Paper

THE ROLE OF DIGITAL SOLUTIONS IN ECONOMIC RESILIENCE AND GROWTH IN RWANDA

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Abstract

COVID-19 pandemic has disrupted and impacted the daily lives of citizens in an unprecedented manner, therefore governments continue to endeavour hard for protecting lives by imposing lockdowns, testing, segregation, and treatment. As result many businesses are forced to shut down and even businesses are reopened with restrictions. Traditional shopping became difficult to access and people moved to online shopping. This has resulted in spiked in business to customer sales and increased business to business E-commerce. The pandemic has made it clear that e-commerce can be an important tool/solution for consumers. The use of mobile payments has shown its efficiency as a payment solution. Therefore, this research focuses on the role of the use of E-commerce associated closely with E-payment as an important alternative solution to economic crisis resulting from COVID-19 pandemic for supporting people, businesses, institutions and economy as a whole. Secondary data have been collected and analysed using descriptive and comparative analysis. Findings show that E-commerce platforms, whether web-or app-based, are gaining new users and digital payment has increased significantly. Digital solutions have had a profound impact during the COVID-19 crisis in Rwanda, enabling parts of the economy to continue to function online and through remote working. Digital technology in general and digital financial services in particular are accelerating economic resilience and growth and the economy has subsisted.

Key words: Digital solution, economic resilience and growth

1.INTRODUCTION

COVID-19 pandemic has disrupted and impacted the daily lives of citizens in an unprecedented manner, therefore governments continue to endeavour hard to protect lives by imposing lockdowns, testing, segregation, and treatment.

The lockdown measures are forcing many businesses to shut down and even businesses are reopened with restrictions and enforcing social distancing, wearing mask, limited number of customers to enter in shop. When traditional shopping became difficult people moved to online shopping. This has resulted in spiked in business to customer (B2C) sales and increase in business to business (B2B) E-commerce. The increase in (B2C) sales is particularly evident in online sales of medical supplies, household essentials and food products. Demand has fallen, however, for certain services with large online component, such as tourism services. The pandemic has made it clear that e-commerce can be an important tool/solution for consumers. The use of mobile payments has shown its efficiency as a payment solution/alternative.

Rwanda like other countries has established response mechanisms trying to stabilized the situation and with the consequences of COVID-19, including fiscal impulse defer certain payment, liquidity assistance, and the government of Rwanda has encouraged the use of IT in order to cope with the situation prevailing on the ground however the consequences of COVID-19 are evident and very destructive.

Therefore, this research is focusing on the role of the use of E-commerce associated closely with E-payment as an important tools and alternative solution to economic crisis that has resulted from COVID-19 pandemic with an objective to reveal the role of e-commerce and e-payment for supporting people, businesses, institutions and economy as a whole.

2. **Emergence of Digital Economy**

The digital revolution has transformed our lives and societies with unprecedented speed and scale, delivering immense opportunities as well as daunting challenges. New technologies can make significant contributions to realizing the Sustainable Development Goals, but we cannot take positive outcomes for granted. Digital advances have generated enormous wealth in record time, but that wealth has been concentrated around a small number of individuals, companies and countries. Under current policies and regulations, this trajectory is likely to continue, further contributing to rising inequality. More than half the world has limited or no access to the Internet, inclusivity is essential to building a digital economy that delivers for all.

2.1. Evolution of the digital economy concept

Since first coined in the mid-1990s, the definition of the digital economy has evolved, reflecting the rapidly changing nature of technology and its use by enterprises and consumers (Barefoot et al., 2018). In the late 1990s, analyses were mainly concerned with the adoption of the Internet and early thinking about its economic impacts (with reference to the "Internet economy") (Brynjolfsson and Kahin, 2002; Tapscott, 1996). As Internet use expanded, reports from the mid-2000s onwards focused increasingly on the conditions under which the Internet economy might emerge and grow.
Definitions evolved to include analyses of different policies and digital technologies, on the one hand, and the growth of ICT and digitally oriented firms as key actors, on the other (OECD, 2012a and 2014). With improved Internet connectivity in developing countries, and the expansion in the range of digital firms, products and services, studies of the digital economy have begun to include more substantial analysis of the situation in developing countries (UNCTAD, 2017a; World Bank, 2016).2

In the past few years, the discussion has again shifted, focusing more on the way digital technologies, services, products, techniques and skills are diffusing across economies. This process is often referred to as *digitalization*, defined as the transition of businesses through the use of digital technologies, products and services (Brennen and Kreiss, 2014).3 Digital products and services are facilitating more rapid change across a wider range of sectors rather than being confined to those high-technology sectors that had been the main focus previously (Malecki and Moriset, 2007). Reflecting this change, recent work has focused on "digitalization" and "digital transformation" (i.e.the ways in which digital products and services are increasingly disrupting traditional sectors) to explore various cross-sectoral digitalization trends (OECD, 2016a and 2017a; UNCTAD, 2017a). This is especially relevant for developing countries where the digital economy has begun to affect the traditional sectors, such as agriculture, tourism and transportation. Indeed, the most important economic changes may well occur through the digitalization of traditional sectors rather than through the emergence of new, digitally enabled sectors.

An analysis of how investments in, and policies related to technologies or infrastructure enable or limit the emergence of the digital economy is necessary for understanding its development implications. Equally important is to assess the digital economy through the lens of certain sets of technologies. As highlighted by UNCTAD (2017a), for example, the evolving digital

economy can be associated with an increased use of advanced robotics, AI, the Internet of Things (IoT), cloud computing, big data analytics and three-dimensional (3D) printing. In addition, interoperable systems and digital platforms are essential elements of the digital economy. However, there is always a risk of paying too much attention to the latest innovations that are most in vogue, rather than to those technologies that are of the greatest relevance for developing countries. One way to overcome this limitation is to explore the main components of the digital economy.

2.2. Trends in Emerging Digital Technologies

The evolution of the digital economy is closely associated with progress in several frontier technologies, including some key software-oriented technologies, such as blockchain, data analytics and AI. Other emerging technologies range from user-facing devices (such as computers and smartphones) to 3D printers and wearables, as well as specialized machine-oriented hardware, such as IoT, automation, robotics and cloud computing. Rapid advances in these increasingly converging technologies have been enabled by a surge in capacity – as well as considerable cost reductions – of data storage, processing and transmission.

