

Income from innovation in digital economy: the use of wireless technologies

Ingresos de la innovación en la economía digital: el uso de las tecnologías inalámbricas

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ABSTRACT:

Nowadays, digital economy is developing globally, and even the countries of the third world use mobile communications and mobile payments. In some aspects developing countries even outpace developed countries due to the introduction of information technology. The purpose of our research is to study the impact of digital economy on the incomes of the subjects involved in the economic activity. The study is based on the collected data, compilation and processing of a sample of 350 enterprises engaged in business in Nairobi and Kenya. It can be concluded that "mobile banking" has a higher income-equalizing effect than "mobile phone penetration". Our research deals with the contribution of financial development to mobile inequality in order to assess its role in mobile banking.

Keywords: innovation, digital technology, wireless communication, mobile payments, M-PESA

RESUMEN:

Hoy en día, la economía digital se está desarrollando a nivel mundial, e incluso los países del tercer mundo utilizan las comunicaciones móviles y los pagos móviles. En algunos aspectos, los países en desarrollo incluso superan a los países desarrollados debido a la introducción de la tecnología de la información. El objetivo de nuestra investigación es estudiar el impacto de la economía digital en los ingresos de los sujetos involucrados en la actividad económica. El estudio se basa en los datos recopilados, la compilación y el procesamiento de una muestra de 350 empresas que operan en Nairobi y Kenya. Se puede concluir que la "banca móvil" tiene un efecto igualador de ingresos mayor que la "penetración de la telefonía móvil". Nuestra investigación trata de la contribución del desarrollo financiero a la desigualdad móvil para evaluar su papel en la banca móvil.

Palabras clave: innovación, tecnología digital, comunicación inalámbrica, pagos móviles, M-PESA.

1. Introduction

Today, a completely new and modernized model of the work and interaction of the state

and society is being created by digital economy. The main innovations are electronic commerce, wireless communication, electronic financial services, transport and utilities cards. The use of mobile phones for mobile banking, controlling and managing cash flow is the most common opportunity provided by digital economy.

Mobile phones were adopted faster than any other device in the history of mankind and became consumer-oriented (Jack & Suri, 2011). As elsewhere in the world, developing countries in Africa quickly adopted new wireless technologies. However, the transformation processes caused by these new technologies had never been more decisive and fundamental. It was here that the mobile phone and its capabilities brought dramatic economic and social changes. The Kenyan technology platform M-PESA, launched in March 2007, is the most well-known concept of success. M stands for "mobile" and PESA means cash in Swahili.

The M-Pesa platform allows its users to keep funds on their SIM cards or in the form of electronic currency, which can be used to pay for goods and services, as well as money transfer. The platform was first developed as a banking product in partnership with Safari.com, a telecommunications company (Telco), the Commercial Bank of Africa (CBA) and a commercial bank in Kenya (Morawczynski & Pickens, 2009).

The literature review makes it possible to conclude that there are no macroeconomic data on the effects of poverty on mobile penetration. Many studies (Mas & Radcliffe, 2010; Mbogo, 2010) are based on the fact that policy-making authorities should provide necessary instructions regarding the problems associated with the penetration of digital technologies and mobile banking, which significantly affect income equality.

There are four main directions to study the impact of wireless communication on mobile banking (Ndung'u, 2018). The first direction deals with the utility of mobile transactions (value accumulation, cash conversion and transfer of the accumulated value). The second direction is the concept of savings (basic or partially integrated) in mobile banking. The third direction connects mobile banking with the global system for mobile communication (GSM), while the fourth direction provides some statistics on mobile telephony in Africa.

The works (Jacob, 2016; Pessa, 2018; Wellen & van Dijk, 2018) highlight that the majority of mobile operations in developing countries can be performed in the following formats:

1. Users can make a payment using their mobile phones and the available funds on their accounts. When the user has a bank account, there is a connection with the bank account and, as a rule, there are no problems. If the user does not have an account, the automated process creates a bank account or a pseudo-bank account that is owned by a third party or the user's mobile operator (Wellen & van Dijk, 2018).
2. Cash conversion: when an account is connected to a bank account, users can visit banks for depositing and withdrawing funds. In many cases, users can also visit the retail stores of GSM providers (Pessa, 2018).
3. Internal money transfers. Users can transfer funds between accounts associated with two GSM using a set of short message services (SMS) (or menu commands) and a personal identification number (PIN). New services provide an opportunity to move funds from one account to another and are an alternative to the payment system (Jacob, 2016).

