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Infrastructure deficiencies and adoption of mobile money in Sub-Saharan Africa☆

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ABSTRACT

We use survey data conducted in 11 countries in Sub-Saharan Africa in 2011 to analyze how the availability of physical infrastructure influences adoption of mobile phones and usage of mobile services. The availability of physical service infrastructure is approximated by data on nighttime light intensity in the areas in which survey respondents reside. After controlling for a number of individual and household characteristics including disposable income, we find that adoption of mobile phones is higher in areas with better physical infrastructure. However, mobile phone users who live in areas with poor infrastructure are more likely to rely on mobile phones to make financial transactions than individuals living in areas with better infrastructure. On the other hand, the use of mobile phones to access services such as email, skype, social media networks and Internet browsing is not dependent on the availability of physical infrastructure. Our results support the notion that mobile phones improve the livelihood of individuals residing in remote areas by providing them with access to financial services which are otherwise not available physically.

1. Introduction

The deployment of mobile telecommunications allows developing countries to overcome poor or non-existent fixed-line infrastructure and lack of Internet access. These are key burdens to economic growth in these countries. Access to mobile telecommunications can dramatically improve standard of living in these countries by saving wasted trips, providing information about prices or serving as a conduit to banking, health care and other services. Aker and Mbiti (2010) identify a few potential mechanisms through which mobile phones can provide economic benefits to consumers and producers in developing countries. First, mobile phones can increase market efficiency by improving access to information and reducing search costs. Second, better communication can improve management of supplies and increase productive efficiency of firms. Third, mobile phones facilitate services which are in general not available to low income households, such as mobile phone-based financial, agricultural, health, and educational services. In this paper, we focus on the third point and analyze how the availability of physical infrastructure influences the adoption of mobile phones and the use of mobile phone services such as mobile money.

As of 2014, mobile phone penetration in low income countries reached 90%.[1] This contrast with high income countries which had 121%. At the same time, in low income countries, only about 54% of the population have an account, compared to 94% in high income countries (see www.worldbank.org). The main reasons for lack of access to financial services are deficient infrastructure, inaccessibility and financial illiteracy. Mobile phones can change this situation by enabling people to make use of financial services overcoming the problem of poor physical infrastructure. Mobile banking or m-money provides access to account balances and money transfers using mobile networks, which does not require the proximity of other physical infrastructure.[2] In this way, the expansion of mobile

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[1] See www.itu.int.

[2] For instance, one of the main South African banks, Standard Bank, as of 2012 operated about 10,000 so-called bank shops in townships with predominantly black residents. These bank shops have a mobile phone banking capability allowing clients to do money transfers. They enable hawkers, who usually close shops in

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banking may have a significant impact on economic growth and poverty reduction in low income countries.

To date, there is a limited body of literature on the adoption of mobile financial services in low income countries.[3] This is largely due to the shortage of individual-level data on the use of mobile banking in these countries. Aggregate country-level data cannot fit the purpose because of short time span since the availability of mobile banking and low level of adoption in the majority of countries world-wide. Among few available studies, Mbiti and Weil (2011) use two waves of individual-level data in Kenya to analyze the use of M-Pesa. They find that the use of M-Pesa lowers the propensity of people to use informal savings mechanisms, but raises their probability of being banked. Gutierrez and Singh (2013) use data on 37,000 individuals from 35 countries to analyze factors which determine mobile banking usage. They construct a regulatory index and find that a supporting regulatory framework is associated with a higher use of mobile banking for the general population as well as for the unbanked. They conclude that regulators can foster the development of mobile banking services through the enactment of supporting regulation. In another paper, Economides and Jeziorski (2014) use mobile financial transactions among subscribers of a major mobile phone service provider in Tanzania to estimate price elasticities for different types of transactions. They find that demand for long-distance transfers is less elastic than for short-distance transfers, which suggests that mobile networks actively compete with antiquated cash transportation systems in addition to competing with each other. In another paper based on a qualitative approach, Bourreau and Valletti (2015) asses the economic features of mobile payment systems in low income countries. They conclude that mobile money has the potential to drive financial inclusion of poor households at low cost.

