



***"It's easier to use your mobile phone to pay for a taxi
in Nairobi [Kenya's capital] than in New York."***

Tom Standage in "Virgin Territory" Economist article (17 Nov. 2011)

Mobile Banking and Economic Growth

ERASMUS UNIVERSITY
ROTTERDAM Erasmus School of
Economics Department of
Economics Supervisor: Josse Delfgaauw

Name: Noralie van 't Hul
Exam number: 345415
E-mail address: Noralie91@student.eur.nl

Abstract

In this thesis I examine the effect of mobile payments on economic growth in Kenya and Tanzania. A lot of research has already been done about the economic effects of mobile banking on the household and community level, but there is no research done about the effect on macro economic level. Empirical analysis, using a panel data-set for 38 Sub-Saharan African countries between 1990-2014, shows a significant negative relation between economic growth and mobile payments.

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1. Introduction

One of the main questions I always asked myself as a kid was how a poor country could escape poverty and ultimately become rich. Back then I thought money was the answer, but growing up made me realize that the world was more complex. During my study I found out more people were asking the same question. There are entire models made, studies done and innovations invented about how a country can initiate growth which will lead to a higher level of consumption.

To initiate growth, well-developed financial markets are essential. Although it needs to be said that economists disagree about the role of the financial sector in economic growth. Research however shows a strong positive relationship between financial development and economic growth. (Levine, 2004) Financial systems influence saving rates, investment decisions and technological innovation. It provides an improvement of information and lowers transaction costs. Financial markets are important for the accumulation of capital and the production of goods and services. (Federal Reserve Bank of San Francisco, 2015) Hereby financial markets influence economic growth.

Without a well-developed financial market it is for example more costly to raise capital. The interest rates in developing countries are higher than the rates in developed countries. Take Kenya as an example, the Central Bank rate was 11,5% in July 2015. In Europe this rate was only 0,050%. (Central Bank of Kenya, 2015) (European Central Bank, 2015) A poor-developed financial market may also lower the return on savings and investments. Limited information and non-financial transparency makes it difficult to find the right product. There is little trading activity in such a market.

Financial institutions are another aspect of financial development. These institutions, in particular banks, are also important for lowering transaction costs and bringing transparency. Therefore financial development is not only important for governments, it also plays a role for consumers and small entrepreneurs. The focus in this thesis is mostly at consumers and SME's.

According to the Financial Development Index 2012 the financial markets and institutions in different African countries are poorly developed. In the index 62 countries are covered, the African countries are at the bottom of the list. (World Economic Forum USA Inc., 2012) For these countries, it is important to stimulate cash flows, improve market transparency, provide information and lower transactions costs. This is easier said than done. A closer look at the financial stability shows that Tanzania and Kenya are in an early-stage of financial markets. With regards to the financial access it can be said that the market penetration of bank accounts is low, as is the total number of ATM and is it not easy to get a loan or credit. Besides, only 20% of families have bank accounts in Africa. In Kenya and Tanzania those percentages are even lower, 10% respectively 5%. (Kshetri & Acharya, 2012) These people don't have any alternative for their cash, such as credit cards or bank accounts.

Since it is more common to have a mobile phone than having a bank account in Africa, M-Pesa might be a solution. M-Pesa is a money transfer service. It enables people to send and receive money and make bill payments with their mobile phones. It is especially for those people who do have a mobile phone, but don't have or have limited access to a bank account. (Vodafone, 2015; Valickova, Havranek, & Horvath, 2013) M-Pesa was launched in Kenya in March 2007. The provider is Safaricom and the product name is M-Pesa. M-Pesa started as a person-to-person service (P2P), but since a few years it is also used for customer-to-business (C2B) transactions. Customers use it for example to pay for their clean and fresh water.

There are a lot of advantages coming with mobile banking. To use this service, customers only need to have a mobile phone. They can register themselves at an authorised agent. Often this agent is just a small phone store or retailer. It isn't necessary to have a bank account nor a starting capital. The customer can deposit cash in exchange for electronic money at the agent. This money can be send to family and friends by SMS. The recipient receives this electronic money, which he can cash for real money by visiting another agent. In this way people can receive money, even if there isn't an ATM close by.

M-Pesa affects the daily lives of people. An ethnographic study from November 2008 showed among other things that users of M-Pesa make smaller and more frequent transfers, the income of rural recipients increases and the users are integrating M-Pesa into their savings portfolio. (Morawczynski & Pickens, 2009) This study, which is only done on micro level, shows M-Pesa can have a huge impact. With this thesis I want to show the impact on macro level. If it is the case that M-Pesa contributes significantly to the development of the financial market (and thus indirect to economic growth), governments of countries with a poorly developed financial market should consider establishing or encouraging the development of systems like M-Pesa.

