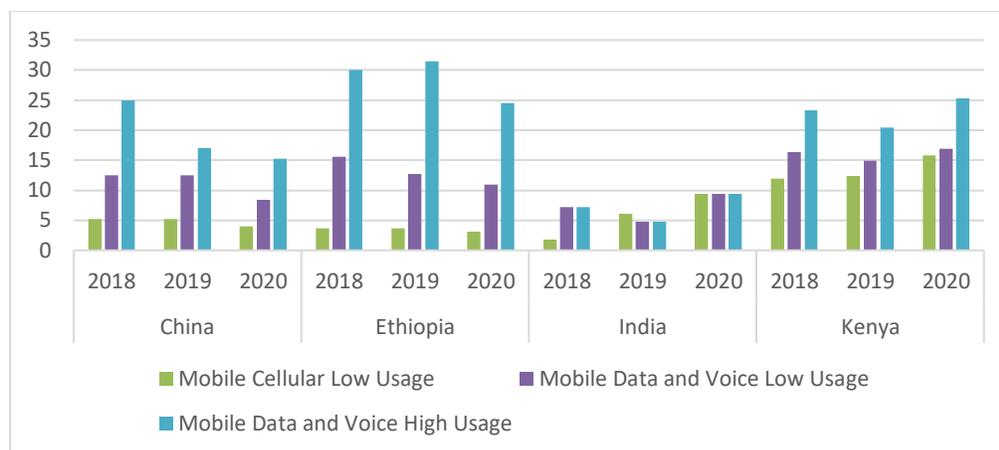
Figure 3: Mobile-cellular subscriptions per 100 inhabitants



Source: International Telecommunication Union

Prices of ICT services, along with expansion of mobile-cellular network infrastructure, are another important policy area where government’s attention is required. Figure 4 below displays ICT price baskets for mobile-cellular data and voice for high and low usage. Comparing the price baskets for Kenya India, China, prices in Ethiopia are relatively higher than these countries. Affordability of the prices of the different services (text, voice, and internet data) is an important factor to have a mobile phone, which in turn is a driver for the adoption of internet-based technologies.

Figure 4: ICT Price Baskets for Mobile Cellular Data and Voice Low and High Usage (In PPP)



Source: International Telecommunication Union

## 5.2. Creating a more competitive environment for mobile money

Use of digital payment and mobile payment systems is low in Ethiopia. Table 1 presents the different instruments for using digital/mobile payment systems using Findex data (Demirguc-Kunt, 2018). The table shows that only about 35 percent of the population are banked in 2017 with more than 65 percent of the population without a bank account. This is even worse in the rural areas with only 32 percent having a bank account. This is significantly lower than the Sub-Saharan average of 43 percent and 39 percent for overall and rural areas respectively. Overall, 12 percent of the population in Ethiopia made or received any form of digital payments in 2017. However, only 0.6 percent used the internet to pay bills or to buy something online.

While there has been a good progress in mobile-cellular expansion for the past decade, only a small share of people, particularly those in rural areas, used mobile phone to make and receive mobile payments. A very insignificant proportion of Ethiopian mobile users used their mobile phones or the internet to access financial institution account (0.4 percent) and/or to check account balances (1.4 percent). Furthermore, they used their mobile phones to send or receive domestic remittances (0.2 percent), to pay utility bills (0.1 percent), and receive government payments (0.3 percent). Only 0.3 percent had mobile money account in 2017.

