



# IMPACT OF MOBILE PHONE PENETRATION ON FINANCIAL INCLUSION AND ECONOMIC GROWTH IN SADC.

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**Abstract:** This study investigated the impact of mobile phone penetration on financial inclusion and economic growth in SADC using a panel of ten countries and annual data from 2000 to 2018. The relationship between mobile phone penetration was captured by the number of mobile subscribers. The role of mobile phone deployment for financial inclusion is therefore estimated by including variables measuring access to financial services, namely the number of deposits and loans. Dynamic panel data model was used to address issues of endogeneity together with static models. A combination of panel regressions techniques was employed to meet research objectives. Findings revealed that mobile phone penetration has a beneficial impact on economic growth in SADC and also part of the positive effect of mobile penetration is channelized through financial inclusion. Findings confirmed that the main driver of economic growth is financial inclusion which is made evitable by mobile phone penetration in SADC although this relationship is not as strong as expected. Undoubtedly, the researcher recommends authorities to make some regulations and policy promotions targeting towards further utilisation of the great potential for inclusive growth that higher mobile phone penetration reveals. This can be done through lowering the cost of communications as this stimulates the diffusion of mobiles phones and spurring growth. Policy implications of this study would be that financial institutions must strengthen loan origination to be able to curb the greater part of financial inclusion. Regulatory authorities along with the central government engage in crafting policies that promote money lending for every country in the SADC region. Favorable policies that promote growth in loans and deposits include designing lucrative interest rates packages that attract many people as well as promoting policy consistency in SADC to allow investors to better plan and forecast the future environment. This study has been undertaken to investigate the determinants of stock returns in Karachi Stock Exchange (KSE) using two assets pricing models, the classical Capital Asset Pricing Model and Arbitrage Pricing Theory model. To test the CAPM market return is used, and macroeconomic variables are used to test the APT. The macroeconomic variables include inflation, oil prices, interest rate and exchange rate. For the very purpose monthly time series data has been arranged from Jan 2010 to Dec 2014. The analytical framework contains.

**Keywords:** *Mobile phone penetration, Financial inclusion, Economic growth, Mobile technology*

## I. INTRODUCTION

The recent mobile revolution, together with technological elevations, has not only made it possible for many subscribers worldwide to call or to text messages, but it also changed the way people live be it at work or at home. One of the notable breakthroughs that mobile phones have brought is the access to banking services where people carry out monetary transactions through the mobile device. This is referred to as mobile financial services. Given this expansion of mobile phones, the development of mobile financial services gave a great potential for underserved populations to gain access to formal financial services which revolutionalise the banking industry through the emergence of mobile banking thus financial inclusion. In African continent, there is a vast political momentum around the issue of financial inclusion as governments have realized the pivotal role that financial inclusion can play in elaborating poverty and contributing to inclusive economic growth. Many countries have now addressed the issue of financial inclusion strategies and spearhead key programs and initiatives to improve financial markets. As a result, by merging mobile phone expansion and the rise of mobile financial services in line with the financial infrastructure gap, it all collectively shows great potential for the late underprivileged people to gain access to the formal financial sector.

### 1.1 Background of the Study

The Southern African Development Community (SADC), comprising 14 member countries of which nearly 75% per cent are classified as low-income countries. World Bank (2011) views the alleviation of poverty as its foremost priority in the economic integration process. Access to basic financial services is today widely recognised as one possible means to achieve a better life for the poor, empirical research by Caskey et al. (2006), and Dupas and Robinson (2009). This is also the case in SADC where currently more than 50 per cent of its members claim to have a strategy document for the advancement of financial access, World Bank (2010).

The development of phone market, given this access to the SADC country's financial sector, has played a central role in the economy. The SADC financial inclusion strategy complements and strengthens country strategies via integration and support. As more people gain access to formal financial services, the size of the financial sector increases resulting in contribution of economic growth. Consequently, the research presents an attempt to provide a starting point for discussion of the relevancy of mobile phone communications on countries' economic growth. The focus of this study is therefore specifically analyses the impact of mobile phone penetration on financial inclusion and economic growth rates in 10 SADC countries between 2000 and 2018.

The access and use of mobile telephones have increased with 6 billion telephone subscriptions out of 7 billion people of the world population, World Bank (2013). According to Aker and Mbiti (2010), 60% of sub-Saharan populations have mobile telephone coverage. In essence mobile telephones in Africa have become more than just simple communication tools but have also emerged as service delivery tools which can improve lives through applications and services Donner and Marcela (2010). Rashid and Elder (2009), state that increased use of mobile devices together with the evolution of technologies has enabled customers to conduct financial transactions, fostering financial access and inclusion. One such vehicle that has improved access to banking services, filling the void left by traditional, conservative and 'slow moving banks' has been mobile money transfer schemes. According to the World Bank (2013), mobile money transfers have expanded to 16% of the total population in the Sub Sahara. Mobile telephones have brought what Donner and Marcela (2010), terms transformational benefits, new ways to receive services and to support livelihoods. The rapid uptake of mobile telephones has generated a great deal of curiosity regarding its effects on livelihoods and economy as far as mobile money, credits, insurance, and mobile transactions are concerned. The growth in SADC countries is exceptional, with figures ranging from 39% to 72% from 2000 to 2018 respectively. Even though there appears to be a growing appreciation about mobile phones improving potential of livelihoods, the clear-cut ways and the degree to which they contribute to sustainable livelihoods in developing countries is still contentious, Mushongah and Scoones (2012).

Figure 1.1: Mobile Phone Subscribers in SADC countries (2000-2018)

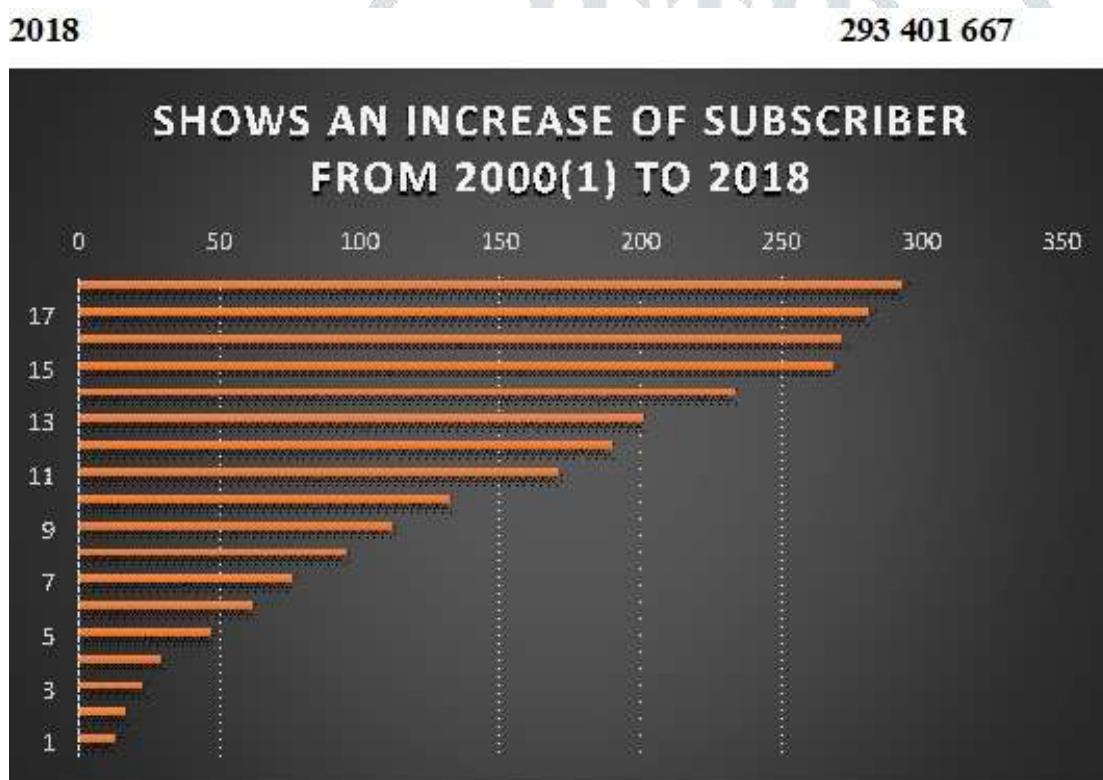


Fig1 Mobile Subscribers in SADC countries from 2000-2018

Fig 1 above displays the number of mobile phone subscribers in SADC countries. The figures on the graph reveal a steep increase in mobile phone subscribers which is in indication of the mobile phone penetration. The rate at which mobile phone subscriptions has been growing in developing countries tally with the observation by the World Bank (2012) that the developing world is "more mobile" than the developed world. This indicates that in SADC developing countries, more people, each year, have access to a mobile phone. The developing world followed the "mobile first" development approach while mobile communications have added value to legacy communication systems and have supplemented and expanded existing information flows in the developed countries, World Bank (2012). This concept is known as financial inclusion.