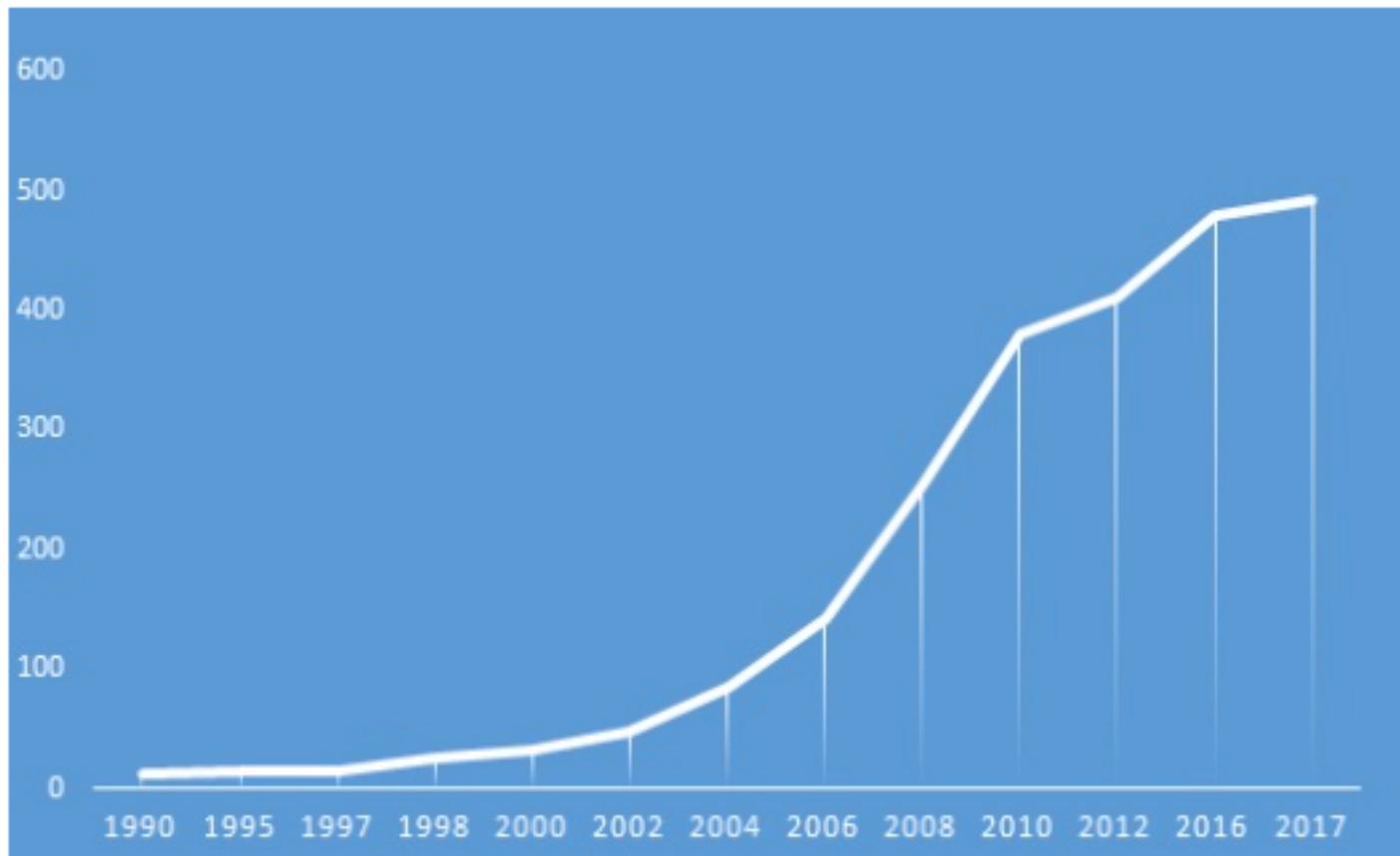
As some economists have suggested (Ngugi & Komo, 2017), the introduction of mobile banking systems has been particularly significant in the Philippines. At the same time, in (Omanga & Dreyer, 2017) it is stated that the development of the digital economy in Africa is hampered by the growing income inequality.