Besides this social relevance, there is also a scientific relevance. A lot of studies about the relation between financial markets and economic growth have been done. The development of financial markets has been examined extensively. However, M-Pesa is not previously been considered as a factor. The most recent research dates from 2011 (Jack & Suri, 2011) and this was a qualitative research. As far as I know, there hasn't been done any quantitative research, not to mention that M-Pesa hasn't been related with economic growth. In a recent overview of the literature on mobile banking, Shaikh and Karjaluo (2015) conclude that the literature is fragmented. (Shaikh & Karjaluo, 2015) There are only limited studies done on the use of mobile banking as a service where a bank account isn't required. Therefore my thesis is also of scientific relevance.

In this thesis I want to examine the relationship between the rise of mobile payments in Kenya and Tanzania and economic development. Therefore, my research question is:

"What is the relation between the rise of mobile payments in Kenya and Tanzania and economic growth?"

To answer this question I first conduct a literature review trying to estimate determinants of economic growth and the impact of a well-functioning financial market on economic growth. Furthermore, I construct a panel data-set consisting of 38 Sub-Saharan African countries. I use this data-set to analyse whether there is a

relation between economic growth in Kenya and Tanzania and the rise of mobile payments in these countries. In this analysis, I control for several variables that are commonly found to be related to economic growth, such as population growth, inflation, human capital, health and development of the financial sector.

The rest of this thesis is organized as follows. In Section 2 the main related literature about economic growth is discussed. In Section 3 and 4 I will elaborate on the financial development and M-Pesa. Data are defined in Section 5. In Section 6 the empirical results are discussed. I conclude in Section 7.

2. Related literature on Economic growth

Most African countries have a depressing or negative economic growth since the 1970s till 2000. Poor economic performance can be attributable to drought, poorly developed infrastructures, bad governance, ethnic wars, lack of human and physical capital, diseases such as HIV and diarrheal, etcetera. (Oketch, 2006) The focus is not on what causes the poorly performance; I'd rather focus on how economic prosperity can be reached.

According to Adam Smith, the country's gross domestic product (GDP) is a way to measure the level of prosperity in a country. (Sørensen & Whitta-Jacobsen, 2005, p. 31) Over time, the country's GDP grows. All countries experience economic growth, but there are differences in growth rates between countries. Some countries experience long periods of stagnation, while others exhibit periods of spectacular growth. Growth rates vary substantially across countries.

Economic growth is important for a country, because through growth the country can reach a higher level of income. Sustained growth determines the wealth and poverty of the nation. It is therefore important to identify the determinants of economic growth.

In this section I start with a brief overview of the different growth models necessary to explain the variation in growth. I make a distinction between the exogenous growth model and the endogenous growth model. The focus will be on empirical research concerning economic growth.

2.1 Exogenous growth

First I want to discuss the Solow-model. (Solow, 1970) Solow is just one among others who developed the neoclassical growth model. His model contains an explicit description of the process of capital accumulation by which saving and investment become new capital. Robert Solow developed the model in 1956 and it was an extension of the Harrod-Domar model of 1946. In the model of Harrod and Domar the savings rate had to be equal to the required ratio of investment to output to be in a steady state. Solow disagrees with the model, because according to the model economies should be incapable of steady-state growth. The determinants of the model were independent constants and this gives a problem. Only by the merest

fluke it is possible to be in a steady-state. Solow gets rid of the assumption that the technology of the economy has fixed coefficients. He states that here are three exogenous sources of economic growth. The first one is the increase in the working population. If the rate of population growth increases, the country becomes poorer. The second one is capital accumulation; this could be measured as the rate of saving. The higher this saving rate is, the richer the country will be. The third one is the increase in productivity, better known as technological process. The capital/output ratio is a variable in his model. Besides capital he adds labour as a factor of production. In the end, countries reach different steady states.

Bernanke and Gürkaynak studied whether economic growth is exogenous in the long-run. (Bernanke & Gürkaynak, 2001) They re-visited the Solow model of economic growth. They find that the saving rate correlates with long-run growth rates, but that this is inconsistent with the hypothesis that the Solow model is true. Their conclusion is that long-run economic growth is correlated with behavioural variables.

The Solow-model is an important model, although it is not complete. Confronted with cross-country data, the exogenous growth model wasn't a good fit. Research shows that there are more sources of prosperity and growth besides capital and labour. Human capital, natural resources, the evolution of technology and the openness of real world economies are all important determinants of economic growth. Therefore it is necessary to also focus on other determinants concerning economic growth.

2.2 Endogenous growth

Whereas supporters of the exogenous growth model believe growth arises due to influences outside the economy, the endogenous model explains growth by internal factors like policies, internal process and investment capital. (Romer, 1989) Endogenous models are mostly alternatives of the Solow growth model. The main objective was to replace the Solow long run steady state. According to those who embrace the concept of endogenous growth, growth should be sustained from within the country. In this way it is possible to explain the differences in wealth between countries.