2.3 Main components of the digital economy

With digital technologies underpinning ever more transactions, the digital economy is becoming increasingly inseparable from the functioning of the economy as a whole. The different technologies and economic aspects of the digital economy can be broken down into three broad components:

i. Core aspects or foundational aspects of the digital economy, which comprise fundamental innovations (semiconductors, processors), core technologies (computers, telecommunication devices) and enabling infrastructures (Internet and telecoms networks).

ii. Digital and information technology (IT) sectors, which produce key products or services that rely on core digital technologies, including digital platforms, mobile applications and payment services. The digital economy is to a high degree affected by innovative services in these sectors, which are making a growing contribution to economies, as well as enabling potential spillover effects to other sectors.

iii. A wider set of digitalizing sectors, which includes those where digital products and services are being increasingly used (e.g. for e-commerce). Even if change is incremental, many sectors of the economy are being digitalized in this way. This includes digitally enabled sectors in which new activities or business models have emerged and are being transformed as a result of digital technologies. Examples include finance, media, tourism and transportation. Moreover, although less often highlighted, digitally literate or skilled workers, consumers, buyers and users are crucial for the growth of the digitalized economy. These components are being used in various ways as a basis for measuring the extent and impact of the digital economy. At their most basic level, methodologies focus on measures of the core and digital/IT sectors (or suitable proxies), notably related to investment and policies relating to the digital economy (e.g. digital infrastructure investments, broadband adoption), and how these are linked to the growth of that economy, particularly in terms of outputs and employment in the digital and digitally enabled sectors (OECD, 2017a; UNCTAD 2017a and b). Such analyses help to provide direction for policies and investments in the digital economy, and to assess potential impacts on firms, consumers and workers

Measuring the digital economy beyond digital and digitally enabled sectors is more difficult. Impacts from the use of digital technologies may result from spillover effects, and intangible

outcomes (such as firm flexibility, management approaches or productivity) also depend on other variables (Brynjolfsson, 1993). Some studies have assessed digitalization by means of surveys and e-commerce data, by measuring the spillover effects from the ICT/digital sectors across an economy (Barefoot et al., 2018; Knickrehm et al., 2016), or by exploring the changing geography of global data and knowledge (Manyika et al., 2014; Ojanperä et al., 2016). These approaches often face limitations due to methodological challenges and the lack of reliable statistics. Detailed descriptions and analyses of each of these technologies is extensively presented in this section focusing on some recent trends and prospects for these technologies and their geographical evolution, in order to provide an indication of the relative position of developing countries in the evolving digital technology landscape.

2.3.1 Blockchain technologies.

Blockchain technologies are a form of distributed ledger technologies that allow multiple parties to engage in secure, trusted transactions without any intermediary. It is best known as the technology behind cryptocurrencies, but it is also of relevance for many other domains of importance to developing countries. These include digital identification, property rights and aid disbursement. Open-source platforms, such as Ethereum, allow programmers to develop decentralized applications to run on their blockchain. However, one challenge for blockchains is that, for some applications, they require a substantial, reliable electricity supply for processing. Some blockchain applications are already in use in developing countries, for example in the areas of fintech, land management, transport, health and education in Africa (UNECA, 2017). According to Gartner's blockchain business value forecast, after the first phase of a few high-profile successes in 2018–2021, there will be larger, focused investments and many more successful models in 2022–2026. And these are expected to explode in 2027–2030, reaching more than $3 trillion globally (WTO, 2018). Currently, China alone accounts for nearly 50 per cent of all patent applications for technology families relating to blockchains, and, together with the United States, they represent more than 75 per cent of all such patent applications (ACS, 2018).

2.3.2 Three-dimensional printing.

Three-dimensional (3D) printing, also known as additive manufacturing, can potentially disrupt manufacturing processes by boosting international trade in designs rather than in finished products. It offers opportunities for developing countries to leapfrog traditional manufacturing processes. Indeed, a number of 3D-printing ventures can already be found in some developing countries. For example, in Africa, such ventures exist for local entrepreneurship in Togo, for medical supplies in Uganda, for filling import gaps in Nigeria, for commercial ventures in South Africa and for renewable energy in Rwanda (Atlantic Council 2018). India's largest bicycle and scooter maker has been using 3D printing since 2014, allowing products to reach markets at faster rates; and 3D printers are being used to create prosthetics in countries such as Cambodia, the Sudan, Uganda and the United Republic of Tanzania. But 3D-printing capacity remains highly concentrated in fact, in the five leading countries (the United States, followed by China, Japan, Germany and the United Kingdom) account for an estimated 70 per cent of the total.

2.3.3 Internet of Things (IoT)

It refers to the growing array of Internet-connected devices such as sensors, meters, radio frequency identification (RFID) chips and other gadgets that are embedded in various everyday objects enabling them to send and receive various kinds of data. It has wide applications, including in energy meters, for RFID tagging of goods for manufacturing, livestock and logistics, for monitoring soil and weather conditions in agriculture, and for wearables. In 2018, there were more "things" (8.6 billion) connected to the Internet than people (5.7 billion mobile broadband subscriptions), and the number of IoT connections are forecast to grow at 17 per cent a year, to exceed 22 billion by 2024 (Ericsson, 2018). The top seven countries (the United States, followed by China, Japan, Germany, Republic of Korea, France and United Kingdom) account for nearly 75 per cent of worldwide spending on IoT, with the first two countries representing 50 per cent of global spending. The global IoT market is expected to grow tenfold, from $151 billion in 2018 to $1,567 billion by 2025 (IoT Analytics, 2018). IDC (2018) estimates that by 2025, an average connected person in the world will interact with IoT devices nearly 4,900 times per day, or the equivalent of one interaction every 18 seconds. This represents an exponential increase in comparison to 298 times per day in 2010 and 584 in 2015. Such rapid growth in the use of IoT will generate a further expansion of digital data.

2.3.4 5G mobile broadband Fifth generation (5G)

The wireless technology is expected to be critical for IoT due to its greater ability to handle massive volumes of data. 5G networks can process around 1,000 times more data than today's systems (Afolabi et al., 2018). In particular, it offers the possibility to connect many more devices (e.g., sensors and smart devices). While 72 mobile operators were testing 5G in 2018, 25 of them are expected to launch the service in 2019, and another 26 in 2020 (Deloitte, 2019). It is estimated that by 2025, the United States, followed by Europe and Asia Pacific will be leaders in 5G adoption. In order for developing countries to maximize the impact of IoT, significant investments in 5G infrastructure will be required. By 2025, the share of 5G in total connections is expected to reach 59 per cent in the Republic of Korea, compared with only 8 per cent in Latin America and 3 per cent in sub–Saharan Africa. Moreover, the deployment of 5G may further increase the urban-rural digital divide, as setting up 5G networks in rural areas with lower demand will be commercially challenging (ITU, 2018a).