### 1.1.1 Financial Inclusion

Financial inclusion has reshaped the global financial landscape as depicted by the demographic changes in combination with the rise of the world's middle class. It has in particular been highlighted and gained momentum, World Bank (2014); IMF (2014). Demographic changes in combination with the rise of the world's middle class have reshaped the global financial landscape.

Table 1: Indicators of Financial in SADC (2018)

| INDICATOR              | DEFINITION   | REGIONAL BASELINE  |
|------------------------|--|--|
| Regional access strand | Overall level of financial inclusion across the region                                 | 66% of adults in the region are financially included   |
| Mobile money           | Proportion of adults use mobile money  | 23% of adults use mobile money   |
| Savings                | Proportion of adults use savings and what proportion of adults use formal saving       | 51% of adults save – formally or informally 17% of adults use formal saving mechanisms/ products   |
| Credit                 | Proportion of adults use credit and what proportion of adults use formal credit        | 32% of adults use credit/ borrow- formally or informally 15% of adults use formal credit products  |
| Insurance              | Proportion of adults have insurance and what proportion of adults use formal insurance | 27% of adults have insurance- formally or informally 18% of adults have formal insurance products  |
| Location               | Access to financial services through banks for rural populations                       | 22% of rural adults are banked (out of 55% financially included – compared to 52% of urban adults banked) – banked relevant as it shows the extension of physical infrastructure |

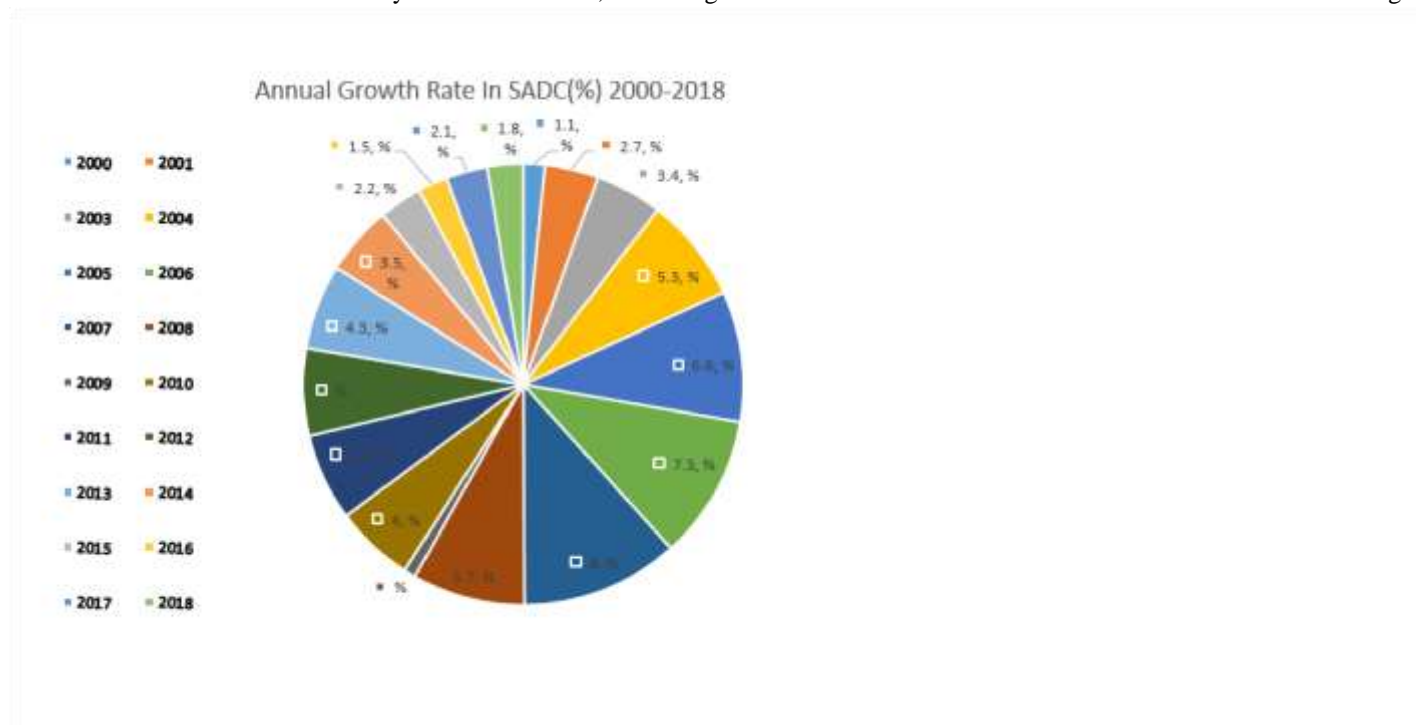
Source: Finmark Trust

### 1.1.2 Economic Growth

Economic growth is usually measured as the annual growth in a country's gross domestic product (GDP). Aghion and Howitt (2009), argued that it is considered to be the major determinants of the economic snapshot of a country and material well-being of billions of people around the globe. Through the establishment of SADC common market, the overall goal of economic development and regional integration is to facilitate trade and financial liberalisation, to establish competitive and diversified industrial development, to increase investment, and eradicate poverty. SADC real GDP has been fluctuating since 2000, with the period 2003 to 2006 having high levels before a decline in 2007 as shown in the table below.

Figure 1.2: Annual Growth Rates in SADC(2000-2018)

From 2009 to 2010 GDP increased by more than 5 times, remaining well above 4 until 2013 when it decreased and started fluctuating



at a low level. There is a primary requirement, therefore, to more fully understand the suggested potential for mobile phone penetration and the reality of the financial services they provide in relation to economic growth. This study seeks to assess the impact of mobile phone penetration on financial inclusion and economic growth in SADC countries.

### 1.2 Statement of the problem

Figure 1.1, Table 1.1, and figure 1.2, for mobile phone development, financial inclusion and economic growth based on real gross domestic products respectively shows that there is an increase of mobile phone development in the period 2000 to 2018. More so, there is also an increase in percentage of people who are financially included in the region. However, the figures of GDP are fluctuating as of the period 2004 to 2018. This research will help to fill the gap in literature by investigating the impact of mobile phone penetration on financial inclusion and economic growth where the number of mobile phones seem to be increasing together with financial inclusion as well as GDP. The researcher seeks to assess if financial inclusion functions as a channel through which mobile phone penetration affects economic growth. As the GDP also showed that the figures were not increasing but rather fluctuating as well as the rate of mobile penetration increasing, as such the research seeks to gain clarity on such relationship. It is imperative to evaluate how mobile phone services would enhance the countries to achieve goals of financial inclusion. This research, however, seeks to address the impact of mobile phone penetration on financial and economic growth in the SADC region.

### 1.3 Aims of the study

The study seeks to assess the impact of mobile phone penetration on financial inclusion addressing the following objectives:

- Assess the link between mobile phone development and economic growth.
- Investigate the relationship between financial inclusion, mobile phone penetration and economic growth.
- Examine the interaction between mobile phone penetration and financial inclusion.

## II. Literature review

ICT development is increasingly considered a factor in economic growth rather than a distinction of it, as mentioned by Tchong et al. (2007). There are characteristics of ICT who explain this view which among them include that ICT are ubiquitous in most business sectors, improve continuously and therefore reduce costs for the users and that it contributes to innovation and to the

development of new products and processes. This chapter will present relevant background information on the spread of mobile phones, mobile financial services thus financial inclusion and its link to economic growth.

## 2.1 Theoretical Literature

This section will help in evaluating the theoretical literature which is in support with the principle that mobile phone penetration has impact on financial inclusion and the issue that financial development link to economic growth.