*Table 1: Status of Digital Finance and mobile payment systems in Ethiopia (percent)*

Digital Finance	2014	2017
Have a bank account (national)	21.8	34.8
Have a bank account (rural)	19.0	32.4

Main mode of withdrawal: ATM	0.9	-
Used the internet to pay bills or to buy something online	0.4	0.6
Sent or received domestic remittances: through a mobile phone	0.1	0.2
Paid utility bills: using a mobile phone	0.1	-
Received wages: through a mobile phone	-	0.0
Used a mobile phone or the internet to access a financial institution account	-	0.4
Used a mobile phone or the internet to check account balance	-	1.4
Received government payments: through a mobile phone	-	0.3
Mobile money account	0.0	0.3
Made or received [any form of] digital payments	5.4	11.9

Source: Global Findex Data (Demirguc-Kunt, 2018)

Some of the factors for low adoption of digital/mobile payment systems include limited infrastructure and unreliable connectivity, lack of awareness of the services, and limited digital skills and restrictive regulations (Ministry of Innovation and Technology, 2020). There are currently three mobile money operators in Ethiopia. M-Birr, the first Ethiopian based mobile money transfer system. It was founded in 2009 by Ireland-based company in partnership with the 5 largest MFIs in Ethiopia. The second is *helloCash* and it was established in February 2015. *HelloCash* was established by Netherlands-based BelCash in partnership with 2 banks and 1 microfinance institution (Biallas & Ngahu, 2018). Telebirr is the third and the latest - launched in May 2021 by Ethio telecom. Telebirr is planned to reach out financially excluded section of the society. Ethio telecom also planned to have 33 million subscribers and cover 40 to 50 percent of the annual transactions in the next five years. At the time of the service launch, more than 1,600 agents were onboard and this number was planned to increase to 15,000<sup>5</sup>.

In an effort to increase financial services and promote inclusiveness, along with the expansion of the existing and traditional banking services, the Ethiopian government wants to allow more mobile money providers, as an alternative to existing services, and ease market entry requirements. To achieve this objective, the government has to make progress on some areas to develop a viable mobile payment system.

---

<sup>5</sup> Telebirr was launched while writing this review. Rate of growth of subscription was high (more than a million subscribed in the first two weeks). Because it's a new service with less than two months old, its impact on service provision, employment and overall economy is yet to be seen.

One of these areas is to design and implement a flexible and conducive regulatory framework. This is particularly important given the expected increasing number of mobile money platforms and the strong linkage with the financial sector. These legal structures are vital to developing a viable mobile money platform. Supportive regulatory framework is associated with higher usage of mobile payment systems both for the general population as well as for the unbanked (Gutierrez & Singh, 2013). However, this does not mean enacting unreasonably stringent and prohibitive regulation as these heavy regulations might be self-destructive. In a study on 22 developing countries with both success and failure stories in mobile money systems, it was found that the insistence that banks play a central role in those schemes, together with burdensome know your customer (aka KYC) and agent restrictions, can be bottlenecks to igniting mobile money schemes. These stringent laws also drive up compliance costs and hampers the growth of mobile money innovation (Evans & Pirchio, 2015; Logan, 2017).

In developing mobile money regulatory framework, regulatory bodies in general aim for promoting competition, reporting requirements, financial protection and customer protection (Logan, 2017). Digital finance has risks. These risks come from making users susceptible to cybercrimes. Furthermore, due to the ease of transferring funds, mobile money can encourage illicit financial flows across the globe (Tropina, 2016). Therefore, developing the technical capacity to detect, prevent and investigate these activities should be an area of investment by the Ethiopian regulatory body.

### **5.3. Digital literacy and skills development**

Technology education, i.e. digital literacy and skills development, is an important driving force for adopting new technologies. The better-educated part of society are most likely to benefit from digital technologies as they are more likely to have more advanced knowledge including of ICT skills (World Bank, 2016; Riddell & Song, 2012). Employees with more education have longer work experiences in using computers than those with less education (Riddell & Song, 2012). Three forms of skills are necessary for the digital economy in general: cognitive, social & behavioral, and technical skills. Technical skills refer to manual dexterity and the use of methods, materials, tools, and instruments and can be developed through postsecondary schooling or training or acquired on the job (World Bank, 2016).

