POLICY BRIEF

The Impact of Network Coverage on Adoption of Fintech Platforms and Financial Inclusion

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Abstract

This paper analyses the effect of mobile network coverage on financial inclusion using the survey data of 12,735 individuals from nine sub-Saharan African countries conducted in 2017. We use the geolocation of respondents to combine the survey data with information on the proximity of mobile network towers. We estimate a two-stage model: in the first stage consumers decide to adopt a technology device, and in the second stage they decide whether to use digital financial services or not. The results show that financial inclusion is positively influenced by mobile network coverage. In counterfactual

simulations, we consider that the whole population lives within 2km of the towers of any of these networks and find that the adoption of digital financial services would increase by 2%, on average, depending on the country. Considering a case where the whole population lives within a 2km radius from the LTE tower, financial inclusion would increase by 6% in Mozambique and 3% in Ghana, Rwanda, and Senegal. In Tanzania, where mobile money is a common financial service, investment in GSM and UMTS would have a larger impact on financial inclusion than LTE. These results show that non-Internet-based digital financial technologies have a greater impact on financial inclusion in East African countries than those that require consumers to be connected to the Internet. The results also indicate that digital financial platforms act as substitutes for a bank account among the poor, and as a complement for those who own a bank account.

Introduction

Empirical research has shown that the adoption of mobile phones and the Internet have a remarkable impact on economic growth performance. Roller & Waverman (2001), Pohjola (2002) and Jalava & Pohjola (2002) identify a few potential mechanisms through which Internet and mobile phones, specifically smartphones, can stimulate economic growth. First, it accelerates productivity and innovation by improving access to information and reducing search costs. Second, it improves social well-being through increased social interaction (Jorgenson et al., 2008). In Africa, where more than 33 per cent of the population live in extreme poverty in remote areas and 36 per cent are illiterate. The adoption of mobile phones and the Internet has the potential to serve as a virtual infrastructure for the provision of services that is generally not available to poor people.

The proliferation of mobile devices has increased the adoption of digital services among remote-area dwellers and increased access to online education and programmes, health information, agricultural programmes and digital finance. The current study focuses on the role of investment in mobile network infrastructure for broadening access and the use of digital financial services in nine sub-Saharan African (SSA) countries, a region that is not critically addressed in the literature. Digital finance includes all financial services that are provided through mobile phones, personal computers, the Internet or cards linked to a reliable digital system. It encompasses a host of financial products and services delivered by fintech companies and innovative financial service providers, including mobile network providers, banks and finance-related software companies (Ozili, 2018). These platforms enable individuals and companies to have access to payments, savings and credit facilities without the need to visit a brick-and-mortar bank branch (Mothobi & Grzybowski, 2017).

Digital finance can increase the speed and reduce the cost of payments. It has also been found to enhance security due to increased transparency through digital accounting, and it can provide an entry point into the formal financial system while at the same time promoting increased saving and allow users to smooth consumption in the face of small adverse shocks (Demirgüç-Kunt et al., 2018). Digital financial services provide an opportunity to promote financial inclusion through innovative and cheaper platforms that link poor people with providers of savings, credit and insurance products (Radcliffe & Voorhies, 2012). In this context, financial inclusion means that individuals and businesses have access to affordable financial products and services: payments, transactions, savings, credit, and insurance (Sarma & Pais, 2011). Digital finance platforms have opened doors for the poor, who were previously excluded from orthodox financial systems, to have access to payment systems, savings, and credit facilities via online and mobile phone financial services without the need to have a bank account or visit a bank branch (McKee et al., 2015).

The Internet and mobile phone-based technologies can change this situation by enabling the excluded to make use of digital financial services. In this way, they can overcome the problem of poor infrastructure and expensive traditional banking models that rely on a network of physical branches. Despite the development of digital financial services, which provide the potential for improved financial inclusion, the banking sector in SSA remains underdeveloped. Based on a survey conducted by Research ICT Africa in 2017 used in this paper, only 29% of people in SSA countries have a bank account. This number is far below the average for developing countries worldwide.