2.3.5 Cloud computing

Cloud computing is enabled by higher Internet speeds, which have drastically reduced latency between users and far away data centres. Data storage costs have also plummeted. The cloud is transforming business models, as it reduces the need for in-house IT expertise, offers flexibility for scaling, and consistent applications rollout and maintenance (UNCTAD, 2013). Some free cloud services provide office-like application tools that are useful for micro, small and medium-sized enterprises (MSMEs). This is particularly useful for countries where the cost of licensed software can be an obstacle to creating applications and providing the services. However, in many developing countries, high costs of additional international bandwidth to access overseas servers and data centres still limit the uptake of cloud services. Most cloud traffic is generated in North America, followed by Asia Pacific and Western Europe, which together account for about 90 per cent of all cloud traffic. From 2016 to 2021, the fastest annual growth rate in cloud traffic is expected to occur in the Middle East and Africa, at 35 per cent, followed by Central and Eastern Europe and Asia Pacific, each with a growth rate of 29 per cent. The cloud market is also highly concentrated. According to Synergy Research Group

(2019), the share of the top five providers − Amazon Web Services (AWS), Microsoft, Google, IBM and Alibaba − in the global cloud infrastructure services market exceeds 75 per cent, with AWS alone accounting for over a third of that market.

2.3.6 Automation and robotics

Automation and robotics technology are increasingly used in manufacturing, which could have significant impacts on employment. There are concerns that such technologies may constrain the scope for developing countries to adopt export-led manufacturing as a path to industrialization (UNCTAD, 2017c), and that the more developed economies may increasingly use robots to "reshore" manufacturing jobs. According to the International Federation of Robotics (2018), global sales of industrial robots doubled between 2013 and 2017. This trend seems set to continue, with sales expected to increase from 381,300 units in 2017 to 630,000 units by 2021. The top five markets (China, followed by Japan, the Republic of Korea, the United States and Germany) represented 73 per cent of the total sales volume of robots in 2017. China is showing the strongest demand, with a market share of 36 per cent. Robots are mainly used in the automotive, electrical/electronic and metal industries.

2.3.7 Artificial intelligence and data analytics Developments in AI

Artificial intelligence and data analytics Developments in AI, including machine learning, are enabled by the large amounts of digital data that can be analysed to generate insights and predict behaviour using algorithms, as well as by advanced computer processing power. AI is already in use in areas such as voice recognition and commercial products (such as IBM's Watson). It has been estimated that this general-purpose technology has the potential to generate additional global economic output of around $13 trillion by 2030, contributing an additional 1.2 per cent to annual GDP growth (ITU, 2018b). At the same time, it may widen the technology gap between those that have and those that do not have the capabilities to take advantage of this technology. China and the United States are set to reap the largest economic gains from AI, while Africa and Latin America are likely to see the lowest gains. China, the United States and Japan together account for 78 per cent of all AI patent filings in the world (WIPO, 2019). Another related key technology in the digital economy is data analytics, sometimes dubbed as "big data". This refers to the increasing capacity to analyse and process massive amounts of data. Indeed, the above technologies have one element in common, which is that they strongly rely on data it is well known that, digital data are one of the core elements of value creation in the digital economy.

2.3.8 Recent evolution of E-commerce

E-commerce is one of the components of the digital economy. It covers goods and services sold and bought online, including transactions via platform-based companies such as ride-hailing apps, reflected under business to-consumer (B2C) revenue reported by the transportation sector, and room-sharing platforms reported under accommodation. The global value of e-commerce is estimated by UNCTAD to have reached $29 trillion in 2017, which is equivalent to 36 per cent of GDP. This corresponds to a 13 per cent growth from the previous year. The list of top 10 countries by total e-commerce sales has remained unchanged since 2016, with the United States being the market leader. Global business-to-business (B2B) e-commerce was $25.5 trillion in 2017, representing 87 per cent of all e-commerce, while B2C e-commerce was $3.9 trillion in 2017, an increase of 22 per cent over the previous year. The top three countries in B2C e-commerce sales were China, followed by the United States and

the United Kingdom. Cross-border B2C sales by value of merchandise exports amounted to an estimated $412 billion in 2017. This corresponds to almost 11 per cent of total B2C sales, up from 7 per cent in 2015. E-commerce allows consumers to benefit from greater choices and lower prices. An estimated 1.3 billion people, or one quarter of the world's population aged 15 years and older, shopped online in 2017. This is 12 per cent higher than in 2016. China has the largest number of online shoppers (440 million), whereas the United Kingdom has the highest proportion of online shoppers to the population (82 per cent of those aged 15 years and older). Uptake in low-income economies is considerably lower, suggesting that it takes more than wireless connectivity for e-commerce to take off.

2.4. Emergence of Digital Economy in Rwanda

With rapid digital transformation now reshaping our global economy, permeating virtually every sector and aspect of daily life, investment in the foundational building blocks that underpin digital economy growth will help determine a country's ability to succeed in the global market place, harness emerging opportunities and ultimately offer its citizens a better quality of life. Disruptive technologies are already altering traditional business models and pathways to development, yielding significant efficiency and productivity gains, increased convenience, as well as better access to services. Globally, growth of the digital economy is quickly outpacing the growth of the overall economy. Well-functioning digital economies are thus expected to achieve much faster economic growth, offer more innovative services, as well as create more jobs. There is a mounting body of evidence that illustrates the capacity of digital technology adoption to significantly boost productivity and support poverty reduction. Access to broadband and digital financial services have, for example, been associated with significant GDP and per capita income growth, with access to innovative digital services such as mobile money helping to pull thousands out of poverty.

Despite its small size, Rwanda has distinguished itself as a country that has "bet big"on digitization, as means to accelerate growth and reduce poverty. Rwanda has already begun to chart an ambitious course for achieving rapid digital transformation. This includes investing heavily in the roll-out of digital infrastructure, piloting innovative schemes and partnership with non-profit and for-profit organizations to boost the nation's digital skills base, expanding its public digital service capability and creating an enabling environment for digital service and business innovation. Rwanda's ICT sector has been growing rapidly over the last five years, witnessing a 12.7 percent value-added increase in 2014-2018.The World Economic Forum's Networked Readiness Index subsequently rated Rwanda first among East African nations in terms of its readiness to exploit the opportunities offered by ICT to boost growth and competitiveness. *World Bank 2020.*

However, there is room to do more in terms of capitalizing on progress and investments made so far. For Rwanda to leverage digital transformation as a driver of growth, job creation and greater service delivery, digital adoption needs to markedly improve. Rwanda will need to tackle the affordability of digital devices and services, but also bridge the lingering basic digital skills gap, to increase uptake of digital tools and services among both individual users and Businesses, creating a virtuous cycle of demand that can help propel further expansion and application of digital products and services. However, a lingering digital skills gaps emerges a key cross-cutting barrier to increasing digital adoption and expanding digital innovation.