### 2.1.1 The Development of Mobile Phone and Economic Growth

Information Communication and Technologies (ICT) are tools that facilitate the production, transmission, and processing of information, Grace et al (2003). Looking at the mobile phone, it is a relatively recent device that had its breakthrough during the late 1990s. ICT devices, mainly mobile phones, are now at a crossroads. The first official mobile phone was introduced in 1946, Kumar and Thomas (2006), in which three generations of mobile phones were introduced later and became a staple of modern society in the developed world. Research which was previously done investigated the effects of ICT on economic growth and mainly focused on fixed phones, radio and television. The link between these older forms of ICT and economic growth is, however, relevant for mobile phone penetration as well, since the mechanisms through which fixed and mobile phones affect growth are very similar, Andrianaivo and Kpodar (2012). Hence, this section takes a wider perspective on ICT development and its effects on economic growth. Grace et al (2003), argued that telecommunication affects growth through network externalities; the value of a telephone line increases exponentially as the number of users grows but in order to have effect on economic growth, a certain level must first be reached.

As such, benefits from mobile development have previously been restricted to high-income countries since resources in low- and middle-income ones have been insufficient to reach such a threshold. Contrary, recent research suggest that low- and middle-income countries may also gain from ICT development, as it is valued with the same importance as basic utilities such as water, electricity and transport, Andrianaivo and Kpodar (2012). According to Waverman et al. (2005), telecommunication networks are part of the social overhead capital, having the same characteristics as education, health services, and roads; the trait being that social return is higher than private return. Thereby, ICT is considered to have similar positive externalities as public infrastructure. Turning to the economic benefits of ICT, which can be either of direct or indirect nature, Lewin and Sweet (2005), argue that the direct effects arise from the supply of telecommunication services, whereas the indirect effects stems from the use of such services. The mechanisms through which ICT development affects growth are presented in Table below.

Table 2.1: Channels through which ICT affects Economic Growth

| Direct Effects                  | Indirect Effects                                 |
|---------------------------------|--|
| Increased employment and demand | Productivity gains and reduced transaction costs |
| Higher government revenues      | Rural development and opportunities for women    |
| Improved balance of payments    | Financial inclusion                              |

Looking at the direct effects of increased supply of ICT, it can have a positive impact on employment and demand, government revenues, foreign direct investment (FDI) and countries' balance of payments. This happens when the supply of ICT increases, job opportunities are created since there is a growing need for support functions such as network builders, system managers, and manufacturers. As such, domestic demand is increased as a result as more people are employed and receive decent income. In addition, through the collection of various taxes such as value added tax (VAT), income taxes, and corporate taxes, government revenues increase. Furthermore, Foreign Direct Investment (FDI) increases due to foreign interest in domestic ICT development, which in turn has positive effects on the balance of payments. Datta and Ararwal (2004), were of same view that a more developed ICT system attracts further FDI, resulting in even higher investment rates, creating more job opportunities and government revenues, all contributing to higher economic growth.

Moving on to the indirect effects of ICT development, these include inducing of capital accumulation, increased firm productivity, better markets, rural development, empowering of women, and deeper financial inclusion. Andrianaivo and Kpodar (2012), viewed developed mobile systems as ones having positive effects as better information flows further thereby improving farmer's bargaining power, reducing the use of intermediaries, and making the development of economic activities that are non-agricultural possible. In addition, ICT development may be particularly beneficial for women since they often lack the requirements needed to open a formal bank account. The potential of raising the power of women by making them financially independent is further an important aspect of financial inclusion GSMA Women (2013). The framework does not cover enough information to differentiate between ICT for women and men in terms of its effects on gender so the researcher can view this as something which does not completely reflect benefits to women. Turning on mobile services, mobile phones create a lot of jobs by increasing the demand for mobile-related services. Klonner and Nolen (2008), for instance, found that the introduction of mobile coverage in South Africa was correlated with a 15 percent increase in employment. They used panel data from annual labor force surveys in South Africa and data from a mobile network provider to measure the effect of mobile network coverage on labor market outcomes after constructing a fixed effects model

Moreso, the study also concluded that employment among young men shifts away from agriculture because of the introduction of mobile phones whilst employment among women increased as well. Mobile phone technologies enhance the development of many mobile services that may facilitate market efficiency. Aker and Mbiti (2010), postulated that mobile devices enhance development through mobile banking which in turn creates business and entrepreneurship opportunities. Ivatury and Pickens (2006) discuss the impact of mobile banking in South Africa, finding that m-banking increases the availability of money, credit, and other financial services to poor people. Since banking can be done electronically, mainly using mobile phones, people no longer need to spend time and money traveling to distant bank branches. Mobile banking reduces transaction fees that ATMs typically charge. With mobile banking, individuals can make payments, transfer money, and buy prepaid electricity and mobile airtime. They can also make balance

inquiries and deposits and withdraw cash. So far, the mobile banking provider WIZZIT has launched m-banking in South Africa Ivatury and Pickens (2006), and Safaricom has implemented MPESA in Kenya, Jack Suri (2009).

Furthermore, a study by Aker and Mbiti (2010) gives the channels through which mobile phone adoption in sub-Saharan Africa has affected economic growth and development. He opines that mobile phones are used to keep in touch with relatives, as well as learn about corn and tomato prices in Ghana, whereas in Niger, they are used to find about job opportunities. To add on, mobile phones and text messages remind users to take prescribed medications on time and report violent conflicts. Aker and Mbiti viewed mobile devices as not just a simple communication tool, but it is an agent of change that can transform lives. The number of mobile phone subscriptions in Africa has increased from 16 million in 2000 to 376 million in 2008 International Telecommunications Union (2009). The engagement of the mobile phone has been important in improving agricultural labor market efficiency thereby increasing producer and consumer welfare. Aker and Mbiti (2010), further added that mobile phones reduce information asymmetry by allowing better access to and use of information, by reducing search costs, and by improving coordination among agents. Thus, mobile phones helped firms in managing their supply chains and streamlining production processes by improving communication between firm and supplier.

Abraham (2007) studied the effect that mobile phones had on the fishing industry in India. He noted that the tele density of phones was about eleven telephone lines per 100 people, and the ratio suggests that there is room for growth in telecommunications in the nation. Abraham found out that that 80 percent of the respondents thought mobile phones useful after conducting a survey of Indian fisherman. He made his conclusions that there could more easily access market information, including selling prices and demand, if fisherman could take their mobile phones with them to the sea where they could then decide, for instance, how much fish to catch. The increased availability of information reduced the risks and uncertainty of the volatile fish market. In this case, mobile phones thus reduced search costs, reduced waste and improved quality of life, hence increasing the market share. Various ways in which mobile phones contribute to development have been reported in non-statistical studies. Mobile phones are used for mobile banking systems, and users find the service convenient because they can keep a record of the transactions Foster (2007). Sesay (2004), was of the view that mobile phones have replaced the landlines destroyed during civil war in Sierra Leone though rural areas still lack coverage. They are now used to coordinate business transactions as well as communicate with relatives. Moreso, mobile phones have generated business on the micro level. This was viewed by Hesse (2007), who said that entrepreneurs in developing countries such as Africa purchase multiple mobile phones, purchase airtime in bulk, and then sell calls to anyone passing through a village center. Some of business people establish kiosks to send money without mobile banking, for instance, in Uganda, customers buy mobile minutes on a prepaid card to transfer to a distant recipient. Kiosk owners send the minutes to another kiosk owner by reading the activation code aloud over Through the mobile phone, kiosk owners send the minutes to another kiosk owner by reading the activation code. In the same way, the other kiosk owner will then change the minutes into money after subtracting a commission and lastly deliver the funds to the distant recipient. Thus, mobile phones enable those without bank accounts to receive money and also do other types of business activity.

In addition, financial inclusion, as a channel through which mobile phone penetration may affect economic growth, is of main interest for this study. Faye and Triki (2013), argued that the innovative use of ICT management of large amounts of small transactions is much cheaper. Hence it has become profitable for actors to offer such services, which previously required transactions of larger size to be gainful. Furthermore, mobile financial services may play a crucial role in bringing financial inclusion even though unbanked people are not necessarily financially excluded. An individual can still have access to monetary services or accounts either through mobile financial services or the informal financial sector despite the he or she does not have access to a formal bank account. Thus, mobile banking can help solve major hindrances to financial inclusion such as geographical barriers and high transaction costs, thereby acting as an important step towards the use of formal financial services. As a result, more capital is flowing into the financial system, which in turn raises investments and economic growth. Comparable to other ICTs, mobile banking creates network externalities, meaning they become more cost effective as more users join the system, World Bank (2014).