Robert Barro, an American classical macroeconomist, is in favour of the endogenous growth model. (Barro, Determinants of economic growth: A Cross-country empirical study (NBER Working Paper No. 5698), 1996) He was one of the first doing research on endogenous growth. He didn't use any model, instead he regressed growth rates on explanatory variables. His results show that, for a given starting level of real per capita GDP, higher initial schooling and life expectancy increases the growth rate. This also applies to lower fertility, lower inflation, better maintenance of the rule of law, smaller government consumption and improvements in the terms of trade. Apparently there are different determinants within the endogenous growth model. Some researchers focus on human capital, while others consider inequality, health, the political system or inflation to be of significant value. The financial development is also an endogenous determinant across to real growth. This specific aspect is examined in section 3, the others will be discussed below.

Human Capital

Human capital has everything to do with *acquired capacities which are developed through formal and informal education at school and at home, and through training, experience and mobility in the labour market.* (Mincer, 1984) Acquiring these capacities involve costs and benefits. Mincer gives a brief overview of the theory on human capital. The acquisition of human capacities is seen as an act of investment; pre-school investments, investments in formal school education and investments in labour market mobility and job training. If human capital is seen as a factor of production, alongside physical capital in an aggregate production function, it could be possible to understand macro-economic differences in levels and in growth of income.

The endogenous growth theory started with a research of Romer focusing on human capital in the late 1980s. (Romer, 1989) As a measurement for human capital, he takes literacy. Romer points out, by discussing different previous researches, that education has a positive causal effect, but that the relation is imprecise. The effects of education do not help understand the variation in growth rates observed. Due to some problems with multicollinearity, the only conclusion Romer could draw is that the change in the level of literacy helps explain the rate of investment.

In 1990, Mankiw, Romer and Weil extended the Solow growth model. (Mankiw, Romer, & Weil, 1990) Besides saving and population growth rates, they included accumulation of human as well as physical capital. Their conclusion is that adding human capital to the Solow model improves its performance. With this model, they were able to explain about 80% of the international variation in income per capita over the sample of 98 countries.

A highly relevant paper is the one of Oketch. (Oketch, 2006) His research is about the determinants of human capital, economic growth and development in Africa. His main conclusion is that investments in human and physical capital are important determinants of economic growth and development in Africa. This is in line with the findings of McMahon (1987) and Grier (2005), which papers Oketch extended. He uses expenditure on education as a percentage of GDP to measure human capital. It captures the quality level, which enrollment rates wouldn't.

The paper of Glewwe et al. examines recent studies concerning the impact of education on economic growth. (Glewwe, Maiga, & Zheng, 2007) Some studies show strong impact while others show little or no effect at all. Every study has multiple estimation problems. Studies with a focus on Sub-Saharan Africa also show conflicting results. It is important to run the regressions using only Sub-Saharan African countries, for the quality of education is quite low compared with other regions. Therefore the impact of education on economic growth is smaller in Africa than it is in other parts of the world.

The results from the studies discussed above suggest that investment in human capital can raise economic growth. It has to be said that controlling for other variables, might change the results. Education has, due to the poor quality in the Sub-Saharan African countries, little impact on economic growth. Still, I am going to use human capital as a control variable in my own analysis.

Income inequality

Inequality could also be a determinant of economic growth. (Barro, Inequality and Growth in a Panel of Countries, 2000) In the economy of an underdeveloped country, the agricultural sector is the engine of the economy. This sector features a low

income per capita and there is little inequality within the sector. The industry sector is the other sector. Initially this sector is small, has a higher income and inequality within the sector is higher. As an economy develops, inequality first rises. This is due to a shift of persons and resources from agriculture to the industry. At later stages of development, inequality decreases. This is because more people leave the agricultural sector (therefore the wages rises) and join the rich industry sector. The people that started out at the bottom, now move up to the richer workers. The relationship between an indicator of inequality, for example a Gini coefficient, and economic growth can be described by an inverted-U, better known as the Kuznets curve.

The Kuznets curve is accepted on empirical level. The Kuznets relation is significant, but it only explains relatively little of the variation in inequality across countries over time. According to the research of Barro (Barro, *Inequality and Growth in a Panel of Countries*, 2000), the overall effects of inequality on growth and investment are weak. Inequality slows economic growth in poor countries down. GDP per capita should be below \$2000 (1985 U.S. dollars).

What is worth mentioning is that Barro examines the determinants of inequality. One of these variables is the average years of school attainment for adults aged 15 and over. The results are that primary schooling is negatively and significantly related to inequality, secondary schooling is negatively (but not significantly) related to inequality and higher education is positively and significantly related to inequality.