For Rwanda's digital evolution to become truly transformational, the private sector also needs to play a far greater role in spearheading digitization, alongside the ambitious initiatives launched by government, through both increased technology adoption and support for innovation that can enhance productivity, spawn new services and create new off -farm jobs. However, for the private sector's contribution to the digital economy to increase and for areas like e-commerce to thrive key enablers need to be in place, including greater adoption of broadband, digital payments and access to a larger market of digitally savvy consumers that allow digitally enabled new companies to quickly scale.

2.5. Snapshot of Rwanda's Digital Development Journey

Rwanda's digital development journey to date has been spearheaded by a government deeply committed to leveraging ICT as a cross-cutting enabler of economic growth, innovation and service delivery. This commitment is reflected in the sheer number of related strategies and policy plans that the Government has adopted over the years, as well as sizable investments and ambitious initiatives launched that have sought to create an enabling environment for ICT adoption, expand digital infrastructure, digital platforms and services, promote further digital skills development, foster a national culture of innovation and position Rwanda as a regional digital hub.

2.5.1. Digital infrastructure

Rwanda's access to international bandwidth has grown ten-fold over the last five years, on the back of new cross-border terrestrial links that allow Rwanda to access undersea cables landing in neighbouring Kenya and Tanzania. Meanwhile, the roll-out and expansion of a national fiber optic backbone network, leveraging sizable government investment, has helped distribute said connectivity across Rwanda, bringing a growing part of the population within closer proximity to high-speed internet. Rwanda has set the bar regionally in terms of mobile network coverage, which provides last mile access to broadband for a majority of existing users. 3G network coverage is now at 93.5 percent, compared with a regional average of 76 percent. Moreover, Rwanda has also achieved impressive 4G network coverage, by leveraging a public-private partnership (PPP) between the Government of Rwanda and Korean Telecom to support the launch of a 4G wholesale network - resulting in the establishment Korean Telecom Rwanda Networks (KTRN) Today, Rwanda's 4G coverage officially stands at 96.6 percent – an unprecedented level of coverage for a country with Rwanda's level of socio-economic development. According to the Rwanda Utility Regulatory Authority (RURA), of the current population of 12 million, internet users in the country have reached 5.6 million in 2018. The official projections show that by 2020 the rate should reach nearly 60%. Most of the users access the internet from smart phones: Rwanda's mobile telephone penetration rate stood at 76.6% in 2018, with almost 9 million subscriptions. The main operator is MTN Rwanda (43%), followed by Tigo Rwanda and Airtel (38% and 19%, respectively). Rwanda continues to be one of the fastest growing African countries in the ICT sector, with good IT infrastructure compared to the standards of the region. The most popular web search engines in Rwanda are Google (93.5%), Bing and Yahoo (4.5% and 1.5% respectively).

While Rwanda's expansion of digital infrastructure has been impressive, big gaps in the uptake of high-speed internet services remain. Official figures put internet penetration at 58.3 percent, yet actual use is estimated to be lower, based on the number of active subscribers reported by mobile network operators (MNOs). A mix of barriers related to digital literacy, affordability, services quality and perceived relevance and value currently appear to be hampering uptake of

broadband, and along with it access to other digital services that require users to first be connected. Notably, the affordability of devices and broadband remains a key barrier. The present cost of handsets prevents some 37 percent of households from owning a phone, which typically also stops them from accessing mobile and broadband services altogether. Moreover, weak access to smart phones and 4G compatible devices restricts access to basic 2G or slower 3G internet services, with some 74.3 percent of current Rwandan mobile subscribers therefore continuing to rely predominately on 2G services that have limited practical application or use beyond voice and SMS based services. Government is committed to addressing the issue, through ongoing discussions with mobile operators and manufacturers, including through the launch of new schemes. To date, efforts to boost local manufacturing, including the recent launch of the Mara Group's local smartphone production and assembly, is yet to target or bring down the cost of smart phones for those at the base of the pyramid. Affordability of broadband services is also a key factor that adversely affects internet consumption. While Rwanda has some of the lowest absolute prices in the region, broadband services remain expensive relative to average incomes and below global affordability target. The average monthly price of 1GB of data was US$ 0.56 in 2018, equivalent to 5.1 percent of the median monthly income and more than double the Alliance for Affordable Internet (A4AI) target of 2 percent.

Despite Government's large investment in 4G and impressive coverage, the network remains underutilized. The two main MNOs appear to have taken the business decision to invest in upgrading their own 3G networks and promoting their proprietary 3G services, over promoting re-sale of 4G services utilizing the KTRN wholesale network. The MNOs are prevented from further upgrading their own networks to offer 4G services due to the KTRN 4G license exclusivity. 4G service offerings and active promotions are therefore mostly coming from smaller internet service providers (ISPs) utilizing the KTRN network. While these ISPs are growing quickly, they still cover only a small consumer base. These factors, combined with still
limited affordability of 4G capable devices have resulted in lower-than-expected 4G penetration. The Government is actively looking to address these bottlenecks as part of its wider efforts to ensure a conducive environment for broadband market development.

2.5.2. Digital skills

Government has sought to embed digital skills training in the national education system. Basic digital skills are now included in the national competency-based curriculum (CBC) at both primary and secondary school level, which spans from "befriending" the computer and learning basic usage in lower primary school, all the way to teaching optional and specialized classes in programming and database management at upper secondary level. Moreover, schemes such as One Laptop per Child (OLPC), launched in 2008, and the more recent SMART classrooms initiative have sought to boost access to devices. In 2017, some 44 percent of primary schools, and 60.2 percent of secondary schools thus reportedly had access to ICT for teaching and learning. However, a lingering basic digital skills gap emerges as a key cross-cutting barrier to increasing digital adoption and expanding digital innovation. Government estimates that computer literacy is a mere 8.4 percent, which hampers usage of even the most basic digital devices and applications, but also dampens demand for more advanced tools and services. Government has thus launched a plethora of initiatives aimed at tackling this issue.

However, gaps in access to key enablers in schools, including connectivity, digital devices, reliable electricity, digital content and adequate teacher capacity, continue to adversely affect both the integration of ICT in the classroom and delivery of digital skills training. For example,

a mere 25.1 percent of primary schools and 41.3 percent of secondary schools reportedly had access to the internet in 2017, which meant that ICT was predominately being taught in an offline environment, or in theory, with limited practical application. More broadly, issues related to the current quality of education and weaker enrolment at secondary level, particularly in STEM-related subjects, also affect digital skills attainment, including the pipeline of graduates that can proceed to access more advanced digital skills training.