In the Ethiopian formal education system, ICT is included as a separate subject in secondary schools (grades 9-12) and as part of the Technical Vocational Education and Training (TVET) system with an

implementing division at the federal TVET institute. Ministry of education has recently started providing freshman courses on ICT in universities/college entrants. The new curriculum which covers subjects such as emerging technologies, data science, artificial intelligence, internet of things (IoT), augmented reality. Furthermore, skills training through a collaboration with technical and vocational education and training institutions was among the instruments used for one of the components of the social protection scheme for promoting employment and opportunities in Ethiopia (Endale, et al., 2019). There are very little, if any, evidence available on the effectiveness of the ICT related skills. Nonetheless, such skills development schemes and programs are good ways of reaching out people in the informal sector to introduce new technologies.

There is limited ICT based education process in Ethiopian even though students, particularly of secondary schools, in Ethiopia have better access to mobile phones and other technologies at home and outside of schools. This is because of insufficient ICT infrastructures, lack of coordination for the pedagogical use of ICT, and insufficient capacity building training for teachers (Bati & Workneh, 2020). As a result, the use ICT has not been well utilized (MoE, 2018). Hence, given that one of the policy issues of the new Ethiopian higher education policy and strategy is to establish a well-designed, high-end ICT infrastructure (MoSHE, 2020), the government should create a more integrated ICT education system that can reach out the general population. The government should also evaluate the existing attempts of ICT education, with the contents of the on-going curriculum revisited to accommodate recent developments in digital economy—e.g. critical thinking, creative problem solving and effective communication.

#### **5.4. Creating an enabling system for technology hubs (digital incubation centers)**

With tech entrepreneurship on the rise in Africa following the global trend, countries like Ethiopia can benefit from creating an enabling environment for technology hubs or digital incubation centers for the private sector. These hubs/centers are areas where a high intensity of startup companies clusters together utilizing common infrastructure (such as technology, input and output market infrastructures etc.) and the collaboration between different stakeholders –e.g., between academia and industry. This type of infrastructure for developing technology entrepreneurship benefited the United States and many other countries (Kushida, 2015; Bresnahan, et al., 2001). While the government of Ethiopia has invested in STEM education that resulted in talented and adept graduates, no preparation was made for

applying their skills in a startup ecosystem. There are few private incubation hubs: iceaddis<sup>6</sup> which started in 2011 as a university based initiative but now become an independent entity, x-hub<sup>7</sup>, blueMoon<sup>8</sup> and Gebeya<sup>9</sup>. However, these centers are not affordable for a new graduate with little or no source of income, which suggests that a more competitive ecosystem is necessary to lower prices. This suggests the government should provide land and other major technology and market infrastructures for investors in this area.

## 6. Conclusions and recommendation

Drawing on the existing literature on the role of ICT on growth and employment and taking mobile money as a case study, this review focuses on some of the policy concerns that the government of Ethiopia should pay attention to. Results of the synthesis suggests the following:

1. In order to capture the benefits from ICTs sector, the Ethiopian government should give priority to better access to ICT services through improved access to the internet. While over the last 15 years Ethiopia has made considerable progresses in expanding mobile-cellular networks, the country still lags behind both compared to other countries and as compared to the increasing local demands. Furthermore, compared with other countries such as Kenya and India, prices in Ethiopia are relatively higher. Affordability of the prices of the different services (e.g., text, voice, internet data) is an important factor to have a mobile phone, which in turn is a driver for the adoption of internet based technologies. In this regard, the recent policy moves by the Ethiopian government towards liberalizing the telecom sector helps realize a better mobile-cellular network expansion. It also helps achieve affordable services through reduced prices that comes from a more competitive environment. The Ethiopian Communications Authority awarded the Global Partnership for Ethiopia a nationwide full-service telecommunications service operator license on May 2021<sup>10</sup>. By encouraging and facilitating this new entrant

---

<sup>6</sup> <https://www.iceaddis.com/>

<sup>7</sup> <https://www.xhubaddis.com/>

<sup>8</sup> <https://www.blumoonethiopia.com/>

<sup>9</sup> <https://www.gebeya.com/>

<sup>10</sup> Global Partnership for Ethiopia is a consortium consisting of Vodafone of UK, Safaricom of Kenya, Vodacom of South Africa, Sumitomo Corporation of Japan, and CDC Group (UK's International Development Finance Corporation).

including allowing expansion of rural infrastructure (e.g. installation of its own rural towers), the country can benefit from the current liberalization process.