Despite the different points of view of scientists and the direction of their research, everyone comes to the same conclusion: it is necessary to reduce poverty and alleviate the inequality on the African continent.

The author of the scientific work (Asongu & Nwachukwu, 2016) believes that the quality of life of many people has been improved by the mobile revolution, which provides

communication and basic financial access in the form of mobile money transfer and storage. The significant growth and penetration rate of mobile telephony (Fig. 1) ensure the transformation of cellular phones into the pocket banks in Africa. It is these technologies that provide African countries with more affordable and cost-effective means of attracting and retaining the population.

Figure 1
Dynamics of the development of wireless communication
in Africa. Source: [own development]



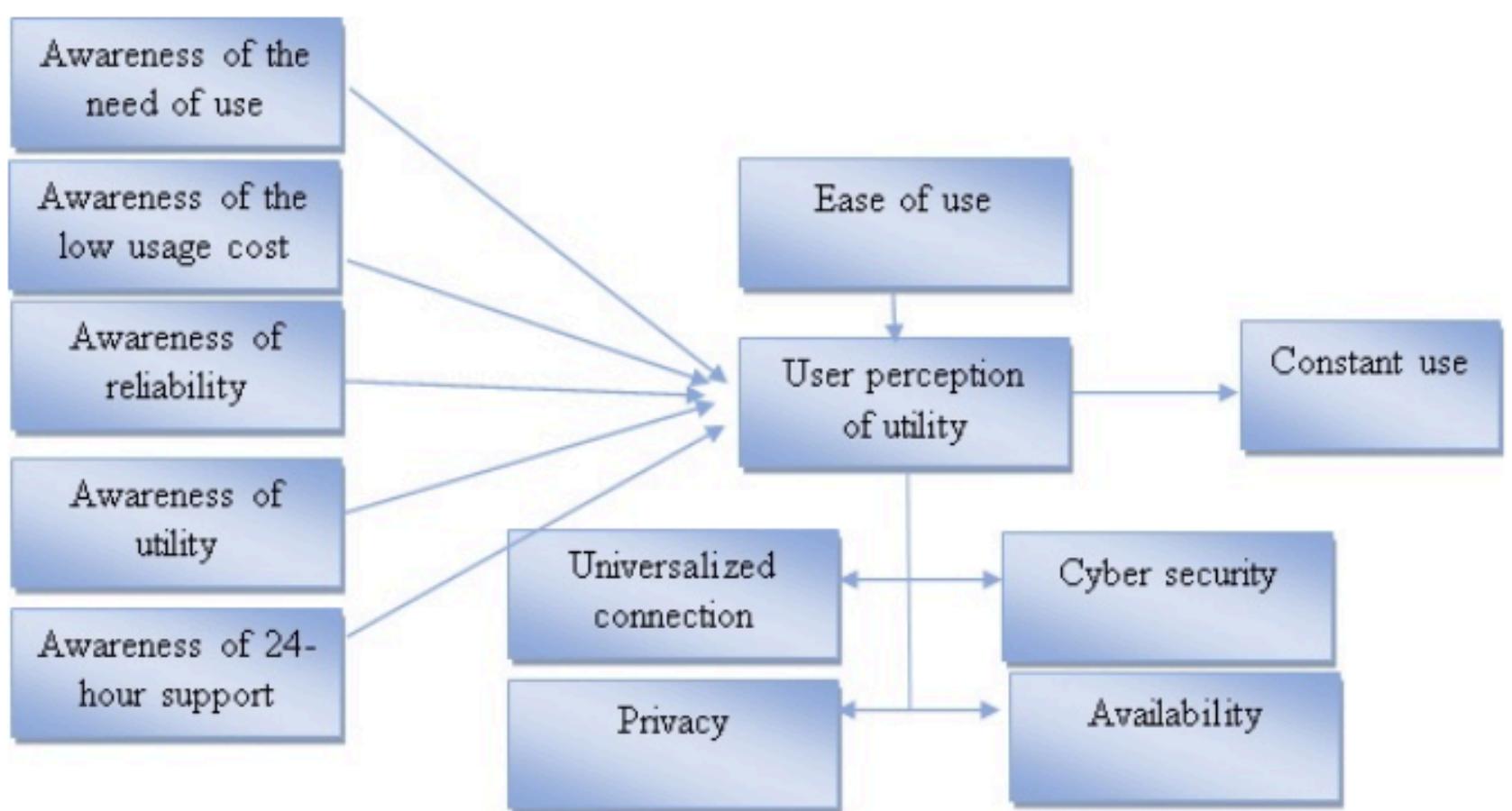
At the “Connect Africa” Summit in 2007 the President of Rwanda, Paul Kagame, noted that “in **10** short **years**, what was once an object of **luxury** and **privilege**, the mobile phone, **has become** a basic necessity in **Africa**” (Kamana, 2014). Wireless communication is a device that was a toy not so long ago, and today it is a powerful factor in economic development in the poorest countries of the world. In other words, a mobile phone has become an important tool for economic development.