The current study seeks to examine the effect of mobile network coverage on the adoption of financial technologies. In addition, the study aims to investigate how investments in network coverage might impact financial inclusion. Taking into consideration the differences in network technologies, where urban areas are more likely to have high-speed technology, the study contributes to the literature by providing insights on how different technologies are likely to drive financial inclusion. The current study differs from the existing literature in three ways. First, the study models of financial services are used as a two-stage procedure to account for sample selection. Second, while the majority of the literature that studies the impact of technologies on financial inclusion focuses on the adoption of mobile phones, in this study we consider digital devices, including mobile phones, computers and access to the Internet as a virtual infrastructure for providing financial services and, finally, the study aims to investigate how different network technologies impact financial inclusion. Hence, this study is unique and provides an opportunity to disentangle how different technologies affect the adoption of financial services. The results obtained from this study can be generalized to other developing countries that have similar characteristics than the surveyed countries.

The results suggest that individuals who live near towers are more likely to own a digital device than those who live further away. The results show that financial inclusion is positively influenced by mobile network coverage. Individuals who live near towers are more likely to adopt digital financial platforms. Our results further indicate that investment in LTE towers to a radius of 2km per household would increase financial inclusion by 6% in Mozambique and 3% in Ghana, Rwanda, and Senegal. However, in countries where mobile money is common, investment in GSM and UMTS would have a larger impact on financial inclusion than LTE. Our results also show that once the hurdle of device ownership has been overcome, gender disparities disappear. However, digital financial inclusion inequalities are still explained by differences in incomes, education level, location, and employment status.

Digital financial inclusion in Africa

Since 2011, new technologies, innovative business models and the number of banked individuals has continued to rise. Between 2011 and 2014, the number of individuals with a bank account increased by 700 million. Data from the World Bank shows that as of 2017, 1.2 billion adults worldwide have been able to access an account since 2011. Today, 69% of adults have an account. However, about billion adults, or 31 per cent of all adults worldwide are still unbanked, with most living in developing economies where 46% of adults are unbanked, compared with just 6% of adults in high-income economies.

The COVID-19 pandemic has amplified the urgency of utilizing fintech to keep financial systems functioning and keep people safe during a time of social distancing, falling demand, reduced input supply, tightening of credit conditions and rising uncertainty. While digital platforms such as Internet banking are on the rise in developed countries, the use of Internet banking is still very low in Africa. This is mainly due to the low levels of Internet use in these countries. Only an elite of individuals who have access to the Internet can access these platforms, more specifically fintech services that are routed through the Internet. For example, less than a third (27%) of the population in Africa have this access. However, in contrast to African and Asian countries, Latin American countries have reached a critical mass, with about 75% of adults among the surveyed Latin American countries using the Internet. Among individuals who have access to the Internet only a small proportion transact online via online stockvel (8%), online betting (4%) and financial transaction with government (4%).

The most common form of digital finance in SSA is M-Pesa, which is a mobile money transfer and micro-financing service launched in 2007 by Vodafone in Kenya for the operators Safaricom and Vodacom. It enables users to cash-in money using a mobile account (referred to as a wallet) that is linked to a unique mobile phone number of a subscriber. It also allows access to a wide range of services such as domestic and international money transactions, payments for bills, flights, hotels, and airtime

top-up (see Morawczynski and Miscione, 2008). M-Pesa is most common in East African countries, such as Kenya, Uganda, Tanzania, Rwanda, and Burundi, but it has expanded to other African countries such as Côte d'lvoire, Senegal, Madagascar, Mali, Niger, Botswana, Cameroon, and South Africa. Outside of Africa, M-Pesa operates in Afghanistan, Jordan, and other countries. Several banks in Africa have also rolled out a similar service called e-wallet. E-wallet differs from M-Pesa in that it requires the sender to have a bank account even though the receiver can only withdraw cash from an ATM using their mobile phone number and a personal identification number (PIN), which is sent to their mobile phone. At present, mobile money supports electronic payments and airtime top up/transfers, mobile banking, digital lending, international remittances and fintech.