The focus in this thesis is the relation between mobile banking and economic growth rather than explaining the variation in inequality across countries. Therefore, and also because the overall effects of inequality on growth are weak, I won't take inequality into account.

Health

Health can be seen as a fundamental component of human capital. (Bloom, Canning, & Sevilla, 2001) According to Bloom et al., good health has a sizable, positive and significant effect on economic growth. They made a data-panel of countries. They used life expectancy as a proxy for health, because a higher life expectancy is

associated with a better health status. They are however aware of the fact that life expectancy could increase economic growth by the accumulation of capital.

The paper of Gyimah-Brempong and Wilson focuses specifically on this relation in the Sub-Saharan African countries. (Gyimah-Brempong & Wilson, 2004) They measure health as the ratio of government health care expenditure to GDP. Although it needs to be said, and they also say it themselves, that health care expenditure doesn't automatically improves health. Their result is that health has a positive direct effect on per capita income level.

Regime type

Tiruneh examines if the regime type influences economic growth in Africa. (Tiruneh, 2006) Therefore he investigates the economic performances of authoritarian and democratic system. Economic growth is defined as a change in GDP per capita. He controls for economic development, domestic investment, education, economic openness, privatization, external debt, foreign aid, population growth and political instability. A notable finding is that domestic investment seems to promote economic growth in Africa. One explanation is that domestic investment could lead to the creation of jobs, improvements in infrastructure and growth opportunities for businesses. Education showed no effect on economic growth. The relationship between the regime type and economic growth is not strong and consistent.

Inflation

Inflation has a negative relationship with economic growth. The previously discussed research of Barro (1996) shows this relation. Higher long-term inflation reduces growth. The magnitudes of effects are not that large. Although small changes in growth rates, could have dramatic effects over long periods. For this reason he argues price stability is important.

A study done by Savvides focuses on the economic growth in Africa. (Savvides, 1995) He also includes inflation as an indicator of macro economic stability and the effects of monetary policy. Only in one of the three models inflation is a significant determinant of economic growth in Africa.

A more recent study focuses on the relation between inflation and economic growth. (Bittencourt, Eyden, & Seleteng, 2013) Their results are based on panel time-series data and analysis. They found that inflation has a damaging effect on economic growth. Moreover, inflation is a robust macroeconomic determinant of economic growth.

3. Financial sector development

Another important determinant of economic growth is the development of the financial sector. In theory, the financial sector could affect growth through the improvement in savings, physical capital accumulation and total factor productivity growth. A country with a well-developed financial sector is also more attractive for foreign companies to invest in. There are a lot of recent empirical studies about the relationship. A meta-analysis done by Valickova et al. shows that taken 67 studies together, there is a positive and statistically significant effect of financial development on economic growth. (Valickova, Havranek, & Horvath, 2013) Private capital flows can only improve economic growth when there is a well-developed financial sector. (Agbloyor, Abor, Adjasi, & Yawson, 2014)

Since the level of financial development might seem important, I therefore start this section with some remarks about the measurement of financial development and the development of the financial sector in Sub-Saharan Africa. After that I will discuss a few empirical studies that examine in which ways financial development could stimulate economic growth.

3.1 Measurement of Financial Development

A good measurement of the financial sector is important for examining the relation between the financial sector and economic growth. The financial sector is complex and therefore a lot of empirical studies used for example the ratio of private credit to GDP as a measurement for the financial development. Recent work however shows that this variable isn't comprehensive for it says nothing about the quality of financial services or the stability of the sector. Cihák et al. (2013) assembled the Global Financial Development Database in order to obviate this problem. To measure how well financial systems are doing, there are four broad indicators. These indicators are measured as well for financial institutions as for financial markets.

1. The size of financial institutions and markets (financial depth);
2. The degree to which individuals can and do use financial services (access);

3. The efficiency of financial intermediaries and markets in intermediating resources (efficiency); and
4. The stability of financial institutions and markets (stability).

The database is an extensive dataset on financial development. It shows that there are enormous differences between countries. The cartogram below indicates the unequally developed financial systems. Germany's financial system is for example bigger than the combined systems of the countries in Sub-Saharan Africa.