2. Mobile money has the potential to change the lives of many Ethiopians particularly of those who do not have access to formal banking financial services. Studies from other countries show that mobile money systems were able to increase incomes and per capita consumption of households, improved performance of firms with efficiency gains that comes from reduced transaction costs, and created jobs. However, there has been low adoption of mobile money in Ethiopia with only 0.3 percent of the population having a mobile money account. In addition to providing better access to mobile network and improving connectivity, the government should create a competitive environment for mobile money platforms through designing and implementing a conducive legal framework.
3. Digital literacy and skills development are important factors in digital technology adoption. Although the Ethiopian government included ICT curriculum in some school levels, there is still a need for creating a more integrated ICT education system that can reach out the general population. The existing attempts of ICT education should also be evaluated with the contents of the on-going curriculum revisited to accommodate recent developments in the digital economy. Furthermore, to make digital transition and substitution of labor smoother and ameliorate the impact of automation on the labor market, the government should pay attention to re-skilling of the labor force by developing an education system (e.g. on-job training).
4. Creating an enabling technology ecosystem including the development of tech hubs or tech incubation centers is fundamental for developing a conducive environment for technology entrepreneurship.

## References

- Afawubo, K., Couchoro, M. K., M. A. & Gbandi, T., 2019. Mobile money adoption and households' vulnerability to shocks: Evidence from Togo. *Applied Economics*.
- Agrawal, A., Horton, J., Lacetera, N. & Lyons, E., 2013. Digitization and the Contract Labor Market: A Research Agenda. *NBER Working Paper 19525 National Bureau of Economic Research*.
- Aker, J. C., Boumnijel, R., McClelland, A. & Tierney, N., 2016. *Payment Mechanisms and Antipoverty Programs: Evidence from a Mobile Money Cash Transfer Experiment in Niger*, s.l.: University of Chicago.
- Akerman, A., Gaarder, I. & Mogstad, M., 2015. The Skill Complementarity of Broadband Internet.. *NBER Working Paper 20826*.
- Aron, J., 2018. *Mobile money and the economy: A review of the evidence*, s.l.: The World Bank Research Observer.
- Atasoy, H., 2013. The Effects of Broadband Internet Expansion on Labor Market Outcomes. *Industrial and Labor Relations Review*, 66(2), p. 315–45.

Baily, M. N., Gordon, R. J., Nordhaus, W. D. & Romer, D., 1988. The Productivity Slowdown, Measurement Issues, and the Explosion of Computer Power. *Brookings Papers on Economic Activity*, 1988(2), pp. 347-431.

Bank of England, 2014. *Innovations in payment technologies and the emergence of digital currencies*, s.l.: Bank of England.

Batista, C. & Vicente, P. C., 2021. *IS MOBILE MONEY CHANGING RURAL AFRICA? EVIDENCE FROM A FIELD EXPERIMENT*. [Online]

Available at: [http://www.catiabatista.org/batista\\_vicente\\_mm\\_experiment.pdf](http://www.catiabatista.org/batista_vicente_mm_experiment.pdf)

[Accessed 04 April 2021].

Bati, T. B. & Workneh, A. W., 2020. *Evaluating integrated use of information technologies in secondary schools of Ethiopia using design-reality gap analysis: A school-level study*. [Online]

Available at: <https://onlinelibrary.wiley.com/doi/10.1002/isd2.12148>

[Accessed 05 April 2021].

Biallas, M. & Ngahu, J., 2018. *IFC Mobile Money Scooping-Country Report: Ethiopia*, s.l.: s.n.

Blinder, A. & Krueger, A., 2013. Blinder, Alan, and Alan Krueger. Alternative Measures of Offshorability: A Survey Approach. *Journal of Labor Economics*, 31(2), p. S97–S128..