## 2.2 Financial Inclusion and Economic Growth

Financial inclusion, or access to financial services, is viewed as an absence of price or non-price barriers in the use of financial services, World Bank (2013). Comparing developed and developing countries, the financial infrastructure is not well developed in developing countries with a limited number of financial services. One way of fighting poverty is to ensure financial inclusion among the marginalized populations. This means that doing all that is possible to make formal financial services not only available but also accessible and affordable to all groups of people in each society Triki and Faye (2013). The question remains on how best we can promote financial inclusion, or if its promoted does it contributes to the growth of the economy at large. The services usually include provision of credit and insurance services, banking and formal channels for making payments. Access, usage and quality are important dimensions of financial inclusion, African Development Bank (2013). When promoted, financial inclusion does not lead only to the improvement of the poor, but it also promotes economic growth at the global level.

Financial inclusion alone does not contribute to higher economic growth, through financial development. The size of the economy increases, as more people gain access to the formal financial system which contributes to higher economic activity. Referring to the theoretical framework presented by Levine (2005), greater financial development can have a positive effect on economic growth through the following five mechanisms. Firstly, financial intermediates provide information about potential investments at lower costs in comparison to individual investors, which results in a more efficient resource allocation since the most promising projects, and not only the ones with the most available information, will get funding.

Secondly, by monitoring investors after providing them with capital, financial intermediates help to alleviate agency problems, which make people more willing to save, and hence more capital available for investments. Thirdly, by channelizing savings from different individual financial intermediates, we can finance large-scale projects for which a single investor's capital would have been insufficient. Fourthly, financial intermediates invest in a wide range of different projects, thereby pooling the risk by diversifying

their investment portfolios so that they invest in more high-risk projects in comparison to a single risk-averse investor. Thus, financial intermediaries can channelize investments towards projects with higher returns. Lastly, financial intermediaries lower transaction costs between different agents, and thus facilitate exchange of goods and services. Each of the mechanisms described above may have a positive impact on decisions regarding savings and investment, and hence economic growth, Levine (2005). However, the mechanisms do not prove alone the financial development in line with financial inclusion, the next section will continue the discussion by explaining how financial inclusion relates to financial development, and consequently economic growth.

Financial constraints are restraining the poor since they usually either lack the required collateral, the credit history or the connections. Expanding financial services enables these poor people to finance potential high-return investments, which can lead to more efficient resource allocations, Galor and Zeira (1993). Hence financial inclusion may therefore have a positive effect on human capital accumulation. More so, access to formal financial services is negatively associated with poverty as well as with inequality. This was a conclusion supported by both theoretical and empirical evidence, World Bank (2014); GSMA Women (2013). Klapper et al. (2007), pointed out that since financial development may foster growth through the entry of new firms, it becomes crucial for talented entrepreneurs to get access to financial services to commercialise their projects Rajan and Zingales (2003).

In addition, most of the African economies mainly rely on cash and this implies that the population still believe in physical money. Consequently, to promote “invisible money as mobile financial services, it is important to emphasize the easiness of transforming cash to mobile-based cash points, World Bank (2014). Of course, even though full financial inclusion is the overall goal, it does not mean that everyone should be given access to credit at any expense. Besides, the recent financial crisis provides a prominent example of possible consequences of rapid and uncontrolled credit growth, which obviously should be avoided as far as possible, World Bank (2014).

### 2.3 Mobile Phone and Financial Inclusion

Various related studies show the importance of financial inclusion for both unserved populations and banks. Shashank (2014) pointed out that in India, financial inclusion is currently bounded to ensure to the access to saving accounts. Nevertheless, it has global broader perspective. Depending on the level of clients' involvement with financial products and services such as access to credit, financial inclusion has multiple levels. Leeladhar (2006) argued that having a savings account on its own is not an accurate indicator of financial inclusion. In order for banks to extend their services to underprivileged people, at the same time helping them meet their business objectives, technology framework can play a crucial role Shashank (2014). The major barriers to households' access to formal financial services such as bank accounts and borrowing for income-generating activities are costs, distances and bureaucracy, World Bank (2014). These factors do not only contribute to banking market failures but also enhance policy makers with guidelines on financial policies towards poverty reduction. The market failures and lack of policies prevent the poor from accessing financial services such as bank account deposit and borrowings only to mention a few.

However, due to modernization, Information and Communication technology (ICT), mainly mobile phones, is very likely to address these market failures, allowing the poor to have access to financial services they need. Different literature makes some evaluations on factors promoting the financial inclusion in the developing world paying more attention to the effects of modern ICT such as mobile phones, for example, Maria and Frida (2014) and Shashank (2014). Their findings alluded to the fact that mobile phones promote access to financial services, mostly bank account deposits and borrowings, thus enhancing economic growth. The modern ICT can act as a tool that develops a platform which helps the developing countries extend the financial services to reach out rural communities, helping banks reduce their operation costs as well as transaction costs, increase customer reachability and improve business risk management, Shashank (2014). Beyond reducing costs, mobile phones also allow customers to interact directly with their bank, checking balances and making transactions from wherever they are. Furthermore, customers gain a level of immediacy, convenience and control that no other channel can provide by the virtue of using mobile phones.

### 2.4 Determinants of Financial Inclusion

Previous studies suggest that the level of economic development, population density, infrastructure, outreach of bank branches, banks' overhead costs, and institutional capacity are important determinants of financial development. Higher income levels lower the barriers to financial inclusion and economic development, and population density capture the effect of income and market size on the provision of financial services, Kendall et al. (2010). More densely populated areas should be easier to supply with financial services since infrastructure tends to be more widespread in these areas. Bank branches in densely populated areas can reach a larger number of customers, suggesting greater chances of being profitable and thus higher likelihood to be present, Calem and Nakamura (1998). Infrastructure is also considered to be a determinant of financial inclusion since underdeveloped infrastructure makes it more expensive for financial institutions to provide their services. This may in turn have a negative impact on business activities since customers are more likely to face higher transaction costs, thus reducing the overall demand for financial services. Furthermore, access to financial services is crucial for financial inclusion. Since costs and distances are some of the main barriers to financial inclusion, the outreach of bank branches is assumed to be an important determinant of the outreach of the financial sector, Kendall et al. (2010). Moreover, institutional capacity, captured by a strong and well-regulated banking sector, is assumed to cause the effect of macroeconomic shocks. This suggests a positive relationship between measures of institutional development and financial inclusion, Tornell and Westermann (2003).

## III. Research Methodology

This research seeks to assess the impact of mobile phone penetration on financial inclusion and economic growth in SADC countries. This chapter provides the research methodology to be used for the study, that is, the model specification and the discussion of variables to be included in the study. To achieve objectives and address research questions, there was need to understand the role of mobile phone on financial inclusion and its linkage to economic growth, specifically in SADC countries. The researcher will justify why variables were selected and explain the expected relationships between economic growth and all the chosen explanatory variables,

the proxies to be used for each variable will be highlighted as well. A regression analysis approach is adopted to establish this relationship between variables.

**3.1 Model Specification**

This section presents the model specification. Variables for mobile penetration, financial inclusion and economic growth are derived from theories and empirical studies review. Several regression estimation techniques employed in this study are, generalized methods of moments, fixed effects and random effects. Two of the performed models are static in nature which only shows a snapshot at a particular point in time, and they include random effects and fixed effects models. The remaining model is dynamic in nature implying that the model captures the evolution of GDP over time.

**3.1.1 Regression Model 1**

The methodology employed was the one used by Andrianaivo and Kpodar (2012), and previously by Waverman et al. (2005), which applies an endogenous growth model to investigate the impact of mobile phone penetration has on economic growth. We are going to examine the relationship between mobile phone penetration and economic growth using a standard endogenous growth model. Taking into consideration country specific, *i*, and also the time specific effects, *t*, this will result on the left hand side of the equation denoting economic growth for country, *i*, at year, *t*, and the GDP variable on the right hand side represent the corresponding value for year, *t* - 1, that is the lagged growth rate. The econometric model can be written as follows:

$$y_{i,t} = \alpha y_{i,t-1} + \beta mobile_{i,t} + \Gamma x_{i,t} + \eta_i + \epsilon_{i,t} \dots \dots \dots (3.1)$$

where, *y<sub>i,t</sub>* -is the absolute difference in the logarithmic values of logarithm of real GDP and the lagged logarithm of real GDP. *mobile(i, t)*-denotes mobile penetration.