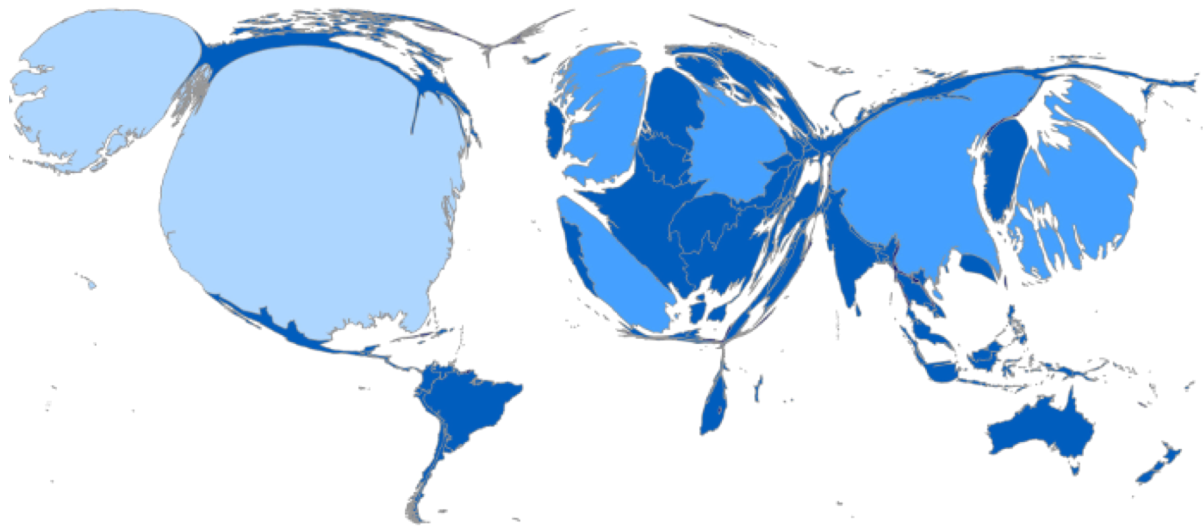


Figure 1 Development of the Financial System

Source: (Cihák, Demirgüç-Kunt, Feyen, & Levine, 2013)

The study of Agobloyor et al. (2014) shows that private capital flows have a negative relation with economic growth in the African countries. Only the countries with a strong domestic financial market are able to transform this negative impact into a positive one. Therefore the development of the financial sector is of importance. The financial systems in Sub-Saharan African countries are mostly underdeveloped. The systems are strongly bank based and the stock markets are not well developed.

The study of Rousseau and D'Onofrio also focuses on the countries in the Sub-Saharan Africa. (Rousseau & D'Onofrio, 2013) They wanted to know whether the relationship between financial development and economic growth holds for the

countries in the Sub-Saharan Africa. In their part 'literature and institutional background' they discuss the differences between the development of the financial sector in Sub-Saharan Africa and the rest of the world. Compared with the rest of the world, the banking depth, measured by private sector credit to GDP, in Sub-Saharan Africa is low. The stock markets have the lowest levels of market capitalization and the smallest number of listed companies of any region in the world. Most markets in Sub-Saharan Africa use manual trading which hinders growth. The same is true for bond markets. It is underdeveloped and the government bond markets don't offer a lot of securities for trading. The amount of credit is small and it is mainly available for the more developed villages. Access to credit remains difficult for small firms and households.

For their empirical section, they have a modern time series methodology to examine the linkages between financial development and real activity. They used data for 22 countries in the Sub-Saharan Africa over the period from 1960 to 2009. They found that monetization plays a central role in the growth process. In order to stimulate financial development it is important to begin with basic monetization. The establishment of banks are some first steps in the process of financial development. They point out that it is important that banks extend their reach to all parts of the population, meaning for example that banking services should be available for the rural population

The study done by Allen et al. (2011) only focuses on the (under)development of the financial sector in Sub-Saharan Africa. (Allen, Carletti, Cull, Qian, Senbet, & Valenzuela, 2011) They find a relation between financial development and economic development. The financial development in Africa remains very low compared with other developing countries. Their most important result is that the population density appears to be important. There is a nonlinear relationship between the banking sector development and the population density. In low-income areas and areas of sparse population, it is difficult for a bank to be viable. Therefore they point out that mobile banking is a promising way for the financial sector in Africa to develop and grow.

3.2 Financial development and economic growth

There are different variables to measure the development of the financial sector. Most studies just use one or a few variables to see if they stimulate (indirectly) economic growth. The most important ones concerning this thesis are FDI, trade and remittances.

Foreign Direct Investment (FDI)

In the literature there has been quite a debate about the impact of the capital flow FDI on economic growth. FDI is foreign capital coming from developing countries. There are multiple ways through which FDI can contribute to growth. There are of course the wages that the capital generates on the capital that FDI brings. Besides there are also the capital spillovers and there is the transfer of knowledge, skills and technical abilities from managers to domestic workers. (Chamarbagwala, Ramaswamy, & Wunnava, 2000) In theory, FDI would be a good contributor of economic growth. Empirical studies are not unanimous on this.

The paper of Alfaro et al. provides evidence that a well-developed financial market is necessary for FDIs to contribute to economic growth. (Alfaro, Chanda, Kalemli-Ozcan, & Sayek, 2004) In this research they acknowledge the importance of not only the financial market, but also the stock market. Stock markets form an important linkage between the local and foreign investors. They used a cross-sectional data model and they found that the local financial market an important role plays in the benefits that FDIs can provide. A lack of development of the financial market may cause that the full benefits, besides only the wages it generates and the capital that FDI brings, may not be realized. Spillovers are dependent on the development of the domestic financial market. The policy recommendation therefore is to improve the local conditions. Not only to attract foreign companies (and thus FDI), but also to be able to maximize the positive effects of FDIs.