Bresnahan, T., Gambardella, A. & Saxenian, A., 2001. Old Economy' Inputs for 'New Economy' Outcomes: Cluster Formation in the New Silicon Valleys. *Industrial and Corporate Change*, 10(4), p. 835–60..

Brynjolfsson, E. & Hitt, L. M., 2000. Beyond Computation: Information Technology, Organizational Transformation and Business Performance. *Journal of Economic Perspectives*, 14(4), pp. 23-48.

Brynjolfsson, E., Hitt, L. M. & Kim, H. H., 2011. *Strength in Numbers-How Does Data-Driven Decisionmaking Affect Firm Performance?*. [Online]

Available at: [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1819486&download=yes](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1819486&download=yes)

Central Statistics Agency, 1999. *National Labor Force*, Addis Ababa: Central Statistics Agency.

Central Statistics Agency, 2005. *National Labor Force*, Addis Ababa: Central Statistics Agency.

Central Statistics Agency, 2013. *National Labor Force*, Addis Ababa: Central Statistics Agency.

CSA, 2016. *Household Consumption Expenditure Survey Report*, Addis Ababa: Ethiopian Statistics Agency.

CSA, 2018. *Report on Large and Medium Scale Manufacturing and Electricity Industries Survey*, Addis Ababa: Central Statistics Agency.

Czernich, N., Falck, O., Kretschmer, T. & Woessmann, L., 2009. Broadband Infrastructure and Economic Growth. *CESifo Working Paper*, Issue 2861.

- Dammert, A. C., Galdo, J. & Galdo, V., 2014. *Mobile Phones for Labor Market Intermediation: A Multi-Treatment Experimental Design*. [Online]  
Available at: [http://www.iza.org/conference\\_files/worldb2014/galdo\\_j2620.pdf](http://www.iza.org/conference_files/worldb2014/galdo_j2620.pdf).
- De los Rios, C., 2010. *Welfare Impact of Internet Use on Peruvian Households*, Lima: Lima: Instituto de Estudios Peruanos.
- Demirguc-Kunt, A. L. K. D. S. S. A. a. J. H., 2018. *The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution*, Washington, DC.: World Bank.
- Dutz, M. L. F.-M. S. O. a. R. W., 2015. *Technological Change and Labor Market Segmentation in the Developing World: Evidence from Brazil*." Background paper for the World Development Report, Washington DC: World Bank.
- Endale, K., Pick, A. & Woldehana, T., 2019. *Financing Social Protection in Ethiopia: A Long Term Perspective*, s.l.: OECD.
- Evans, D. S. & Pirchio, A., 2015. An Empirical Examination of Why Mobile Money Schemes Ignite in Some Developing Countries but Flounder in Most. *COASE-SANDOR INSTITUTE FOR LAW AND ECONOMICS WORKING PAPER NO. 723*.
- FDRE, 2014. *National Social Protection Policy*. Addis Ababa: Government of the Federal Democratic Republic of Ethiopia.
- FDRE, 2014. *National Social Protection Policy*, Addis Ababa: Federal Democratic Republic of Ethiopia.
- FDRE, 2016. *NATIONAL SOCIAL PROTECTION STRATEGY OF ETHIOPIA*, Addis Ababa: Federal Democratic Republic of Ethiopia.
- Fernandes, A. A. M., Nguyen, H. & Marc, 2015. *The Impact of Broadband on Chinese Exports in the Pre-Alibaba Era*." Background paper for the World Development Report 2016,, Washington, DC.: World Bank.
- Frey, C. B. & Osborne, M., 2013. *The future of employment: How susceptible are jobs to computerization?*, s.l.: Oxford Martin School, University of Oxford.
- Gaggl, P. & Wright, G., 2014. *A Short-Run View of What Computers Do: Evidence from a UK Tax Incentive*." Discussion Paper 752,, Colchester, U.K: University of Essex.
- Gasperin, C. D., Rotondi, V. & Stanca, L., 2019. Mobile Money and the Labor Market: Evidence from Developing Countries. *DEMS WORKING PAPER SERIES*.
- GSMA, 2021. *State of the Industry Report on Mobile Money*, s.l.: GSM Association.
- Gullickson, W. & Harper, M. J., 2002. Bias in aggregate productivity trends revisited. *Monthly Labor Review*, 125(3), pp. 32-40.