As it stands, Rwanda is not producing the number of digital specialists needed, nor of the requisite caliber, to propel the kind of cross-sectorial digital transformation that Rwanda aspires to achieve. While ICT courses are offered by most types of TVET institutions, few are considered to be at digital specialist level. Moreover, few TVET students choose to study advanced-level ICT course and even less graduate. Meanwhile, courses available through public and private universities focus primarily on computer maintenance, software development, programming, information management and networking. Available training thus restricts the breadth and depth of digital skill available locally. While a handful of universities do offer courses in cutting-edge technology, few students can afford to access this training. Some 2,544 students were thus estimated to be graduating with a degree in ICT in 2016. However, these graduates typically lack hands on experience, due to limited opportunities for practical training, as well as misalignment between skills taught and those demanded by prospective employers. An 'inadequately educated workforce' thus emerges as one of the barriers to doing business in Rwanda, identifying by some 28 percent of employers. Rwanda is thus outperformed by many other African nations in relation to overall digital skills acquisition in the workforce.

To address this, Government has sought to spearhead a series of innovative partnerships to expand access to basic and advanced digital skills training – both within and outside the formal education system. In 2017, it launched the flagship Digital Ambassadors Program (DAP), in partnership with the World Economic Forum (WEF) and the Digital Opportunities Trust, which aims to deliver basic digital skills training to some 5 million people. Government has also partnered with for-profit training provider such as Andela to offer rapid advanced digital skills training in coding, and sought to attract world-renowned academic institutions such as Carnegie Mellon University, which established its Africa campus in Rwanda in 2011. In early 2019, the Government launched the Rwanda Coding Academy, targeting TVET institutions. Meanwhile, donor funding has helped launch a series of other smaller schemes such as WeCode. While the private sector has also contributed to informal basic digital skills training, there is scope to do more in terms of crowding in the private sector, but also to expand existing schemes such as the DAP.

2.5.3. Digital Platforms

Rwanda has put in place many of the key building blocks needed to support government digitization, which has allowed it to quickly scale its e-service offering from a very low base. Rwanda has made marked progress in terms of digitalizing public records, expanding the use of management information systems and rolling-out shared cloud-based infrastructure, enabling greater data exchange between various government entities. The development of Rwanda's e-government ecosystem has also benefitted from a robust and centralized institutional framework, the application of an innovative PPP with Online Rwanda Ltd to roll out new digital services, and development of critical enabling platforms such identification (ID). Rwanda has developed one of the strongest foundational ID systems in Africa, which today provided near universal (98 percent) ID coverage.

Rwanda thus emerges as one of Africa's top ten performers in global e-Government rankings. Today, the Government's Irembo platform provides access to a growing array of public Government-to person and Government-to-business e-services. Moreover, several back-end systems are improving the delivery of key government functions in areas such as financial management, public procurement, education and health. Rwanda has also introduced a foundational legal and institutional framework related to cybersecurity, and has begun to revise its framework for data protection. Nevertheless, uptake of public e-services remains rather modest, with most existing users preferring to access Irembo's services via agents and paying in cash for services rather than using the platform's digital interface and digital payment options. A mere 1,500 users were accessing services via Irembo, on a daily basis, in 2018. Issues noted above, related to weak mobile phone ownership, limited internet usage, and gaps in digital skills, all help explain the relatively low usage figures, and dampen the use of platforms more broadly – particularly among those at the base of the pyramid who could benefit the most from access to critical public services.

The local e-commerce ecosystem is growing, but from a small base, with Rwanda ranking 19th in Africa in the 2018 UNCTAD Business-to-Consumer E-commerce Index. Harnessing e-commerce as a more significant driver of growth will require tackling a number of interrelated challenges. Micro small and medium size Enterprises (MSMEs), which dominate the local commercial landscape, have generally been slow to adopt online business practices. Many businesses and consumers remain wary of conducting business electronically, and often fail to see the potential benefits, in terms of facilitating access to new markets and services. Users are held back by both economic and knowledge barriers, including how to market goods and services online. Goods-focused e-commerce companies in Rwanda also face growth challenges, due to the cost and reliability of last-mile postage, transportation and logistics services, the absence of a national addressing system, the speed and costs of customs, a culture of face-to-face transactions, and low transaction volumes. While some 'native' e-commerce platforms have emerged, helping to create a nascent online marketplace, e-commerce transactions in Rwanda are still minimal. Cross border e-commerce is also growing but relies mostly on large foreign platforms such as Alibaba and Ali Express.

2.5.4. Digital Financial Services

While usage of digital financial services (DFS) has been growing rapidly over the course of the last five years, led primarily by the adoption of MNO wallets, much of the potential remains untapped. Overall uptake of DFS remains rather low, when compared alongside neighbouring Kenya and Uganda. According to Findex, only 31 percent of adults owned a mobile money account in 2017. MNO wallets are currently offered by the two main operators, MTN and Airtel, which are mainly restricted to basic transactions. MTN leads the way in terms of spearheading further innovation, partnering with the Commercial Bank of Africa to offer mobile savings and short-term loan service –yet, uptake of related services has been limited. There is thus ample room to grow MNO wallet adoption, increase transaction volumes/usage and expand the existing service offering, which could provide a meaningful way of boosting financial inclusion, but also facilitate the expansion of other e-transactions that rely on digital payments such as e-commerce. However, poor consumer awareness and weak merchant acceptance emerge as two critical issues that continue to hamper greater usage. Banks are only just starting to enter the digital payments sector and have been slower to embrace digital channels and support innovation. Several banks have, however, started offering services in mobile and online banking, and upgraded their core systems to provide open APIs that enable the development of more innovative products and services. While usage of related services

continues to grow, it is yet to gain scale. For example, in late 2016, there were reportedly one million account holders using mobile banking services, performing some 4 million transactions annually. Moreover, although the number of ATMs and card-reading points of service has grown, a mere 5 percent of adults reportedly owned a debit card in 2016. While existing DFS regulation and payments infrastructure, including the deployment of an integrated payment processing system and pending introduction of a national payments switch, have helped level the playing field and boosting interoperability between financial service providers (FSPs), a handful of restrictions specific to banks continue to hinder banks' ability to fully participate and compete with other "non-bank" FSPs.

2.5.5. Digital innovation and entrepreneurship

Government plays an active role in supporting the local innovation and entrepreneurship ecosystem, which still remains nascent. This has notably included efforts to build out critical support infrastructure for aspiring digital innovators, resulting in the introduction of the pre-incubator KLab, its sister organization FabLab and the construction of the Kigali Innovation City complex that seeks to convene key ecosystems players. While related initiatives have been welcomed by the local tech community, stakeholder consultations revealed that the private sector has not yet grown enough to make the digital entrepreneurship ecosystem independent of government and donor funding. Meanwhile, there appears to be a limited pipeline of viable start-ups that can attract investment. While Rwanda boasts a handful of successful digital start-ups, such as Zipline, existing startups typically face a number of challenges in terms of scaling their business.