A certain level of financial development is necessary to benefit from FDIs. A study of Chang from 2009 obtains a strong long-run relationship between FDI, financial development and economic growth. In this research, the interactions between FDI and financial development are taken into account. They used different methods (panel data approach, heterogeneous panel cointegration tests, heterogeneous

dynamic panel data approach, OLS and VECM). It is striking that the financial development indicators have a larger effect on economic growth than the FDI has. It is likely that the relationship between FDI and economic growth is influenced by the development of the domestic financial sector. Therefore policy makers should focus on the development and improvement of the domestic financial system. Besides, they shortly mention the development of a country's banking system. The development should be healthy, if it is to contribute to FDI. They end their paper mentioning that a broad financial reform is not an easy task and that it depends on lots of other things, such as investment culture, good trade statues, governments' policies and advanced human capital.

Asman-Saina et al. did a study in 2010 and found similar results. (Azman-Saini, Law, & Ahmad, 2010) They used a threshold regression model and found that there is only a positive impact of FDI on economic growth after the financial market reaches a certain level of development. For their data, they used four measures of banking sector development. Those are the four measures that Alfaro et al. also used. The first is the private sector credit, the second is the bank credit, third is the commercial bank assets and the fourth measure is the liquid liabilities of the financial system. All the data are from the Financial Structure Database of the World Bank. Also this paper concludes that policies should also aim at promoting financial market developments instead of policies only focussed on attracting FDI.

Another study, done by Agbloyor et al., examines the relation between private capital flows and economic growth. (Agbloyor, Abor, Adjasi, & Yawson, 2014) They used various capital flows; FDI, EFPI, private non-guaranteed debt and aggregate private capital flow. Their theory is that financial markets ensure that savings, domestic or induced from foreign capital flow, are transformed into investments. These investments increase technological innovation and human capital. This ensures that the level of productivity increases, which leads to an increase in economic growth. Using data on 14 African countries, they found that FDI on its own is likely to have a negative influence on economic growth. Capital flows even might be detrimental in countries where the financial market is underdeveloped. This is due to the fact that these countries are more vulnerable to financial crises, which

could easily lead to an outflow of foreign capital. This outflow lowers economic growth. The findings of this study are in line with the research of Alfaro et al. The recommendation is that these kind of countries should encourage the development of their financial markets.

The conclusion of different empirical research is that there is a clear relation between FDI and economic growth. It also shows that FDI is not the only variable that contributes to economic growth. Other capital flows and the financial development also play a role. However, the spillover effects only take place if the development of the financial market is at a certain level.

Trade openness / Financial deepening

Recently there is a lot of research done about the link between international trade and financial development. In theory, an increase in trade openness might lead to a supply of more sophisticated financial instruments. Having more financial services and instruments, expands the size of financial institutions and markets. This could be described with the term financial depth, the first indicator of financial development (see Cihák et al. (2013)).

The study of Gries et al. found only limited support for the relationship between financial depth and economic development for 16 Sub-Saharan-Africa countries. (Gries, Kraft, & Meierrieks, 2009) There is only little evidence that supports that financial deepening has promoted economic development through trade openness. Neither financial deepening nor trade openness seems to be a precondition of economic development. Therefore their policy recommendation is to also focus on other fundamental development factors like political or macroeconomic stability.

A more recent study shows the same results. (Menyah, Nazlioglu, & Wolde-Rufael, 2014) With a financial development index based on four different financial development indicators, the results imply that financial development as well as trade does not seem to have a significant impact on growth.

Remittances

Growing financial flows to developing countries are remittances-transfers. International migrants send their earnings to their mother countries. The remittances

can be transmitted through official channels as well as through unofficial channels. The report of the World Bank shows that remittance flows are increasing in volumes. In 2009 it was the case that recorded remittances were almost as large as FDI and nearly three times the amount of official aid. (The World Bank, 2011) A lot of money is going to Sub-Saharan Africa by informal channels. Those channels are more attractive, because there is no bank account needed, it can be done anonymously and it is cheaper for the transaction costs are lower. A consequence of using informal channels is that the impact on the financial development is lower than it could be. Since this capital flow has such a big share, it makes sense to briefly discuss some studies done about remittances.

In 2012 a study is done on the role of remittances and financial development on economic growth in a panel of 36 countries in Africa. (Nyamongo, Misati, Kipyegon, & Ndirangu, 2012) One of the main findings in this study is that remittances appear to be an important source of growth for just some countries in Africa, but volatility of remittances appears to have a negative effect on the growth of countries in Africa.