- Gutierrez, E. & Singh, S., 2013. What Regulatory Frameworks Are More Conducive to Mobile Banking? Empirical Evidence from Findex Data. *Policy Research Working Paper 6652*.
- Islam, A., Muzi, S. & Meza, J. L. R., 2016. Does Mobile Money Use Increase Firms' Investment? Evidence from Enterprise Surveys in Kenya, Uganda, and Tanzania. *World Bank, Policy Research Working Paper 7890*.
- ITU, 2012. *Impact of Broadband on the Economy*, s.l.: ITU.
- ITU, 2014. *Measuring the Information Society Report*, Geneva: International Telecommunication Union.
- Jack, W. & Suri, T., 2014. Risk Sharing and Transactions Costs: Evidence from Kenya's Mobile Money Revolution. *American Economic Review*, 104(1), p. 183–223.
- JCC, 2019. *Plan of Action for Job Creation 2020-2025 Briefing Document*, Addis Ababa: Jobs Creation Commission.
- Jenson, R., 2012. Do Labor Market Opportunities Affect Young Women's Work and Family Decisions? Experimental Evidence from India. *Quarterly Journal of Economics*, 127(2), p. 753–92..
- Jones, C. I. & Vollarath, D., 2013. *Introduction to Economic Growth*. Third ed. New York: W. W. NORTON & COMPANY.
- Kennedy, R. et al., 2013. *Assessing the Opportunity for Building a Thriving Industry*. s.l.:William Devidson Institute, University of Michigan.
- Keynes, J. M., 1930. Economic Possibilities for our grandchildren. *Essays in persuasion*, p. #3.
- Kikulwe, E. M., Fischer, E. & Qaim, M., 2013. *Mobile money, market transactions, and household income in rural Kenya*, s.l.: Georg-August-University of Göttingen.
- Kiley, M. T., 2001. Computers and growth with frictions: aggregate and disaggregate evidence. *Carnegie-Rochester Conference Series on Public Policy*, Issue 55, pp. 171-215.
- Klonner, S. & Nolen, P., 2010. *Cell Phones and Rural Labor Markets: Evidence from South Africa* [http://econpapers .repec.org/paper/zbwgddec10/](http://econpapers.repec.org/paper/zbwgddec10/). Hannover,, Proceedings of the German Development Economics Conference.
- Kolko, J., 2012. Broadband and Local Growth. *Journal of Urban Economics*, 71(1), p. 100–13.
- Kosslyn, S., 2019. *Are You Developing Skills That Won't Be Automated?*. [Online] Available at: <https://hbr.org/2019/09/are-you-developing-skills-that-wont-be-automated> [Accessed 25 June 2021].
- Koutroumpis, P., 2009. The Economic Impact of Broadband on Growth: A Simultaneous Approach. *Telecommunications Policy*, 33(9), p. 471–85.