Firstly, there is limited support infrastructure for start-ups beyond a certain growth stage, including incubators and accelerators, which serve a crucial function in terms of facilitating access to skills, networks, mentorship, capital, technology and digital tools for start-ups. There is also weak access to growth-oriented financing for early-stage enterprises. Rwanda lacks many of the diverse funding channels available in more developed E*ntrepreneurial market*, such as venture capital funding, angel investors, and seed stage investment. While this appears to be changing, there is room to build on Rwanda's favourable reputation for being an easy, safe and stable place to do business – encouraging more tech- based firm to use Rwanda as their launch pad into East Africa. Finally, weak local demand for digital product and services, as well as Rwanda's intrinsic market size offers start-ups limited room to expand. Rwanda thus emerges as an easy place to set-up a business but a harder place to scale.

3. Adopted approach

This area of research has few articles and papers due to the occurrence of COVID-19 pandemic. Nevertheless, we have managed to collect data from National Bank of Rwanda, several references have been consulted in addition to compile important information related to this topic. Descriptive and comparative analysis have been used as approaches in our methodology during this research and then, we come up with some findings we are about to discuss.

4. Digital Economy in Rwanda in Context of COVID-19

COVID-19 pandemic continues to have a devastating impact globally, Rwanda as a country, while less affected, is preparing to undergo its own severe social and economic crisis

Yet despite the slow onset, Rwandese's fragile health systems may be overwhelmed if the virus continues to spread. To avoid this scenario, governments are implementing contingency measures with striking collateral damage in the form of shops and factories limiting timework, workers being sent home, and jobs being cut, with the effect that an economic recession is looming.

In response to this, Rwanda have implemented a large number of digital initiatives that address most of the priorities identified to fight the pandemic. These innovative solutions have enabled remote working for public entities, tracking solutions for the pandemic, effective communication with the population, and improvement of healthcare services. Rwanda believes that digital technologies can and will play a critical role in strengthening resilience by enabling fast responses to this crisis while helping alleviate its impact. There are a number of specific use cases where digital technologies help create an enabling environment for human resilience during these difficult times. We are going to analyse only E-commerce as part of digital economy with e-payment closely associated with it during the period of Cod 19 pandemic.

4.1. Online business and E-payment in the Context of COVID-19

Country went even further by using online commerce and online payments to secure the food supply or protect jobs, or solutions to support the people. Online business and e-commerce platforms helped maintain social distancing and reduce the potential spread of COVID-19. Online delivery applications have become the ideal medium to order food, groceries and medical supplies. E-commerce platforms, whether web-or app-based, are gaining new users.
Digital work and learning spaces linked by internet infrastructure and virtual platforms have increasingly become a mainstay for businesses and learning institutions as they connect remote workers and students across countries, regions and globally.

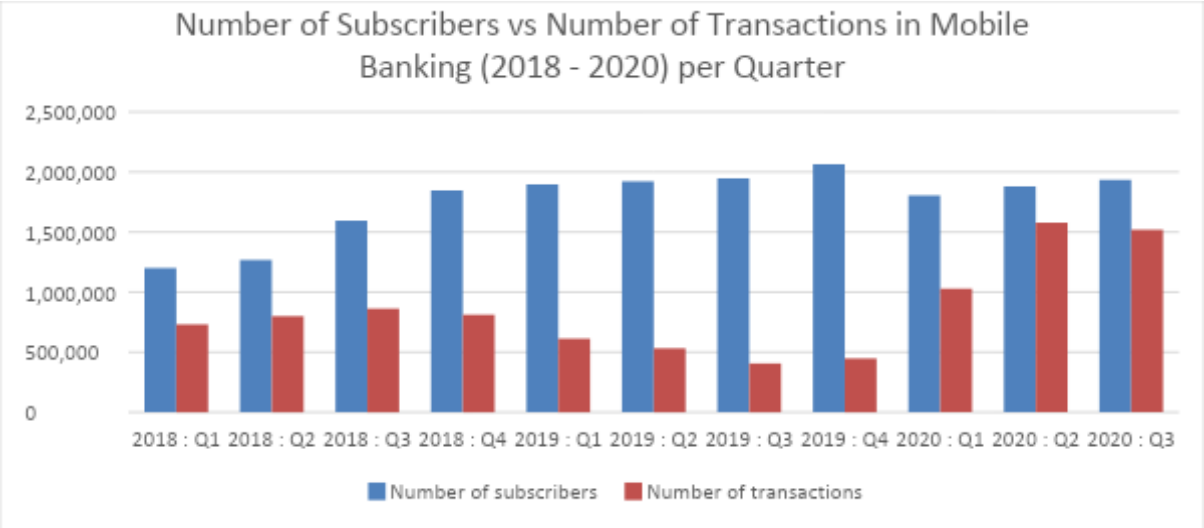
The pandemic has spurred innovative approaches that are helping society respond to and minimize its impact. Even before the global pandemic however, digital technology in general and digital financial services in particular had begun accelerating economic resilience, particularly for the most vulnerable.

The COVID-19 pandemic is severe, and its economic effects are only just beginning to be felt in Rwanda. Still, innovative solutions and technology tools offer a glimmer of hope for human efforts to boost resilience and slow or halt the spread of the virus. We must seize upon the current urgency to rapidly develop and deploy digital services that are universal and inclusive, and which will help shield Rwanda's most vulnerable from future economic shocks.
Rwanda primarily needed to anticipate and manage the pandemic's impact on the economy in the long term, implement solutions to increase economic resilience, and offer sustainable digital solutions that can transform society. Rwanda as a country has demonstrated a strong ability to deploy digital solutions throughout the territory, with a global outlook on the local IT solutions market. The rates of internet users are increasing but limited to cities' population whose digital knowledge may be at very high level and the high rate of mobile phones and smartphones use help Rwanda provide effective digital solutions for the crisis. However, many solutions already developed or created during the pandemic have addressed some of the crisis's challenges.