One of the most recent studies on this topic is from last year. (Coulibaly, 2015) In this paper the link between remittances and financial development in Sub-Saharan African countries is investigated. There appears to be no strong evidence that there is a causal relationship between remittances and financial development in Sub-Saharan African countries. On the other hand financial development doesn't have any influence on the remittances received.

Financial development and poverty

The relationship between financial development and economic growth might be clear. However, it is much more interesting to see if financial development disproportionately raises the incomes of the poor. This study is actually performed in 2004 by Beck et al. (Beck, Demirguc-Kunt, & Levine, 2004) They wanted to know whether financial developments benefits the whole population. They found that financial development reduces income inequality, because the incomes of the poor are boosted disproportionately. For their research, they used a cross-country sample. To measure financial development, they used Private Credit. Data are from the Financial Structure Database.

They tested their results on robustness and potential reverse causality. Reverse causality in this situation means that for example it could be the case that economic growth stimulates financial development or that a reduction in poverty stimulates a higher demand for financial services instead of the other way around. Thereby, the independent variables could be correlated with the error terms of the regression. To control for this potential reverse causality, they used instrumental variables regressions. Legal origin of countries and the absolute value of the latitude of the capital city are used as instrumental variables, because, based on finance and growth literature, these variables might influence financial development. With the Hansen test, the appropriateness of the instruments was tested. They found that the instruments were not correlated with the error term. The instrumental variables could explain cross-country variation in financial development. Therefore the instruments are valid. Even if they use these instrumental variables, they still find a disproportionately positive effect of financial development on the growth rate of the incomes of the poor. The application of these instruments is believable, because they selected their variables based on previous studies done by well known researchers in this field (like Beck and Levine). They explained every step they took and included the p-values of the test in their tables. Besides these two variables, they also used other instrument sets, like the religious composition of countries and ethnic fractionalization.

On the one hand it might be important for developing countries to improve their financial markets in order to stimulate economic growth, attract FDI, reduce poverty and reduce income inequality. On the other hand it also has to be said that the neither the cross-section studies nor the time series studies that focus on Sub-Saharan Africa countries are clear about the findings that financial development leads to economic growth.

4. M-Pesa

Sending money to and within a developing country is costly. Transaction costs are high; therefore migrants for example send their remittances through the informal channel. Other imperfections of financial markets are informational asymmetries and contract enforcement costs. Where fixed lines, but also the physical transportation infrastructure are underdeveloped, inadequate and unreliable, the technology of the mobile phones brings opportunities.

The acceptance and use of mobile phones have taken place at maybe the fastest rate of any other technology in history. (Jack & Suri, 2011) It took less than 20 years to reach 80% of country populations. To compare; fixed line telephone services took 100 years to reach the same coverage. As shown in the chart below, the use of mobile phones has grown enormously in the developing Sub-Saharan Africa countries.