Many economists are trying to figure out (Pasquier, 2013; UN E-government development review, 2017) how digital economy and its development are reflected in the redistribution of income from the perspective of mobile phone penetration and mobile banking. Evaluation of financial policies and their relationship to banks and microfinance institutions (MFIs) is carried out through government and financial regulators, as well as partner development, which provide support to improve the lives of African people. This policy is implemented through poverty reduction, sustainable economic growth and loyalty to customers (Fig. 2).

Researchers have not paid enough attention to the socio-economic impacts of M-banking (payment) systems in developing countries. Research on mobile penetration is theoretical and qualitative in nature, with some empirical developments.

We cannot argue that in developing countries a well-functioning financial sector is necessary, since a coherent and well-functioning public and financial sector in developing countries is crucial for economic development. It plays a key role in the economic progress of the third world countries. However, the majority of the world’s poor countries do not have banks and many enterprises do not have access to affordable and suitable financial services.

Figure 2
Algorithm for accepting mobile payments
by African users [own development]



According to the World Bank, 2 billion people lived below 2 dollars per day in 2016 (The World Bank Group, 2019). The lack of financial resources hampers the development of the economic and social potential of the population. In the work (World Development Report, 2016), it is stated that the tendency of an individual to participate in community life may suffer due to the lack of financial resources. This means a person lives in the world where the institutionalization sphere does not contribute to the lives of people.

We suppose that many projects for the digital economy development have been implemented to improve the prospects of people in the lower part of the socio-economic pyramid. To do this, it is necessary to implement microfinance programs as innovations, which are one of the most important tools for eliminating poverty. Microfinance is the provision of financial services to "low-income people".

The social significance of wireless communication makes it important to regard the innovations described in (Tece, 2017) as affordable innovations aimed at economically weaker sections of the society seeking to bring business into alignment with social welfare. However, the authors also described the impact of economic innovation as "negative results" because firms tend to worry that a low price can make the quality and characteristics of a product worse. As it is described in [18], microfinance can be considered a modest innovation in digital economy, as it adapts financial services to the market.

Recognizing this market potential and social needs, different organizations are targeting their potential customers through cost-effective innovations, the development of new financial products and services, as well as new service delivery mechanisms. Therefore, we believe that it is important to study one of the examples of digital technologies – mobile banking and the M-Pesa system in Kenya.