*x<sub>i,t</sub>* -represents a vector of growth determinants such as inflation and education.

*η<sub>i</sub>*- is an unobserved country-specific effect.

*ε<sub>i,t</sub>*-error term.

This gives a generalized equation which is:

$$GDP_{i,t} = \alpha GDP_{i,t-1} + \beta 1 INF_{i,t} + \beta 2 MOB_{i,t} + \beta 3 PSE_{i,t} + \beta 4 POP_{i,t} + \eta_i + \epsilon_{i,t} \dots \dots \dots (3.2)$$

where,

*GDP* = real gross domestic product (RGDP),

*INF* = Inflation rate

*MOB* = Mobile phone development

*PSE* = Primary school enrollment

*POP* = Population,

Addressing objective 2 of the study, we are going to introduce measures of financial inclusion to the growth model, which is represented by the number of deposits and number of loans. This gives us the following equation:

$$y_{i,t} = \alpha y_{i,t-1} + \beta 1 mobile_{i,t} + \beta 2 Financial\ Inclusion_{i,t} + \Gamma x_{i,t} + \eta_i + \epsilon_{i,t} \dots \dots (3.3)$$

where the variables for financial inclusion are deposits and loans as indicated above. There is a possibility for greater financial inclusion to have a positive effect on economic growth by estimating this model and also getting first impression on the association between mobile phone penetration and financial.

**3.1.2 Regression Model 2**

One of the objectives of the study was to test the relationship of mobile phone penetration and financial inclusion. This will rise to another regression model that tests whether high rates of mobile phone penetration is associated with higher financial inclusion. Therefore, to test this, we add to the growth model a variable of financial inclusion-captured by the number of deposits and loans to check how the coefficient on mobile phone development moves. Following Kendall et al. (2010), and Andrianaivo and Kpodar (2012) the econometric is as follows:

$$FI_{i,t} = \beta 0 + \beta 1 y_{i,t} + \beta 2 Mobile_{i,t} + \beta 3 Population\ density_{i,t} + \sigma_i + \epsilon_{i,t} \dots \dots \dots (3.4)$$

As indicated in equation (3.4),

*FI* - stands for financial inclusion represented by the number of deposits and loans

*y<sub>i,t</sub>* - denotes real GDP

*Mobile<sub>i,t</sub>* - the number of mobile phone subscribers

*Population\ density<sub>i,t</sub>* - is the population density measured as people per square kilometers of land area.

**3.2 Regression Estimators**

This section will specify the models that shall be used for the regression analyses and will furthermore describe the estimators that have been applied before turning to a more detailed description of the data. The choice to use the System GMM estimator will be motivated initially, followed by a motivation of why the fixed and random effects estimator are also appropriate.

**3.2.1 System GMM**

Regression Model 1 dynamic panel data model, having temporal and individual dimensions. A dynamic panel data model raises issues of endogeneity, which refers to the problem of variables being determined within the model. The explanatory variables may be either pre-determined or endogenous, where this refers to a variable that is correlated with previous error terms and the latter to a variable that is correlated with both previous and present error terms. Blundell and Bond (1998) developed a System GMM estimator to address issues to do with predetermined and endogenous variables. The variables determining economic growth in our estimations

are GDP per capita (representing conditional convergence), primary school enrollment rate (accounting for human capital), and other control variables such as inflation and domestic private on credit. For GDP, we use as instruments the annual growth rates.

### 3.2.2 Fixed Effects or Random Effects Estimator

Regression Model 2 is based on a static linear panel data model as mentioned previously. This means that the variables are strictly exogenous, hence are not dependent on current, future or past error terms. This stands in contrast to the dynamic characteristics, where issues of endogeneity needed to be controlled for. Linear panel data models are usually estimated with either a fixed effects or a random effects estimator, Verbeek (2012). In light of this study, the fixed effects estimator will be used together with random effects estimator which summarises effects within the sample, whereas the inference for the fixed one is made with respect to population characteristics. The fixed effects model depicts linear model that allows the intercept to vary with the individual units  $i$ , which refers to countries in this study. The argumentation is based upon the probability of the test. If it is above 0.10, random effect estimator will be appropriate. The random effect estimator requires that the independent variables are strictly exogenous, meaning that they are uncorrelated with the cross-sectional specific effect as well as the time-specific effect. According to Baltagi (2009), if independent variables are correlated, the random effect estimator becomes biased and in-consistent.

## 3.3 Diagnostic tests

### 3.3.1 Panel unit root test

According to Granger Newbold (1974) when the dependent and independent variables have unit roots, a statistically significant relationship between variables will be noted even if there is no economic linkage between them usually when using variables on level. The unit root tests considered both the null hypothesis of a random with a drift and trended (trended).

### 3.3.2 Levin, Lin and Chu Test

Levin-Lin-Chu unit root testing criteria was conducted to detect whether variables were stationary or not. LLC argued that individual unit root tests have limited power against alternative hypotheses with highly persistent deviations from equilibrium. This mainly occurs in small samples.

### 3.3.3 Multicollinearity Test

According to Gujarati (2004) opines that Multicollinearity is when there is a relationship between independent variables. Thus multicollinearity problem is defined as the association between two or more explanatory variables through a strong linear relationship in which the effect of the dependent variables cannot be separated from that of the explanatory variables. It is viewed as an interdependency condition, which is defined in terms of a lack of independence, or of the presence of interdependence which is signified by high intercorrelations within a set of variables. Multicollinearity constitutes a threat both to the proper specification and to the effective estimation of the type of structural relationships commonly sought through the use of regression techniques. The variable is dropped if it depicts high correlation following different techniques used to test for multicollinearity.

### 3.3.4 Correlation Matrix

To test multicollinearity, the researcher used the Correlation Matrix. Correlation matrix between variables is used to determine if variables are correlated or not. The hypothesis is expressed as follows:

$H_0$  : there is no Multicollinearity

$H_1$  : there is Multicollinearity

If the coefficient of correlation is 0.8 and above, we drop the variable as this depicts high correlation.

### 3.3.5 Variance Inflation Factor (VIF)

Variance inflation factor is also one of tools used to identify the severity of any multicollinearity issues so that the model can be adjusted. Farrar and Glauber (1967), proposed that the Variance Inflation Factor (VIF) measures the inflation of the parameter estimates being computed for all explanatory variables in the model. The VIF formula is as follows:

$$VIF = \frac{1}{1 - R_j^2}, j = 0, 1, 2, \dots, m$$

where  $R_j^2$  is the Coefficient of Determination for the explanatory variable. It measures how much the behavior (variance) of an independent variable is influenced or inflated by its inter-action with the other independent variables. Researchers such as Farrar and Glauber (1976) have shown that  $VIF \geq 10$  indicates the presence of multicollinearity between explanatory variables. In general, a VIF of 10 indicates high correlation and is a cause of concern and VIF of 1 shows that the variables are not correlated.

### 3.3.6 Heteroscedasticity Test

This arises when the assumption of constant variance of error terms for explanatory variables is violated. Their consequence is that OLS estimators do not have the minimum variance property in a class of unbiased estimates. The Breusch-Pagan – Godfrey test was used to test for heteroscedasticity. The test will be tested under the null hypothesis that the model does not suffer from heteroscedasticity against the alternative hypothesis that the model suffers from heteroscedasticity.

### 3.3.7 Autocorrelation Test

According to Gujarati (2004), there is high chance of correlation between disturbance terms, if secondary data which usually encompasses estimates is used. Given that the researcher is using secondary data there is great need to test for autocorrelation. If correlation is available, the estimators are consistent and unbiased and they have a minimum variance which will mean they are effective. The hypothesis will be stated as follows:

$H_0$ : Autocorrelation is not present

$H_1$ : Autocorrelation is present.

Decision rule: If probability values are less than 0.05 we reject  $H_0$  and conclude that the model suffers from autocorrelation.

### 3.3.8 Pesaran CD Test for serial correlation/cross sectional independence

For serial correlation in the fixed effects model, the researcher tested the existence using Pesaran CD test. If the p-value is more than 5 percent we fail to reject the null hypothesis that there is correlation hence there is no serial correlation in the model.