The introduction of digital platforms and, more specifically, mobile money services have contributed significantly to increased financial inclusion in developing countries. For example, Demirgüç-Kunt et al. (2018) find that between 2014 and 2017, the share of adults who have an account with a financial institution or through a mobile phone rose globally from 62% to 69%. In high-income countries 94% of adults have an account, while in developing economies 63% do. Based on the Research ICT Africa survey, financial inclusion rose from less than 20% in 2011 to more than 50% in 2017. The main reasons for the low levels of formal bank accounts in Africa are infrastructure deficits, inaccessibility, and financial illiteracy (Mothobi & Grzybowski, 2017).

Data sources

In this paper, we combine a few different data sets to investigate the influence of availability on the adoption of digital finance technologies and financial inclusion. The first data set includes a set of representative individual and household surveys conducted in 2017 by Research ICT Africa in the following nine African countries: Ghana, Kenya, Mozambique, Nigeria, Rwanda, Senegal, South Africa, Tanzania, and Uganda.

Table 1 shows the number of individuals surveyed in each country and the share of mobile phone users. There are 4,554 individuals who declared having a bank account among a total of 12,778 survey respondents. Furthermore, 5,729 individuals used digital finance platforms such as mobile money, mobile banking, and Internet banking for transactional purposes. The survey was conducted using electronic Android tablets and an external GPS device, which was used to capture the exact coordinates of the household. We use geographic coordinates to merge the survey data with the other data sets, including information on the availability of coverage and proximity to mobile network antennas. The second database, on cell tower location, was downloaded from OpenCelliD. In addition to the exact geolocation of each cell, the date of creation and the kind of technology can be observed: GSM (2G), UMTS (3G) and LTE (4G). We

only use antennas constructed before 2017 to ensure that individuals in our survey could use these antennas. For each household we calculate distance to the closest antenna of each technology.

Table 1: Adoption of digital devices and digital financial services

Country	Devices		Digital	Financial			
	Internet	Smart-phone	Finance	Mobile money	Bank	card	N
Ghana	25.9%	25.8%	55.7%	51.6%	30.6%	8.0%	1196
Kenya	36.4%	33.6%	88.1%	80.5%	42.2%	19.9%	1216
Mozambique	20.3%	17.0%	25.2%	23.9%	24.4%	20.6%	1220
Nigeria	29.7%	16.5%	6.3%	2.5%	38.2%	31.0%	1804
Rwanda	14.2%	10.7%	34.2%	33.9%	32.7%	9.0%	1217
Senegal	32.0%	22.1%	35.3%	32.8%	10.6%	4.7%	1233
South Africa	45.7%	43.9%	21.3%	7.6%	57.2%	33.2%	1794
Tanzania	22.2%	20.3%	55.5%	55.4%	17.4%	10.6%	1200
Uganda	32.0%	13.2%	47.8%	47.8%	2.7%	6.8%	1855
Total	28.2%	22.8%	38.5%	34.80%	28.9%	17.0%	12735

Table 1 presents information on the adoption of financial services, Internet use and smartphone adoption across the surveyed countries. The overall number of interviewed individuals in our sample is 12,735, with some variation across countries ranging from 1,196 in Ghana to 1,855 in Uganda. The level of bank account ownership among the sampled individuals is 28.9% of individuals, while 38.5% of individuals use digital financial platforms to conduct their financial transactions. In this paper, we define digital finance as the use of online services and mobile apps to access financial services without the need to visit a physical bank branch. In our sample, 34.8% use mobile money, and 28.9% and 17.0% have a credit card. Using mobile money, owning a bank account, and owning a credit card are not mutually exclusive.