In the middle of 2018, Safaricom had 91 thousand agents, 10% of which were working directly for the company, while others were independent enterprises with several sales outlets. Some representatives only worked with Safaricom products, but mostly they provided other services. Obviously, the use of other firms to serve customers significantly increased the reach of Safaricom, but at the same time, this format also reduced the control and the possibility of direct customer feedback (Suri & Jack, 2008). Regarding this aspect, mobile banking solutions can be considered difficult to be built because they require complex multifunctional coordination.

The economic policy of African countries, namely in Kenya, has undergone many changes. The most important change was the introduction of information communications and technologies. Mobile phones have become a key ICT product that

has influenced business practices. This can be seen in various areas including advertising, marketing, the emergence of new products and new payment methods. Mobile payments are one of the latest innovations in the digital economy of Kenya. They have revolutionized small and large scale businesses. Microbusiness has also embraced the use of mobile payment technology in its operations. They regard this payment method as a more simple form of money transfer to their suppliers and business partners, as well as a relatively affordable and individual system that can be used anywhere and at any time (Kodila-Tedika et al., 2016).

This technology has become attractive and useful: mobile phones, as well as mobile banking and mobile payment services have become available throughout the country. Now the presence of a mobile is equal to the presence of a bank account. Most businesses in Kenya work in the informal sector. They are individual entrepreneurs or family businesses that employ not more than five people.

Business functions in such enterprises are usually performed by the owner or manager on market stalls, open areas, residential houses and undeveloped open areas. In accordance with the Local Government Act (CAP 265) of Kenya, such enterprises must be registered and licensed by municipal city or district councils, but many of them are still not registered. Most of the business participants do not have bank accounts, while those who have them find it inconvenient and difficult to manage banking operations as it is necessary to leave the workplace and go to the bank (Ondiege, 2010).

In 2007, Safaricom made it possible to make mobile payments by launching the M-Pesa mobile money transfer system [9]. Business owners in Kenya adopted the use of mobile payments as a way of doing business because of the relative availability of mobile phones and the mobile banking services. It became possible to carry out various transactions using mobile payments: payment for goods and services, payment of bills, sending money to friends and relatives, cash withdrawals and account replenishment (Asongu & Nwachukwu, 2016).

In such a poor country like Kenya, where most people do not have a bank account, the new M-PESA tool has significantly improved people's lives. If users are registered in M-PESA in any Safaricom outlet, they can transfer money all over the country using their mobile phone. The registration process is simple and much easier than registering a bank account. M-PESA account is tied to one phone number, and the client is allowed to access their money through a mobile phone. Customers have access to a secure account and get a 24-hour support from Safaricom. This security feature helped to develop customer confidence in the M-PESA system, and attracted more and more people to use this system.

In addition, many people who had a mobile phone, but did not have a bank account, received a new opportunity to send money through the phone. M-PESA fully satisfied the current need for digital economy in the Kenyan market. Safaricom dominates the Kenyan mobile market and covers 77% of consumers having 13.8 million customers (World Bank, 2018). This fact dramatically influenced the spread of new technology. There were more registered customers and the growth rates increased from 210% to 735% between 2008 and 2014.

In 2018, the number of M-PESA users exceeded 17 million. The system was approved by most Kenyans. Today, more than 90 percent of Safaricom customers use M-PESA and it serves nearly two thirds of Kenya's adult population. The customers are bribed by the fact that they do not have to pay for the registration with an agent who processes the application and the customer feels loyalty. After installation, customers have several options for using M-PESA on their phones. They can send or receive money, as well as store money in their virtual accounts (Hussain & Ahmed, 2016).

According to the statistical surveys, 28% of M-PESA users use the system to receive money, 25% - to send, 14% - to save, 14% - to buy airtime, 8% - to buy airtime for someone else, 7% - save money for possible emergencies. Currently, the costs of using M-PESA are very transparent, because all possible fees are directly paid by the users, who always control their expenses (World Bank, 2018).

Mobile banking affects inequality indirectly and in combination with other digital technologies (the ability to work remotely – freelance). Banking does not generate income for the user, but creates an opportunity to receive payments for the work performed. In turn, the ability to perform work is generated by the development of remote work exchanges (freelance exchanges).