### 3.3.9 Sargan Test of Over-Identifying Restrictions

Testing of over-identifying restrictions and test for serial correlation for instruments, the researcher employed Sargan test. If the p-value is greater than 5 percent (0.05) this implies that that we accept null hypothesis implying that the researcher cannot reject the null hypothesis that over identifying restrictions are valid hence the instruments will be valid.

### 3.3.10 Arellano-Bond test for Serial Correlation for Instrument Validation

Another test for serial correlation for instrument validation is the Arellano-Bond test for AR(1) and AR (2) in first differences. According to test results, instruments are valid when the p-value for Arellano-Bond test for AR (1) is less than 5 percent and the p-value of Arellano-Bond test for AR (2) is above 5 percent.

### 3.4 Model specification Test.

Gujarati (2004) opined that model misspecification when some important variables are not included in the model (under fitting the model), or if unnecessary variables are included in the model (over fitting the model).

#### 3.4.1 Hausman Test

Hausman test was used to select the best model between fixed effects and random effects models. Panel data has both random and fixed effects, therefore, there is need to conduct Hausman test to select the appropriate model between fixed effects and random effects. The null hypothesis is rejected if the Hausman statistic is bigger than its critical value.

### 3.5 Data types and sources

The study on the assessment of impact of mobile phone penetration on financial inclusion and economic growth makes utilization from the information extracted from the reports and information index from the IMF and World Bank. In this way panel secondary data was utilized for all variables in cooperation in the model. This information was used to run a regression test on the time period of 2000-2018. The advantages of secondary data are that the collection of data is cheap, that is secondary data save money in data collection unlike the qualitative data Ghauri (2005); data is readily available and highly accessible on internet. The secondary data save more time since the use of internet and new technologies will reduce time taken to collect the data, Ghauri (2005). The secondary data can be longitudinal and international comparative studies, since fact of being performed on regular basis allow the researcher to analyze the trend between two or more decades. The study focuses on the period 2000-2018 in order to capture long-term structural trends while avoiding the distortions introduced by the Covid-19 pandemic.

## IV. Results and Discussion

This section addressed research objectives by employing both statistical measures and analytical techniques. It also provides interpretation of descriptive statistics, diagnostic tests and presentation of results obtained from the regression results and panel analysis. It highlights findings on the relationship between the independent variables given and the dependent.

Table 4.1: Descriptive Statistics

| Variable | Obs | Mean    | Std.Dev  | Min      | Max      |
|----------|-----|---------|----------|----------|----------|
| rgdp     | 152 | 0.1297  | 0.8197   | -1       | 9.7646   |
| pd       | 152 | 6.94113 | 6.3132   | 2.8997   | 2.103522 |
| dpc      | 152 | 28.9156 | 34.7686  | -7.03779 | 14.42808 |
| gdppc    | 152 | 0.0516  | 0.1777   | -0.3664  | 1.1632   |
| psc      | 152 | 11.146  | 15.3911  | 6.88467  | 14.7395  |
| infl     | 152 | 7.65    | 4.40221  | 1        | 152      |
| ms       | 152 | 0.26780 | 0.32328  | -0.1346  | 1.6389   |
| dps      | 152 | 0.07517 | 0.07518  | 0.00034  | 0.3236   |
| ln       | 152 | 0.03405 | 0.030367 | 0.00065  | 0.1303   |

As presented in Table 4.1, The economies of SADC grew on average of 0.1297 percent with maximum and minimum of 9.764 and -1 percent respectively per year during the period 2000-2018. Notably is, however, the substantial difference among the sample countries revealed by the large standard errors, which amount to 0.82 percent. Lower level of volatility has been recorded on ratio of mobile subscribers and Table 4.1 shows that the average ratio of mobile subscribers is 0.27 percent with standard deviation of 0.323 percent and a maximum and minimum of 1.64 and -0.13 percent respectively. Moving to the financial variables the average ratio of private credit to GDP is only 29.9 percent, a very low number compared to high-income countries which have ratios of above 100 percent (World Data Bank 2014).

Southern Africa has a poorly developed financial sector which is probably illustrated by the low values of all financial variables. GDP per capita had an average of 0.516 percent and standard deviation of 0.18 percent and minimum and maximum values of -0.37 and 1.16 percent correspondingly. Average inflation rates oscillated around 7.65 percent with minimum rate of 1 and maximum rate of 152. The average ratio of primary school enrolment which measures human capital was 11.15 percent loan with a high level of volatility ranging around 15.4 percent. The minimum enrolment is 6.88 percent whilst the maximum value is 14.74 percent and the reason for such wide gap being of lower levels of income by some of the countries included in the panel for analysis. The variables which measure financial inclusion are deposits and loans. They have lower levels of volatility, sitting at 0.079 percent for deposits and 0.030 percent for loans having minimum of 0.000034 and 0.000065 percent respectively.

### 4.1 Diagnostic test result

#### 4.1.1 Multicollinearity Test

Multicollinearity problem is defined as the association between two or more explanatory variables through a strong linear relationship in which the effect of the dependent variables cannot be separated from that of the explanatory variables.

Multicollinearity constitutes a threat both to the proper specification and to the effective estimation of the type of structural relationships commonly sought by regression techniques. Two tests were carried out to see if multicollinearity exists. Table 4.2 is a correlation matrix showing results of multicollinearity tests. If the coefficient of correlation is 0.8 and above, we drop the variable as this depicts high correlation. The results are shown below.

Table 4.2: Correlation Matrix

|       | gdp    | pd     | dpc    | gdppc  | pse    | infl   | ms     | depo   | Loan |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| gdp   | 1      |        |        |        |        |        |        |        |      |
| pd    | -0.042 | 1      |        |        |        |        |        |        |      |
| dpc   | 0.0783 | 0.2828 | 1      |        |        |        |        |        |      |
| gdppc | 0.0878 | 0.0196 | -0.042 | 1      |        |        |        |        |      |
| pse   | 0.0029 | 0.3235 | -0.261 | 0.0827 | 1      |        |        |        |      |
| infl  | 0.0509 | -0.193 | -0.192 | 0.0647 | -0.070 | 1      |        |        |      |
| ms    | 0.0061 | -0.116 | -0.239 | 0.0784 | -0.037 | 0.0070 | 1      |        |      |
| dps   | 0.0439 | -0.468 | -0.164 | 0.0167 | -0.404 | 0.0926 | 0.1346 | 1      |      |
| ln    | 0.2203 | -0.329 | -0.123 | 0.0378 | -0.085 | 0.2187 | 0.0623 | 0.2981 | 1    |

The results in Table 4.2 are generated and presented in a connection grid to figure out whether logical variables have a straight relationship. Since all variables in the connection framework are below 0.8, as such, none of the variables were dropped in the following analysis, implying that there is the absence of multicollinearity. The non-appearance of severe multicollinearity means that they are a nonattendance of flawless or precise direct connections among regressors.

Table 4.3: Variance Inflation Factor(VIF)

| pd   | dpc  | gdppc | pse  | infl | ms   | depo | ln   |
|------|------|-------|------|------|------|------|------|
| 2.67 | 1.98 | 2.01  | 1.09 | 1.13 | 1.43 | 1.56 | 1.07 |

Variance inflation factor also was used to identify the severity of any multicollinearity issue so that the model can be adjusted. It measures how much the behavior(variance)of an independent variable is influenced or inflated by its interaction with the other independent variables. In general, a VIF of 10 indicates high correlation and is a cause of concern and VIF of 1 show that the variables are not correlated. The variables in table 4.3 had tolerance value less than 10 under VIF approach, and none of the variables were dropped in the analysis, implying that there is the absence of multicollinearity.

#### 4.1.2 Panel unit root test results

Unit root tests are tests for stationarity in panel data. According to Granger Newbold (1974), when the dependent and independent variables have unit roots, a statistically significant relationship between variables will be noted even if there is no economic linkage between them usually when using variables on level.

#### 4.1.3 Levin-Lin-Chu unit-root test)

Levin-Lin-Chu unit root testing criteria were used for panel unit root test.