- Kushida, K., 2015. The Politics of Commoditization in Global ICT Industries: A Political Economic Explanation of the Rise of Apple, Google and Industry Disruptors. *Journal of Industry, Competition and Trade*, 15 (1), p. 49–67.
- Logan, S., 2017. *Regulating mobile money to support scale-up-Synthesis Brief*, s.l.: International Growth Center.
- Luo, Y. & Bu, J., 2015. How valuable is information and communication technology? A study of emerging economy enterprises. *Journal of World Business*.
- Mang, C., 2012. Online Job Search and Matching Quality.. *IFO Working Paper, Institute for Economic Research, Munich.*, Volume 147.
- Marandino, J. & Wunnava, P., 2014. The Effect of Access to Information and Communication Technology on Household Labor Income: Evidence from One Laptop per Child in Uruguay. *IZA Discussion Paper 8415*.
- Ministry of Innovation and Technology, 2020. *Digital Ethiopia 2025. A Digital Strategy for Ethiopia Inclusive Prosperity*, Addis Ababa: Ministry of Innovation and Technology.
- MoE, 2018. *Ethiopian Education Development Roadmap (2018-30): An Integrated Executive Summary (Draft for Discussion)*, Addis Ababa: Ministry of Education.
- MoIT, 2020. *Digital Ethiopia 2025. A Digital Strategy for Ethiopia Inclusive Prosperity*, Addis Ababa: Ministry of Innovation and Technology.
- MoSHE, 2020. *Higher Education Policy and Strategy*, Addis Ababa: Ministry of Science and Higher Education.
- Nan, W. (., Zhu, X. (. & Markus, M. L., 2020. *What we know and don't know about the socioeconomic impacts of mobile money in Sub-Saharan Africa: A systematic literature review*, s.l.: John Wiley & Sons Ltd.
- NBE, 2020. *Annual Report*, Ethiopia: National Bank of Ethiopia.
- NBE, 2020. *National Bank of Ethiopia: Annual Report*, Addis Ababa: National Bank of Ethiopia.
- Niebel, T., 2014. ICT and Economic Growth: Comparing Developing, Emerging and Developed Countries ,. *ZEW Discussion Paper, ZEW Centre for European Economic Research*, p. 14–117.
- Obadha, M., Colbourn, T. & Seal, A., 2019. *Mobile money use and social health insurance enrolment among rural dwellers outside the formal employment sector: Evidence from Kenya*, London: Institute for Global Health, University College.
- Office of the Prime Minister, 2019. *A Homegrown Economic Reform Agenda: A Pathway to Prosperity*, Addis Ababa: s.n.

- Osborne, C. B. F. a. M., 2015. *Technology at Work– The Future of Innovation and Employment*, s.l.: Oxford Martin School and Citi.
- Patnam, M. & Yao, W., 2020. *The Real Effects of Mobile Money: Evidence from a LargeScale Fintech Expansion*, s.l.: IMF Working Paper WP/20/138.
- PDC, 2018. *Poverty and Economic Growth in Ethiopia (1995/96-2015/16)*, Addis Ababa: Planning and Development Commission.
- PDC, 2020. *Ten Years Development Plan. A Path Way to Prosperity 2021-2030*, Addis Ababa: Planning and Development Commission.
- Planning and Development Commission, 2018. *Poverty and Economic Growth in Ethiopia (1995/96-2015/16)*, Addis Ababa: Planning and Development Commission.
- Planning and Development Commission, 2020. *Ten Years Development Plan. A Path Way to Prosperity 2021-2030*, Addis Ababa: Planning and Development Commission.
- Riahi, Y. & Riahi, S., 2018. Big Data and Big Data Analytics: Concepts, Types and Technologies. *International Journal of Research and Engineering*, pp. 524-528.
- Riddell, W. C. & Song, X., 2012. *The Role of Education in Technology Use and Adoption: Evidence from the Canadian Workplace and Employee Survey*. Germany, The Institute for the Study of Labor (IZA).
- Ritter, P. & Guerrero, M., 2014. *The Effect of the Internet and Cell Phones on Employment and Agricultural Production in Rural Villages in Peru*, s.l.: University of Piura, Piura, Peru.  
[http://udep.edu.pe/cceeee/files/2014/07/3B\\_2\\_Ri](http://udep.edu.pe/cceeee/files/2014/07/3B_2_Ri).
- Rochet, J.-C. & Tirole, J., 2003. Platform Competition in Two-sided Markets. *Journal of the European Economic Association*, 1(4), pp. 990-1029.
- Romer, P. M., 1986. Increasing Returns and Long-Run Growth. *Journal of Political Economy*, Volume 94, p. 1002–37.
- Romer, P. M., 1990. “Endogenous Technological Change. *Journal of Political Economy*, Volume 98.
- Romer, P. M., 1990. Endogenous Technological Change. *Journal of Political Economy*, Volume 98, p. S71–S102.
- Romer, R. M., 1994. The Origins of Endogenous Growth. *Journal of Economic Perspectives*, Volume 8 (Winter 1994): 3–22., p. 3–22.
- Schwab, K., 2016. *The Fourth Industrial Revolution*. Geneva: World Economic Forum.
- Siegel, D., 1977. The Impact of Computers on Manufacturing Productivity Growth: A Multiple-Indicators, Multiple Causes Approach. *The Review of Economics and Statistics*, 79(1), pp. 68-78.