2. Materials and Methods

Our research is an empirical study. In the course of our work, we studied and systematized the innovations in the digital economy in African countries. The impact of digital economy on the economic development of the region as a whole has also been considered.

A large number of publications on this issue does not provide solutions to the questions of improving the lives of the population through the use of mobile banking. We have proposed a scheme for building an effective digital economy with the active participation of state committees and departments.

Our research was based on the statistics on African countries and the Safaricom annual reports. The basis of our research was Kenya and the M-PESA system. The methods of analysis and expert assessments based on ranking and rating were used to make an assessment. We created a database for the selected criteria over time and grouped the results. The methods of mathematical statistics were used to obtain a generalized expert opinion and determine the level of the digital economy development in this region.

3. Results

We studied the following main problems:

- the ability of a mobile phone to provide mobile payments to explain income inequality due to other variables;
- the possibility of non-linear combinations and fitted values that explain income inequality;
- the ability of the financial development dynamics to explain the inequality outside the mobile channel;
- the ability of the financial development dynamics to explain the difference between the effects of "mobile phone penetration" and "mobile banking".

The first problem is connected with the value of the estimated coefficients, the second depends on the results of RESET RAMSEY, the third depends on the results of the Sargan OIR test, the fourth problem depends on the comparative analysis between the baseline OLS estimates and their respective 2SLS values.

The RESET results show that if non-linear combinations of independent variables have a response variable, the model can't be used. Therefore, RESET is a general specification test to estimate linear regression. The purpose of the test is to demonstrate that non-linear combinations of fitted values do not explain inequality. Therefore, the refusal to reject the null hypothesis confirms the validity of the linear model specification. The null hypothesis of the Sargan test is the result of the fact that financial tools can explain the inequality using other mechanisms apart from mobile communication (conditionally on control variables). Thus, rejecting the null hypothesis means that tools are affected by endogeneity, since they are associated with an error in the equation. The Hausman test precedes each assessment procedure. His null hypothesis for evaluating OLS is efficient and consistent. Hence, the rejection of the null hypothesis indicates the inconsistency of endogeneity and makes it possible to choose 2SLS estimation to assess the impact of financial development on inequality and mobile communication.

Table 1 shows the regressions of inequality in mobile phone penetration in 45 African countries. The first half of the table presents the OLS results while the second demonstrates their respective 2SLS values.

Table 1

Indicator	Variable: the GINI Index					
	Mobile communication ordinary least squares (OLS)			Mobile banking two-stage least squares (2SLS)		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Permanent	Permanent	84,526	87,958	90,023	87,563	89,885
Mobile	-20,256	-23,001	-28,620	-22,999	-27,632	-63,225
Inflation	0,556	0,711	0,799	0,623	0,656	1,562
Government spenditure	-	0,056	0,069	-	0,425	0,985
Legal expenses	-	-	-1,956	-	-	-39,569
the Ramsey RESET index	1,999	1,4699	1,302	-	-	-
the Hausman Index	-	-	-	0,452	1,562	15,639
the Sargan OIR Index	-	-	-	15,263	9,526	0,0009
the Fisher Index	8,001	6,112	6,063	4,056	3,995	7,211
Number of countries in the sampling	45	45	45	45	45	45
Tools	Inapplicable			Constant		

Source: [own development based on the statistical data from 23]

As for the first problem, mobile penetration positively affects income redistribution or the income-equalizing effect. As for the second question, all the models confirm the assumption about linearity, implying that they are correctly defined linearly, since the null hypotheses are not rejected in most cases. With regard to the third problem, the null hypothesis of the Sargan test showed some deviations for Model 3. This demonstrates a negative impact of "mobile banking" on inequality. In other words, the dynamics of financial development contributes to the income-equalizing effect due to mobile phone penetration. To solve the fourth problem, OLS estimates were compared with 2SLS estimates. We concluded that "mobile banking" had a higher income-equalizing effect than "mobile phone penetration". This is due to the fact that if there is no financial development, the relationship between "mobile penetration" and inequality is weaker.