Table 4.4: Panel Unit Root

| Variable                | <i>p</i> -value | Order of integration |
|-------------------------|-----------------|----------------------|
| gdppc                   | 0.0000***       | I(0)                 |
| Inflation               | 0.0000***       | I(0)                 |
| Domestic private credit | 0.0000***       | I(1)                 |
| Mobile subscribers      | 0.0000***       | I(0)                 |
| Loan                    | 0.0000***       | I (0)                |
| Deposits                | 0.0000***       | I (1)                |

NB:(\*\*\*) (\*\*)(\*) indicates stationary

The unit root tests results showed that inflation, mobile subscribers, GDP per capita, and loans are integration of order zero, while domestic private credit and deposits are integration of order zero I(0). The absolute value of the ADF critic is significant and all

variables get to be stationery at different orders of integration. Thus as noted the application of the ADF were regarded as non-stationary at their level series since the reported  $t$ -statistic for each variable was less than the critical  $t$ -value, the variables were tested for stationarity at first differences and the results confirmed therefore that differencing once was all that was required at all levels of significance (0.01, 0.05 and 0.1), to bring the variables to stationarity.

#### 4.1.4 Pesaran and Sargan Test

Table 4.5: Pesaran and Sargan Test

| Pesaran's Test  | Sargan Test of Overidentifying Restrictions  |
|---|--|
| Pesaran Test of cross-sectional independence<br><br>=1.052<br>Pr=0.2928<br><br>Average absolute value off the-diagonal elements = 0.336 | H 0: Overidentifying restrictions are valid<br><br>chi <sup>2</sup> (26) = 145.72<br>Prob>chi <sup>2</sup> = 0.110 |

For serial correlation in the fixed effects model, the researcher tested the existence using Pesaran CD test. Results are presented in Table 4.5. Pesaran CD test results showed a  $p$  value of 0.2982, which is more than 5 percent, hence the researcher failed to reject the null hypothesis that there is correlation hence there is no serial correlation in the model. Table 4.5 presented Sargan test of over-identifying restrictions and test for serial correlation for instruments. If the  $p$ -value is greater than 5 percent (0.05) this implies that that we accept null hypothesis. The  $p$ -value for Sargan test was 0.11 implying that the researcher cannot reject the null hypothesis that over identifying restrictions are valid hence the instruments were valid.

#### 4.1.5 Hausman test

The null hypothesis is rejected if the Hausman statistic is bigger than its critical value. Test results in Table 4.5 indicated that the  $p$ -value is below 0.05 hence the researcher failed to reject the null hypothesis, implying that random effects model was considered appropriate.

#### 4.1.6 Serial Correlation test for Instrument validation

Table 4.6: Arrelano-Bond Test

|  |                    |
|--|--------------------|
| Arrellano-Bond test for AR(1) in first differences : | z=-4.8 Pr>z=0.0000 |
| Arrellano-Bond test for AR(2) in first differences : | z=1.31 Pr>z=0.385  |

Another test result presented in Table 4.6 is the Arellano-Bond test for AR (1) and AR (2) in first differences. According to test results, instruments are valid since the  $p$ -value for Arellano-Bond test for AR (1) is less than 5 percent and the  $p$ -value of Arellano-Bond test for AR (2) is above 5 percent.

#### 4.2 Regression Analysis

Table below presents regression results for fixed effects (FIXED), random effects (RANDOM) and one step generalized methods of moments (GMM) models. The results of Model 1 with lagged real GDP as the dependent variable are shown below.

## 4.7. Mobile Phone and Economic Growth

| Variable                                       | Fixed Effects           | Random Effects          | GMM                     |
|--|-------------------------|-------------------------|-------------------------|
| Lagged rgdp                                    | -0.22852*<br>(0.08451)  | -0.17783**<br>(0.00967) | 0.05595***<br>(0.00774) |
| pd   | 0.00702<br>(0.00861)    | 0.00188<br>(0.00693)    | 0.00123<br>(0.04254)    |
| dpc  | 0.00023<br>(0.00045)    | 0.00013<br>(0.000348)   | 0.00149<br>(0.00019)    |
| gdppc  | 0.08357<br>(0.47415)    | 0.08185***<br>(0.04776) | 0.07939***<br>(0.03628) |
| pse  | 0.14421***<br>(0.01071) | 0.29132**<br>(0.00808)  | -0.01532**<br>(0.00152) |
| infl   | 0.00023<br>(0.00025)    | 0.00019<br>(0.00020)    | -0.00021*<br>(0.00146)  |
| ms   | 0.10501*<br>(0.10502)   | 0.10142***<br>(0.02745) | 0.11562***<br>(0.20765) |
| Cons   | -0.17809                | -0.36197                | -0.2139                 |
| N  | 152                     | 152                     | 152                     |
| R2   | 0.53618                 | 0.00678                 | 0.03421                 |
| Prob>chi <sup>2</sup>                          | 0.0000                  | 0.0001                  | 0.0000                  |
| Adj-R <sup>2</sup>                             | 0.22324                 | 0.01537                 | 0.00351                 |
| Hausman Test Prob>chi <sup>2</sup><br>= 0.0139 | YES                     | NO                      | NO                      |

Standard errors, \*\*\* p<0.01 , \*\*p<0.05 , \*p<0.1

### 4.3. Interpretation of Results.

The coefficient of determination (R-squared) measured the goodness of fit, the closer the value to 1, the closer the sample regression line to perfectly fit the data. As shown by the value of R-squared, 54% of the variation in GDP is explained independent variables whilst 36% are explained by some factors not included in the model but are captured by the disturbance term. The results suggest that mobile phone subscribers, Inflation, domestic private credit, population and GDP per capita have a positive impact on economic growth, though some probability values show that some of these are not significant in the model. Findings revealed that there are mixed results regarding mobile phone penetration and its impact on economic growth. In GMM model, the coefficient of mobile phone penetration appears to be significant at 1% and its magnitude is 0.116. This means that a percentage change in mobile subscription is associated with 0.116% in the short run. When comparing GMM regressions, the results are very similar to fixed and random effects models also which have 0.105% and 0.101%. The variable is at the 5% and 10% significance level at 5% and 10% on average hence mobile subscription and economic growth exhibit an inelastic relationship respectively.

Moreso, the relationship between mobile subscribers and economic growth is positive and this is shown by the positive coefficient of the variable in fixed effects, random effects and GMM. Thus, having the anticipated effect on economic growth, confirming theoretical as well as empirical previous research Andrianaivo and Kpodar (2012); Roller and Waverman (2001). Referring to Table 4.7, when the penetration rate increases, GDP growth also increases. Inflation has a negative impact on economic growth in GMM model with -0.0002% as its magnitude and significant at 10%. This implies that an increase in inflation does not lead to a proportionate decrease in economic growth measured by real GDP. This is a rare relationship in economics theory and empirics, the researcher expected a positive relationship, more so the variable is statistically significant with the probability above the required level of significance. However, there are other studies who argue with such a relationship, for instance, the Philips curve, highlighted that high inflation will lead to low levels of unemployment, implying that there is positive impact on economic growth. The variable was an insignificant determinant in the fixed and random effects model.

Turning to the growth determinants, human capital (captured by the primary education variable), favors growth hence implying that there is a positive relationship on economic growth as shown by 10% in the fixed effects and 5% in both random effects and one step GMM. The magnitude of the coefficients in the fixed effects model is 0.144% which means that a percentage increase in human capital contributes to less than 2% towards economic growth which is the same behaviour in the random effects model which depicted growth of 0.293%. These findings are in line with previous research. Duman (2008), implied that there were positive relationships between economic growth and schooling in Turkey at both the primary and secondary levels between 1987 and 2005. This is also in line with the findings of Yaylalar and Lebe (2010) who found the same relationship, but the direction of causality is running from primary schooling to economic growth.

However, GMM model suggested a negative relationship between human capital and economic growth with -0.015%. This simply means that a decrease in human capital affects growth. GDP per capita is insignificant in fixed effects but turn out to be positively significant in random effects model and GMM having 5% and 10% level of significance respectively. There is strong relationship between the variable and growth as indicated by the magnitudes of the coefficient which are 0.813 and 0.729. A percentage increase in GDP per capita will result in less than 9 percent in random effects model and less than 8 percent in GMM model. World Bank Development Indicators datasets (2005 to 2014), on their findings show that GDP per capita has significant impacts on economic in financial inclusion hence leading to economic growth. Population density and domestic private credit on GDP tend to be insignificant.

### 4.4 Taking Financial Inclusion into Account

Building on the last section, this section will address the results of the link between mobile phone penetration, financial inclusion and economic growth as one of the research objectives. Variables of financial inclusion to the regression which are number of loans per capita and deposits per capita were included. The dependent variable remained the same, RGDP, and Table 4.8 gives the results from the regression analyses.