Solow, R. M., 1956. A Contribution to the Theory of Economic Growth. *The Quarterly Journal of Economics*, pp. 65-94.

Solow, R. M., 1957. Technical Change and the Aggregate Production Function. *Quarterly Journal of Economics*, pp. 312-20.

Suri, T. & Jack, W., 2016. *The long-run poverty and gender impacts of mobile money*, s.l.: s.n.

Tropina, T., 2016. *Do Digital Technologies Facilitate Illicit Financial Flows?*, s.l.: World Bank, World Development Report, Max Planck Institute for Foreign and.

Vong, J., Fang, J. & Insu, S., 2012. Delivering financial services through mobile phone technology: a pilot study on impact of mobile money service on micro-entrepreneurs in rural Cambodia. *Int. J. Information Systems and Change Management*, Vol. 6(No. 2).

World Bank, 2014. *The Opportunities of digital payments. How digitization of payments, transfers and remittance contributes to the G20 goals of broad-based economic growth, financial inclusion and women's economic empowerment*, s.l.: The World Bank.

World Bank, 2016. *Digital Dividends*, Washington DC: World Bank Group.

World Bank, 2019. *World Development Report: The Changing Nature of Work*, Washington, DC: International Bank for Reconstruction and Development / The World Bank.

Xu, Y., Ghose, A. & Xiao, B., 2018. *The Impact of Mobile Payment Channel on Consumer Consumption: Evidence from Alipay*, s.l.: s.n.

---

## End Notes

<sup>1</sup> The phrase “Big Data” is too ambiguous to have a specific meaning. Rather than providing a precise definition of this phrase, it is better to characterize it with its source, process and uses of big data by comparing with the “small data” sets that we are accustomed to. First, big data is about large and complex data sets and reflects advances in technology that make it possible to capture, store and process increasing amounts of data from different data sources (ITU, 2014). In the literature, characterization of big data has been made in by the so called “5Vs”-volume, velocity, variety, value, veracity (e.g. - (Riahi & Riahi, 2018)). In this document, for the purposes of comparing big data with the type of data we usually use, characterization is made using the sources, processes and uses of these data sets.

- 
1. Sources: While most of the “small data” sets that we are accustomed to come from either administrative, survey or census data, the sources of big data include administrative, commercial transactions (from banks, supermarkets etc.), sensors and tracking devices (road and traffic sensors, climate sensors, mobile phones, satellites/GPS devices etc.) online activities and/or social media, and data exhaust. The speed these datasets are generated and analyzed, the types and forms of data generated and the volume of data generated makes big data different from the types of datasets that we have been using.
  2. Processes: Due to the high volume and variety-and high velocity of being generated, of these datasets requires high storage and computing processing power to make use of big data sets (such as to get insights, train machine learning models etc.). Technological developments in the computer world such as distributed computing and distributed file system are in response to this big data challenge.
  3. Uses: While the value of “small data” sets we usually encounter is to get insights, identify causal relationships between variables and to monitor and evaluate programs/projects, big data sets go further than that – they are used in the broad area of analytics and are behind the many intelligent data products (such as speech recognition, personalized marketing bots, recommender systems to name a few) that have been supported by machine learning algorithms (an approach in artificial intelligence).

**IGC**

[www.theigc.org](http://www.theigc.org)

---