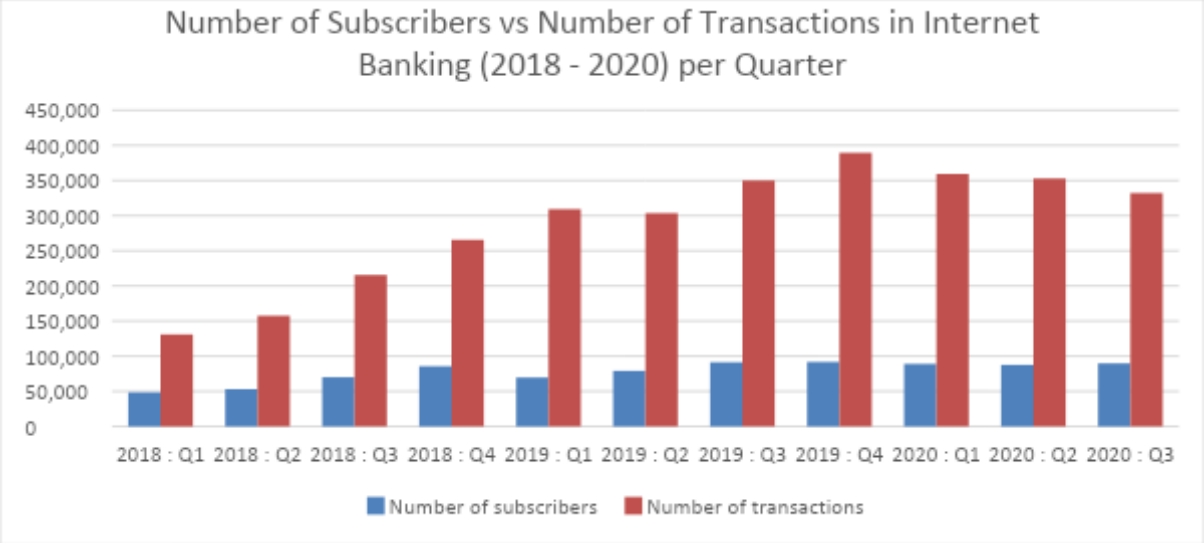
To sum up, the rollout of those solutions is restrained by various challenges. The absence of a digital identity system is an obstacle to identification, monitoring and outreach to poor populations. The limited testing for COVID-19 and access to the internet hinders the deployment of tracking solutions, and the low rate of mobile payment users also limits the possible solutions. They won't help all the challenges in Rwanda, but technological solutions can help country battle the coronavirus, while digitalizing economies and making them stronger.

4. Data Analysis and Discussion

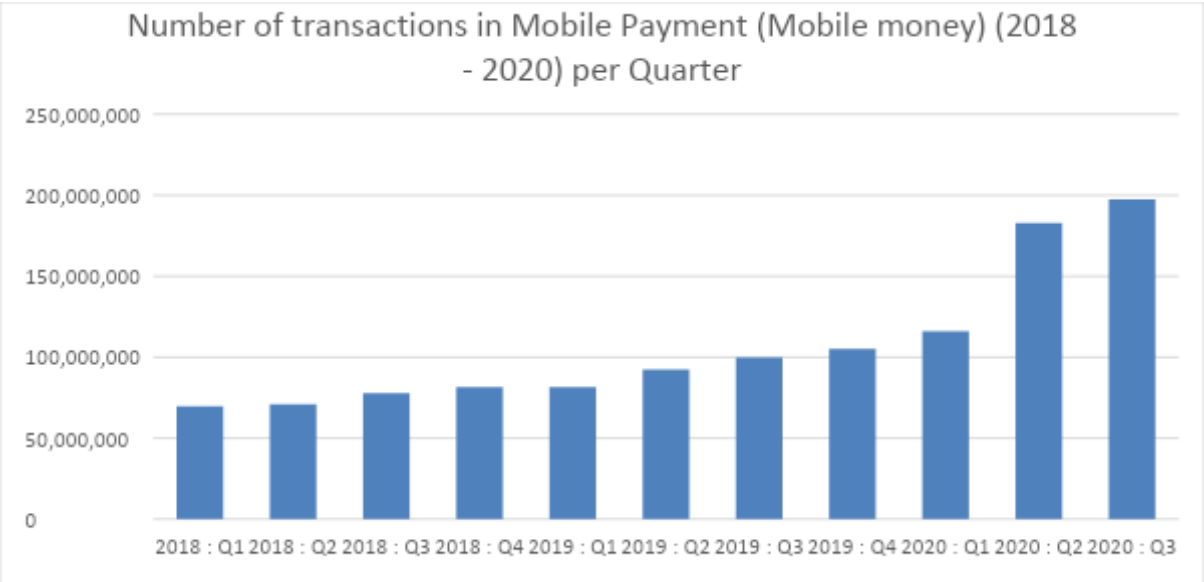
Financial Services Providers (FSPs) increased their rollout and users increase their adoption of digital payment channels.



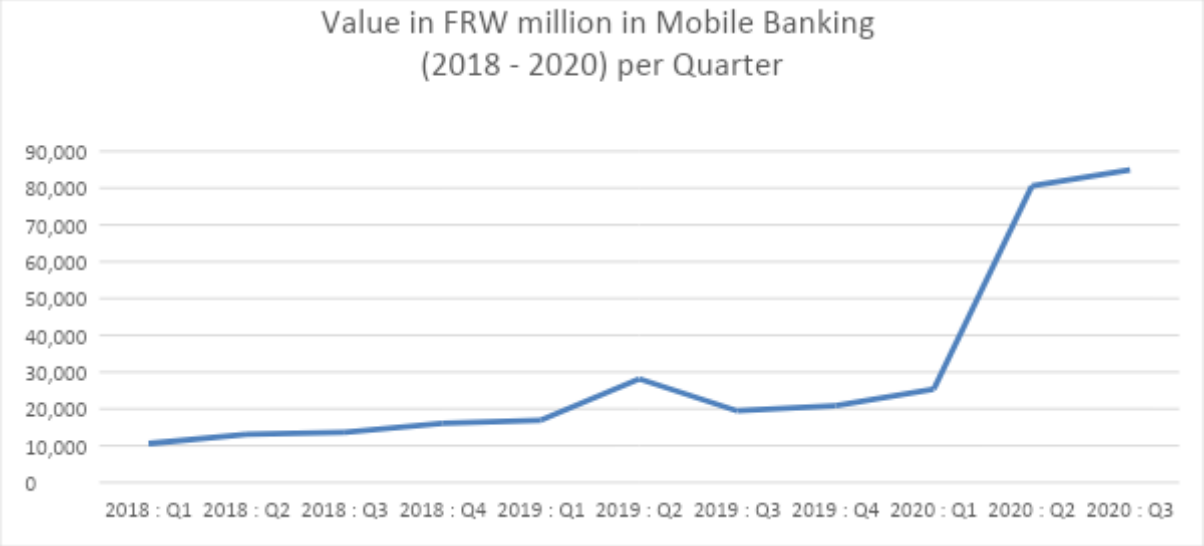
The above bar illustrates how the number of subscribers and number of transactions in Mobile Banking have been varying overtime during year 2018 and 2020. The arrangements are quarterly based. In 2018, there has been an increase in number of subscribers. In 2019, there was also a small change. The number of transactions has been increasing in 2018, however; in 2019, there was as decline. Moreover, in 2020, quarter two, the number of transactions in Mobile Banking has increased by 53% comparing to 2020, quarter one.