High inflation promotes inequality. Institutional quality from the perspective of the supremacy of law reduces income inequality. Inflation can increase mobile inequality, since this effect is more strongly associated with low incomes of the population. The

supremacy of law reduces inequality because it essentially provides a favorable environment for the fair economic prosperity distribution.

4. Discussion

The main objective of our research was to identify the extent to which mobile payment services affected the success and growth of businesses in Africa. Having studied scientific sources, we managed to find out that the majority of scientists provide evidence of the significant impact of the use of mobile payment services on the country's economy (Kamana, 2014). This means that the businesses using mobile payments also recognize the presence of all the perceived structures in the study and positively identify the use of mobile payments.

However, there is a low correlation between the alleged support and actual use of digital economy. This means that business users of mobile payments expect more support from both the mobile payment service provider and the government. In (Wellen & van Dijk, 2018), it is stated that in African countries the minimum amount of daily transactions has increased and there is a decrease in the workload of service lines.

The actual use of mobile payments significantly correlates with other indicators. Business participants understand that using mobile payment services is beneficial for them in terms of convenience, support, cost, satisfaction and security. The constant use of mobile payment with adequate support from both the government and the service provider has a positive effect on their business (Jacob, 2016).

The economic situation and the standard of living of the population should be primarily addressed among the factors that force companies to accept mobile payment services. The alleged support from a mobile payment service provider affects the desire to purchase and use these technologies (Asongu & Nwachukwu, 2016). From a practical point of view, mobile payment services are user-friendly if they are properly supported by the provider. Previous studies examined the ease of use as one of the factors promoting the use of mobile payments (World Development Report, 2016).

Mobile payment technologies are increasingly used by businesses in Kenya. The government and mobile providers should expand the capabilities of micro-business participants with regard to mobile payments and digital technologies. First of all, they should increase the existing minimum amount of daily transaction, which will allow businessmen to make larger payments. They should also strengthen security measures and provide infrastructure that will reduce congestion network problems. These factors will encourage a positive attitude of users towards mobile payments and will ensure a wider use of services (Ngugi & Komo, 2017).

Kenyan banks seized this opportunity and also used the M-Pesa platform to manage micro accounts, provide deposits and financial services to previously underserved people. They invested a lot of money in this technology platform, which enabled them to develop the ability to grow and serve their market niches — strong banks can produce competitive products for their consumers (Asongu & Nwachukwu, 2016).

In (The World Bank Group, 2019), it is argued that the role of the Central Bank of Kenya is to conduct monetary policy, which should be more efficient if financial markets are sufficiently developed. Participation in the banking dominant financial sector is the starting point in Kenya. The access to financial relations was restricted for the majority of the population in Kenya, but with the development of economic opportunities, most commercial banks attracted their branch networks from rural areas and poor suburban centers. Also, most transactions were made in cash and a significant part of the currency outside the banking system. The introduction of the M-Pesa platform has changed the traditional holding of banks and cash preferences. This influenced the speed of money and the money multiplier, which were the main pillars of monetary policy at that time.

The currency crisis outside Kenya's banks and a significant reduction in their turnover rate reflect the changes in money keeping behavior — people keep less and less money outside banks and prefer less cash in their daily operations. In addition, due to the innovations in the banking sector, the M-Pesa technology has resulted in an increase in

the money multiplier (Mbogo, 2010). This provided the best conditions for the monetary policy of Kenya and made it possible to influence the market.

Economists say (Asongu & Nwachukwu, 2016) that the M-Pesa platform is a Kenyan revolutionary innovation that provided people with a safe way to send money home to their families quickly, reliably, efficiently and economically. It allowed organizations to make salary and credit payments, and also allowed customers to pay for educational and public services quickly, reliably and cost effectively.

This technology made it possible to solve the issue of international use of money transfers. Kenyan people abroad were able to send money home quickly and much more efficiently than through other alternative ways. It also improved money transfer operations for the older generation and families who are poor and live in rural areas. In the past, this process was carried out through the physical transportation of money by public transport, which imposed the risk of loss or theft (Suri & Jack, 2008).