There are substantial differences in the usage of digital finance platforms and bank ownership across the surveyed countries. For example, South Africa has the largest proportion of individuals who own a bank account (57.2%) while only 21.3% use digital finance applications. In Kenya, the country with the second-largest proportion of individuals owning a bank account, 88.1% of surveyed individuals use digital finance apps to access financial services. The high uptake of digital finance in Kenya is attributed to the success of mobile money in this country, with 80.5% of the Kenyan population using mobile money to send, receive and save money. In South Africa, 43.9% of the population are smartphone users and 45.7% use the Internet. The lowest smartphone penetration was in Rwanda at 10.7%. With respect to usage of mobile money, Kenya is at the top (80.5%) followed by Tanzania (55.4%). More economically developed countries, Nigeria, and South Africa, have the lowest share of mobile money users, 2.5% and 7.6%, respectively.

As discussed earlier, this may be due to the relatively high penetration of bank accounts in South Africa (57.2%). Conversely, in Nigeria the very low usage can be attributed to regulation that meant initially only banks were allowed to provide mobile money services.

Table 2 shows that there are large differences in average distance to infrastructure by individuals from different countries in our sample. Coverage by mobile infrastructure is approximated by distance to antennas from different networks such as GSM, UMTS and LTE.

Table 2: Households' average distance to towers across countries

	Ghana	Kenya	Mozambique	Nigeria	Rwanda	Senegal	South Africa	Tanzania	Uganda	Total
Mobile										
GSM	4.15	1.48	10.78	3.95	2.83	1.33	1.98	8.91	5.87	4.48
UMTS	5.79	1.84	12.98	5.68	4.19	2.42	2.23	11.31	6.61	5.73
LTE	79.65	14.6	499.7	163.11	25.21	101.13	10.9	106.92	69.69	112.8

Conclusion

In this paper, we analyzed how the proximity to mobile network infrastructure impact the decision to adopt a mobile phone and to use digital financial services. This was done using rich data from a survey of 12,735 individuals that was conducted in 2017 in nine SSA countries: Ghana, Kenya, Mozambique, Nigeria, Rwanda, Senegal, South Africa, Tanzania, and Uganda. The survey data was combined with detailed information on the proximity of physical infrastructure using information on the geolocation of respondents. We approximated coverage using distance from the household location to mobile towers of the GSM, UMTS and LTE networks.

We estimated a two-stage model where, in the first stage, consumers make the decision to adopt a mobile phone. In the second stage, they decide whether to use digital financial services. We found that network coverage has a significant impact on the decision to adopt a mobile phone. Individuals who live within a 2km radius from GSM, UMTS and LTE towers are more likely to adopt a mobile phone. Conversely, results from the second-stage estimation show that UMTS and GSM coverage has a larger impact on the use of digital financial services than LTE networks.

After considering both individual and household characteristics, we found substantial gender disparities in mobile phone ownership, but once this hurdle has been overcome the gender disparity in digital financial inclusion disappears. However, the study shows that even after adopting a mobile phone wealth, employment and education are the main determinants of digital financial inclusion. The results show that the educated, wealthy, and employed are more likely to be digitally financially included than the non-educated, the poor and the unemployed.

Conversely, the results suggest that digital financial services act as a complement to the wealthy, educated and employed individuals, and act as a substitute to those who were previously marginalized and could not access formal financial services. The results are a further indication that mobile money, which does not necessarily require a user to have access to the Internet, is the most common driver of financial inclusion in SSA.

In counterfactual simulations, we considered that the whole population lives within a 2km radius from any of these networks. Here we found that the adoption of digital financial services would increase by 0%–6% depending on country and network. We found that investment in LTE coverage would have a larger impact in Mozambique, Ghana, Rwanda, and Senegal. Conversely, in some countries such as Tanzania, investment in GSM and UMTS coverage would increase financial inclusion by a larger margin than LTE coverage. This outcome can be attributed to the differing financial market structures across these countries. For example, in South Africa and Mozambique most of the financial innovation is bank-led and operated on an LTE network, while in most of the East African countries financial innovations are mobile phone-network led and often run on GSM and UMTS networks. Despite the differing effects, our results are an indication of the importance of investment in network coverage to reduce financial exclusion and digital inequality in African countries. To the best of our knowledge, this is the first paper that uses very detailed individual-level data from several African countries, with geolocation information that is combined with a detailed geographic data on infrastructure coverage.

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