Table 4.8: Mobile Phone, Economic Growth and Financial Inclusion

| Variable    | Fixed Effects          | Random Effects        | GMM                     |
|-------------|------------------------|-----------------------|-------------------------|
| Lagged rgdp | -                      | -                     | -0.00599<br>(0.00779)   |
| ms          | 0.85197**<br>(0.22058) | 0.12773*<br>(0.21474) | 0.11490***<br>(0.02114) |
| dps         | 0.57293***             | -0.14072*             | -0.04973***             |

|   |                       |                       |                         |
|---|-----------------------|-----------------------|-------------------------|
|   | (1.39265)             | (1.00378)             | (0.91169)               |
| ln  | 0.89536<br>(3.14892)  | 0.63407*<br>(2.35180) | 0.04863<br>(0.24058)    |
| dpc   | -0.00168<br>(0.00345) | 0.00345<br>(0.00218)  | 0.00166<br>(0.00196)    |
| pse   | 0.01109*<br>(0.00831) | 0.00343<br>(0.05127)  | -0.00198**<br>(0.00014) |
| gdppc   | 0.30240*<br>(0.38229) | 0.34138*<br>(0.37575) | 0.79342**<br>(0.36403)  |
| Infl  | 0.00761<br>(0.00165)  | 0.00485<br>(0.00158)  | 0.00193<br>(0.00148)    |
| Constant  | -1.49255              | 0.67313               |                         |
| N   | 151                   | 151                   | 151                     |
| R2  | 0.02543               | 0.04297               | 0.00005                 |
| Prob>chi <sup>2</sup>                           | 0.001                 | 0.0000                | 0.0000                  |
| Hausman Test<br>Prob>chi <sup>2</sup> = 0.01344 | NO                    | NO                    | YES                     |

Standard errors, \*\*\* p<0.01, \*\*p<0.05 , \*p<0.1

The variables measuring financial inclusion, which are deposits and loans showed that both variables have a positive effect on economic growth as indicated by the values of the coefficients. This positive effect is somewhat higher for deposits than for loans. The reason being that deposit accounts are easier to access since the process for opening the account is quit easier than the process associated with being granted a loan at a commercial bank and this results in more deposits than loans .The magnitude of the coefficient is positive in the fixed effects model and its magnitude is 0.572 which suggest that a percentage increase in the number of deposits will be associated with a 0.572% in financial inclusion. However, there is a negative relationship between deposits and growth as indicated by 0.141% and 0.049% in random effects and GMM model respectively. This, however, proves the fixed effects to be the best model when estimating the relationship between financial inclusion and growth. Basically, the variable is statistically significant in all models at 1%, 10% and 1% in the fixed effects, random effects and GMM respectively. Loans are however only significant at the 10% significance level in fixed effects model, and the magnitude of the coefficient is 0.634%. However, the variable is insignificant in the remaining two variables which are random effects and GMM The results depict that the increase in the financial inclusion variable, GDP growth also increases with irrespective of what measure of financial inclusion being used, implying that greater financial inclusion is associated with higher economic growth in SADC economies. In fact, better access to finance facilitates economic growth by allowing individuals to embark on different productive investments. In addition, greater access to deposit facilities enhances the ability of financial intermediaries to mobilize savings, which are allocated to projects with the highest returns.

Comparing the coefficient of the magnitude of mobile phone subscribers in Table 4.8 with the coefficients in all models, there is an interesting result as it changes from 0.86 in fixed effects and to 0.13 when financial inclusion variables are introduced into the model. Given the financial inclusion status, the positive impact of mobile phone penetration on economic growth is decreasing,

suggesting the absorption of part of the positive effect into the financial inclusion variable. Hence, this may imply that mobile phone penetration not only has a direct positive effect on economic growth, but also an indirect effect, through the channel of financial inclusion. More so, this proposition also holds for the change in mobile phone coefficient in column 2 model, when controlling loan accounts. However, the weakening of the mobile phone coefficient is smaller. This suggests a less prominent channelizing effect when financial inclusion is captured by loan accounts compared to deposit accounts, something that in turn might be explained by lower average levels of loans than deposits. Nevertheless, the assumption made is only based on the changes in these coefficients and does not address the determinants of financial inclusion, which will be dealt with in the next section.

#### 4.5 Assessing the impact of mobile phone penetration on financial inclusion

Regression Model 2 gives an assessment of whether mobile phone penetration has a direct impact on financial inclusion, and results are presented in Table 4.9 with the number of deposit accounts capturing financial inclusion as dependent variable.

Table 4.9: Mobile Phone and Financial Inclusion

| Variable   | Fixed Effects           | Random Effects         | GMM                    |
|--|-------------------------|------------------------|------------------------|
| L1   | -                       | -                      | 0.44443***<br>(0.0769) |
| D1pd   | 0.00029**<br>(0.00189)  | 0.00018*<br>(0.00182)  | -0.00123<br>(0.00144)  |
| gdppc  | 0.01107**<br>(0.10431)  | 0.07107**<br>(0.01030) | 0.11317<br>(0.01238)   |
| pse  | 0.00041***<br>(0.00236) | -0.00371<br>(-0.00241) | 0.00122<br>(0.00054)   |
| infl   | -2.2606<br>(0.00453)    | -3.0606<br>(0.00446)   | -0.00441<br>(0.00507)  |
| ms   | 0.41364***<br>(0.00608) | 0.38116**<br>(0.00597) | 0.09602<br>(0.00701)   |
| dpc  | 0.00438<br>(0.00996)    | 0.00279<br>(0.00953)   | 0.00246<br>(0.00658)   |
| Cons   | 0.74806                 | 0.71541                | 0.65127                |
| N  | 143                     | 143                    | 143                    |
| R2   | 0.0083                  | 0.0042                 | 0.0000                 |
| Hausman test<br>Prob>chi <sup>2</sup><br>=0.002347 | YES                     | NO                     | NO                     |

Standard errors, \*\*\* p<0.01 , \*\*p<0.05 , \*p<0.1

Results in Table 4.9 show that mobile phone penetration has a positive effect on financial inclusion. The coefficient of mobile phone subscribers in fixed effects model suggests that an increase in the number of mobile phone subscribers with one percent will be associated with a 0.413 percent increase in financial access although the result is significant at the ten percent level which is questionable and considered with caution. However, the variable was more significant in the random effects with 10% level of significance and a percentage increase in mobile subscription is associated with 0.381% in random effects hence mobile subscription and financial inclusion exhibit an inelastic relationship. Through higher mobile penetration, the process of accessing deposits and

loans becomes much easier as information flows better through mobiles thus improving information acquisition of both depositors and financial institutions and enhance monitoring. Also, mobile phone development reduces the cost of financial intermediation and adds to the emergence of branch less banking services, thereby improving access to finance for individuals that would be facing constraints on credit. When adding more control variables to the equation domestic private credit has no significant effect on the number of deposits per capita in all models.

Turning to other variables included in the regression model, population density is significant at 5% and 10% in the static models with 0.0003% and 0.00018% in fixed and random effects models as the magnitude of the coefficient respectively. This shows that there is a moderate relationship between population density and deposit. Lastly, Kendall et al. (2010) finds that inflation had a negative significant effect on deposit penetration, our result on this point is rather in line with the findings as inflation appears to be significantly associated with financial inclusion. The variable is insignificant in the static models and a weak correlation with 0.0004% as the magnitude of the coefficient.

## V. Conclusion

This research examined the impact of mobile phone penetration on financial inclusion and economic growth in selected SADC countries using panel data from 2000 to 2018. Applying both static and dynamic panel estimation techniques, the results indicated that mobile phone penetration has a statistically significant and positive effect on economic growth. The findings further confirm that financial inclusion serves as a transmission mechanism through which mobile phone diffusion enhances economic performance. Increased mobile penetration improves access to financial services such as deposits, loans, and mobile money, thereby expanding participation in the formal financial sector. The study highlights the transformative role of emerging mobile technologies in fostering inclusive financial systems and stimulating economic growth in developing regions. However, the magnitude of the impact depends on the strength of financial institutions and supportive regulatory frameworks. The findings suggest that policies aimed at expanding digital infrastructure, reducing communication costs, and promoting mobile-based financial innovations are essential for achieving sustainable and inclusive growth in SADC economies.

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