There is also emerging literature on the impact of mobile phones on the wellbeing of people. For instance, Jensen (2007) uses data on fishermen in the Indian state of Kerala to show that usage of mobile phones may improve market performance and increase welfare. In another paper, Aker (2008) analyzes how the phasing-in of mobile phone coverage between 2001 and 2006 affected grain prices in Niger. Muto and Yamano (2009) use panel data of households in Uganda to analyze the impact of mobile network coverage on sales of agricultural products. In another paper, Muto (2012) uses the same panel data to analyze how the possession of mobile phone influences labor market and migration. Klonner et al. (2010) analyze the effect of mobile phone coverage on rural labor market outcomes in South Africa. Overall, as documented based on country-level data, development of mobile telecommunications networks has a positive impact on economic growth (see Gruber and Koutroumpis, 2011).

Our study contributes to this growing literature by analyzing how the availability of physical infrastructure influences the adoption of mobile phones and mobile financial services. We estimate a number of logit models using a survey of individuals from eleven Sub-Saharan African countries, which was conducted in 2011 by Research ICT Africa.[4] The survey data is complemented with the Defense Meteorological Satellite Program Open Linear Scanner (DMSP/OLS) nighttime light intensity data, which we use to approximate the availability of service infrastructure at the location of survey respondents. The use of nighttime light intensity data enables us to analyze how spatial differences in infrastructure development across Sub-Saharan Africa influence the adoption of mobile phones and use of mobile services by individuals.

After controlling for a number of individual and household characteristics including disposable income, we find that adoption of mobile phones is higher in areas with better physical infrastructure. However, the estimation results suggest that, in the group of mobile phone adopters, the use of mobile phones for financial transactions is negatively influenced by the level of infrastructure development. Individuals who live in areas with poor infrastructure are more likely to use mobile phones to make financial transactions than individuals living in areas with better infrastructure. On the other hand, in the group of mobile phone adopters, the use of mobile phones to access services, such as email, skype, social media networks and Internet browsing, does not depend on the availability of physical infrastructure. Our results support the notion that mobile phones improve the livelihood of individuals who reside in remote areas by providing them with access to services which are otherwise not available physically. Moreover, we find that the level of income does not influence use of mobile financial services, while wealthier individuals tend to use mobile social services more. This result suggests that once consumers adopt a mobile phone, all income groups benefit from mobile money and transfer services.

The remainder of the paper is organized as follows. In Section 2 we discuss the evolution of mobile phone industry in Sub-Saharan Africa. Section 3 discusses the data sets used in the paper. Section 4 introduces the econometric model and Section 5 presents the estimation results. Finally, Section 6 concludes.

2. Mobile telecommunications in Sub-Saharan Africa

Mobile services have become affordable to a broader group of consumers in low income countries with the introduction of prepaid services. Before that, most individuals, and especially those living in remote areas, did not have access to any telecommunications services at all.

Due to a poor fixed-line infrastructure, Sub-Saharan Africa almost completely skipped the era of fixed-line telecommunications and embraced mobile telecommunications for the use of both voice and Internet services. By the end of 2014, there were 600 million mobile phone subscribers in Africa. This represents a penetration rate of about 68%.[5]

Fig. 1 shows the total number of mobile phone and fixed-line subscribers in the 11 surveyed countries in years 2000–2014 and the subscription rates per country. The number of mobile phone subscriptions in these countries grown exponentially, from 9.3 million in 2000 to 396.3 million in 2014. This represents a growth rate of 41.5% over the period of 14 years. As of the end of 2014, there were in total about 396 million active SIM cards in the countries of interest. In 2014, Botswana had the highest subscription rate with about 167 SIM cards per 100 inhabitants. Other countries with high subscription rates are South Africa (150), Ghana (115) and Namibia (114). On the opposite end, the subscription rate in Ethiopia stood at 32 SIM cards per 100 inhabitants. At the same time, the number of fixed-line connections in Africa stagnated, growing from about 6.8 million in 2000 to 7.8 million in 2014, which represents a growth rate of only 12% in the period of 14 years.[6]

Many mobile phone users in Africa live in remote areas where there is inadequate access to financial services, health services and educational programs.[7] The evolution of mobile networks coupled

the evening when banks are already closed, to use the bank shops to deposit their money.

[3] The empirical literature focused on the adoption of mobile phones is already mature. For instance, Grzybowski (2015) analyzes adoption of mobile phones using panel data of South African households.

[4] For information see http://www.researchictafrica.net.

[5] www.gsma.com.

[6] Own calculation from ITU mobile phone subscriptions data.

[7] To achieve universal access to mobile services, some countries such as Botswana introduced infrastructure sharing policy. This initiative of sharing towers reduced