Other achievements of M-Pesa (Ndung'u, 2018) can also be highlighted: saving lives - charity organizations got access and offered help to people in need when it was not safe to be there during the outbreak of violence in 2008. M-Pesa was extensively used to deliver money to vulnerable people and refugees in isolated places. The goal of M-Pesa is to promote Safaricom to become the best company in Africa that demonstrates innovation and is customer-oriented.

The M-Pesa platform brought prosperity to mobile commerce and mobile financial services in Kenya. It increased the number of people in business and strengthened the relationship of business and people, people and government, government and mobile payments of the population. In 2009, Safaricom started to service the accounts on the M-Pesa platform. Since then, Safaricom has been cooperating with 25 banks and more than 700 enterprises. It ensured the existence of a deposit fund, bank transfers, regular payment of utility bills, insurance premiums and payment by installment (Ondiege, 2010).

Through the expansion of informal networks of risk distribution, M-Pesa allows more efficient distribution of risks, since it ensures timely transfer of small amounts of money until the conditions that cause long-term damage worsen (Asongu & Nwachukwu, 2016). In addition, after expanding the coverage of the M-Pesa platform, it became possible for the government to develop an eCitizen platform (e-government platform). It allows people to apply for public services and pay with mobile money. This significantly reduced the time and effort needed to access public services. Now Kenyan people do not have to pay for maintenance. In addition, the government used the M-Pesa platform to support its social protection programs. For example, (Jacob, 2016) showed that Kenya used the M-Pesa platform to deal with the obsolete protection program. This government initiative improved the financial situation in the country.

The M-Pesa platform provided poor, small and medium scale businesses with the access to finances. Digital systems made large transactions possible. The M-Pesa platform has gone beyond the Kenyan market and continues to grow in other financial markets, such as microinsurance, capital and pension markets, as well as the state social protection program (Morawczynski & Pickens, 2009).

In addition, the M-Pesa platform helps to track cash flow fraud. Secondly, it is an effective tool for ensuring financial accessibility and support of banks as a platform for managing accounts in Kenya. Most Kenyan people did not use bank services due to such factors as low income, irregular cash flows and remote distance to the bank or financial service centre. This technological form allowed banks to develop their growth potential and serve their market niches. Almost 77% of the Kenyan adult population live within 5 km of a financial service centre. From 2007 to 2017, branch networks of Kenyan banks expanded from about 600 to 1,556 branches. In addition, Kenyan banks expanded to the East African region, having opened 310 branches (Ngugi & Komo, 2017).

The M-Pesa technology provides an effective platform for savings and contributes to the evolution and development of the credit market. The course of events in credit markets and credit scoring procedures may change the mechanisms for providing credit funds.

This new opportunity will transform the credit market in Kenya in the future. The new products of the digital economy M-Shwari and KCB Pesa (and M-Pawa in Tanzania) provide short-term loans and establish sustainable pricing for financial products. Side technologies were a major obstacle to the growth of affordable lending and the financial sector in many African countries. These innovations will bring new opportunities for further financial integration and investment (Safaricom, 2009).

5. Conclusion

In our research, we evaluated the role of mobile phones and mobile banking in reducing inequality in 45 African countries. We also considered the role of M-PESA in Kenya. The empirical procedure consisted of studying income redistribution, mobile phone penetration, as well as the impact of the financial development dynamics. The results suggest that income-equalizing effect from "mobile banking" is higher than that of "mobile phone penetration".

It has been revealed that financial development through digital economy and the mobile phone penetration contributes to the income-equalizing effect. Thus, it can be concluded that "mobile banking" has a higher income-equalizing effect than "mobile phone penetration". This is due to the fact that if there is no financial development, the relationship between "mobile penetration" and inequality is weaker.

It has been concluded that the M-Pesa platform contributed to financial development in Kenya: sales of financial products and diversification of services increased, which in turn changed the profile of financial depth. In addition, there was a development of deposit insurance services and people started to understand them. M-Pesa contributed to financial affordability, and at the same time generated an endogenous request for the regulatory reform, regulatory capacity and regulatory technologies. New institutions and economic projects that in the future will protect and support the development of the market appeared in the Kenyan economy.

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