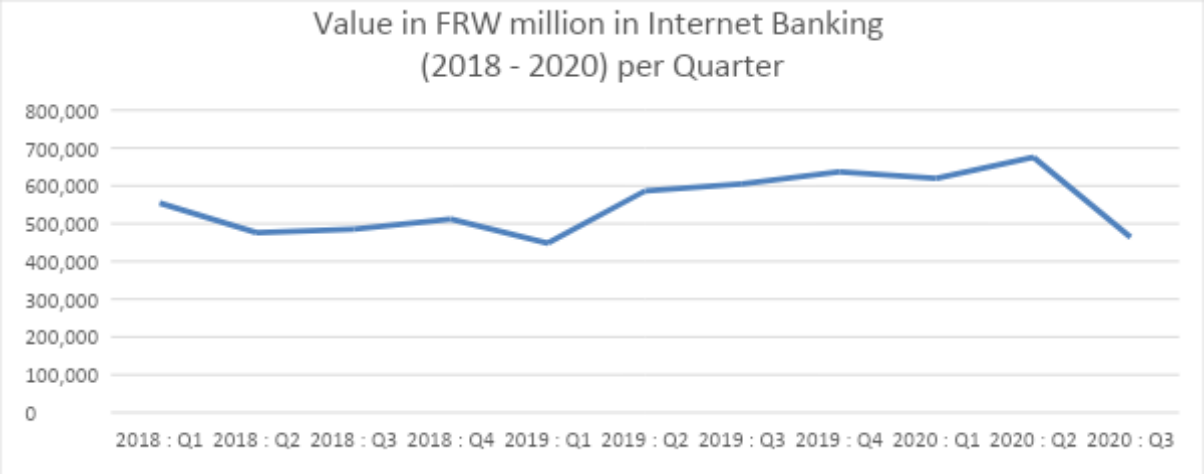
The above bar shows how the number of subscribers and number of transactions in Internet Banking have been changing overtime during year 2018 and 2020. There is a small variation in number of subscribers for above period. Nevertheless, there has been a significant increase in number of transactions. Moreover, in 2020, quarter two, the number of transactions in Internet Banking has decreased by 2% comparing to 2020, quarter one.



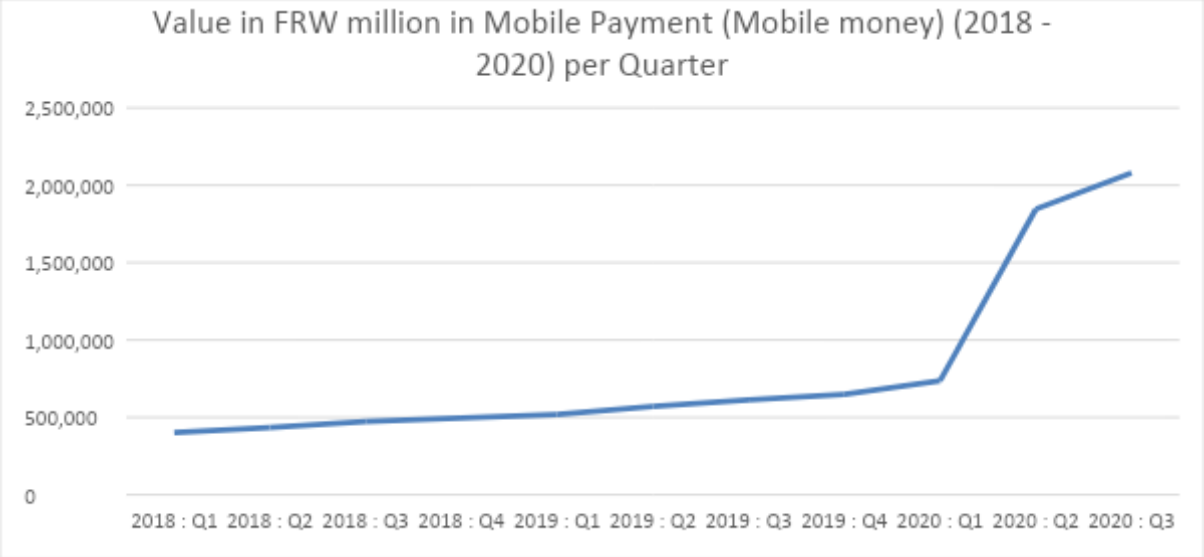
The overhead bar displays how the number of transactions in Mobile payment (Mobile Mone) have been moving overtime during year 2018 and 2020. The bars are rising positively in the stated period, especially; in 2020, quarter two, the number of transactions in Mobile Money has increased by 58% comparing to 2020, quarter one.



The above graph demonstrates how the value in Mobile Banking have been trending actively during year 2018 and 2020. From 2018, there has been rising besides in 2020, quarter two, the Value of FRW in Mobile Banking has strongly increased by 218% comparing to 2020, quarter one.



The above graph reveals how the value in Internet Banking have been fluctuating dynamically during year 2018 and 2020. There were up and downs in the whole period. In 2020, quarter two, the Value of FRW in Internet Banking has increased by 9% comparing to 2020, quarter one.



The above graph discloses how the value in Mobile Payment (Mobile Money) have been growing vigorously during year 2018 and 2020. From 2018 up to 2020 quarter one, the rise was slightly satisfactory, However, in 2020, quarter two, the Value of FRW in Mobile Money has increased by 151% comparing to 2020, quarter one.

5. Conclusion and Recommendations

Digital solutions have had a profound impact during the COVID-19 crisis in Rwanda, enabling parts of the economy to continue to function online and through remote working. In other areas, digital solutions were needed to protect healthcare workers, and treat and care for patients. There now needs to be a consolidation of these digital advances across industries to establish the foundations for a deeper digital transformation and a strong and sustained economic recovery. We consider the advances made during COVID-19 to be part of a longer-term trend towards a smart economy characterized by autonomous systems, augmented processes, digitally represented assets, predictive systems and interconnected devices that creates new business opportunities and productivity improvements.

Our research has convinced us that government action is needed to aid the post-COVID-19 recovery. Focusing on digital solutions can accelerate the move to a smart economy and, in the process, accelerate economic growth for prolonged prosperity. Additionally, below are some recommendations:

- Place digital solutions at the core of the recovery strategy as investing in digital generates greater-than-average returns for the economy.
- Boost infrastructure investment. The foundation of a smart digital economy is a strong and reliable infrastructure.
- Enable a digital recovery for all, not just the happy few targeted initiatives supporting
- Double efforts to improve ICT skills and digital literacy. Ensure that workers, companies and households have the capabilities to benefit from a digital economy.

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