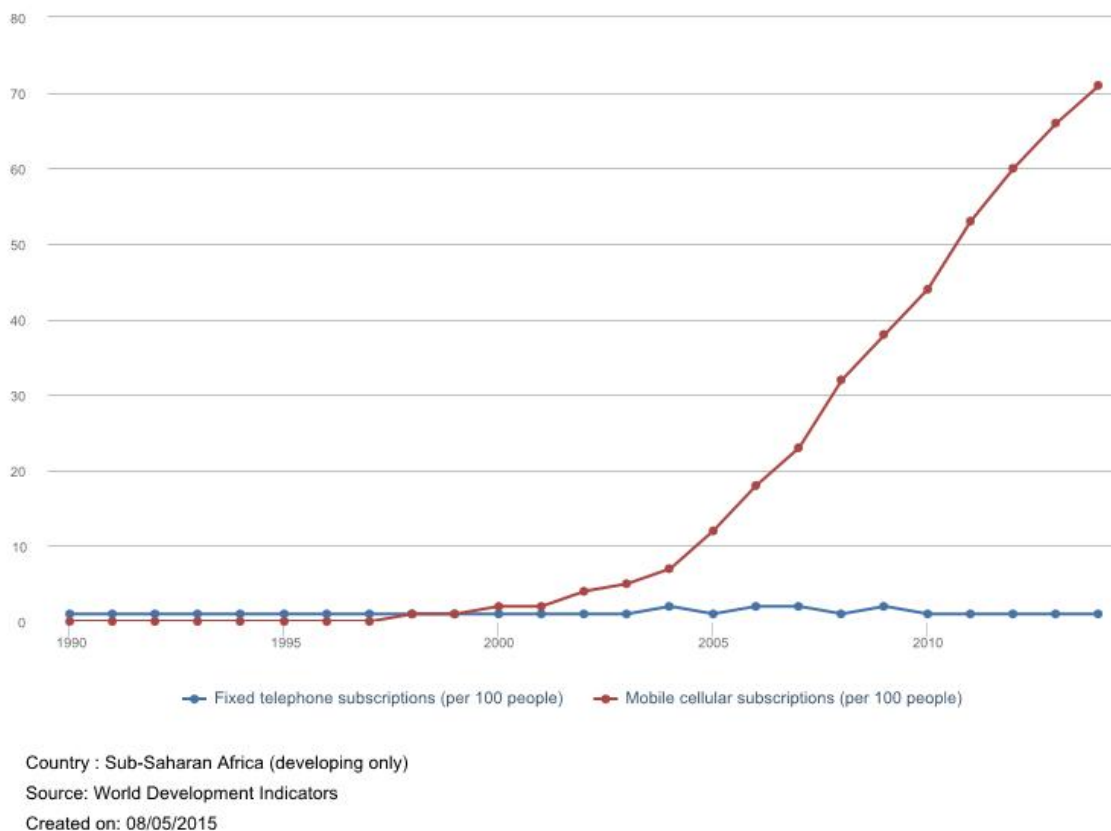


Figure 2 Use of Fixed Telephones and Mobile Phones

The spread of mobile phone technology has various advantages. A study done by Lee et al. investigates the relation between telecommunications and economic growth. (Lee, Levendis, & Gutierrez, 2012) They find that the expansion of mobile phones is an important determinant of economic growth. Where fixed telephone lines are rare, the impact of mobile phones is even greater. This could be explained by the fact that farmers are better informed about the prices on the market. Earlier studies already showed that telecommunications are an essential component of economic infrastructure. Important for their growth framework is the study of Datta and Agrwal. (Datta & Agarwal, 2004) Their results show a positive and significant correlation between growth and the telecommunications infrastructure. The study of Lee et al. makes a distinction between fixed and mobile phones. Mobile phones are different, because the infrastructure costs are lower and these phones are portable compared to fixed lines. Their policy recommendation is to encourage the mobile phone infrastructure in the Sub-Saharan region.

4.1 The benefits of mobile phones; filling in a niche

Besides giving market information and in that way stimulating economic growth, there are more ways for mobile phones to contribute to economic growth. In the previous section a lot is said about financial development and the relation with economic growth. In this thesis the relation between mobile banking and economic growth is central. Mobile banking could be an attribute to financial development. Before discussing M-Pesa, I want to compare some aspects of financial development from developing Sub-Saharan Africa countries with the world.

The graphs below show that the developing Sub-Saharan African countries lag in financial access. Accounts per 1,000 adults and ATM's per 100,000 adults are good measurements for the access of financial institutions. The private sector credit to GDP and the deposits for GDP might give some insights in the depth of financial institutions. The data are from the Global Financial Development database of the World Bank. Because the level of financial development is low, there is a potential for M-Pesa to expand and deliver a financial service to the poor and excluded.

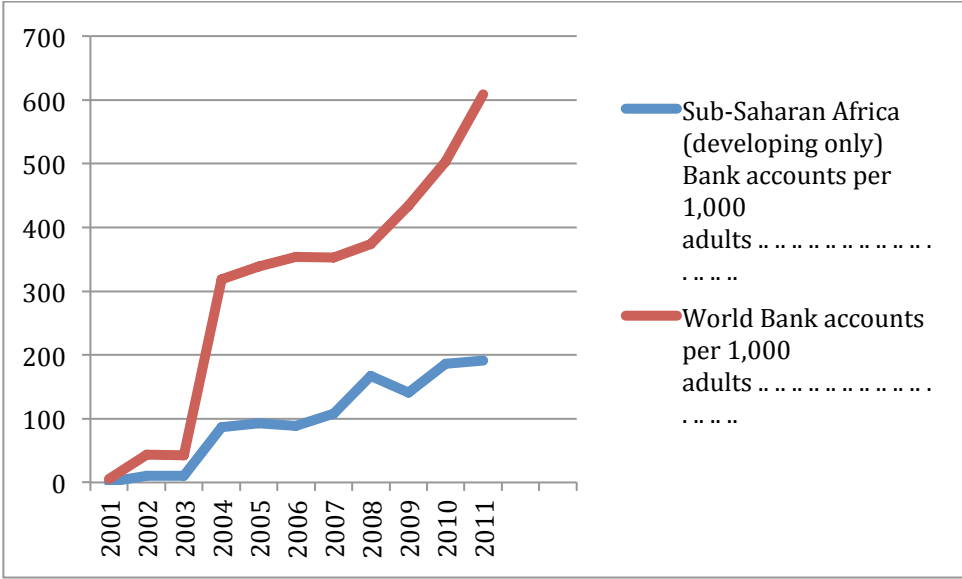


Figure 3 Bank accounts per 1,000 adults

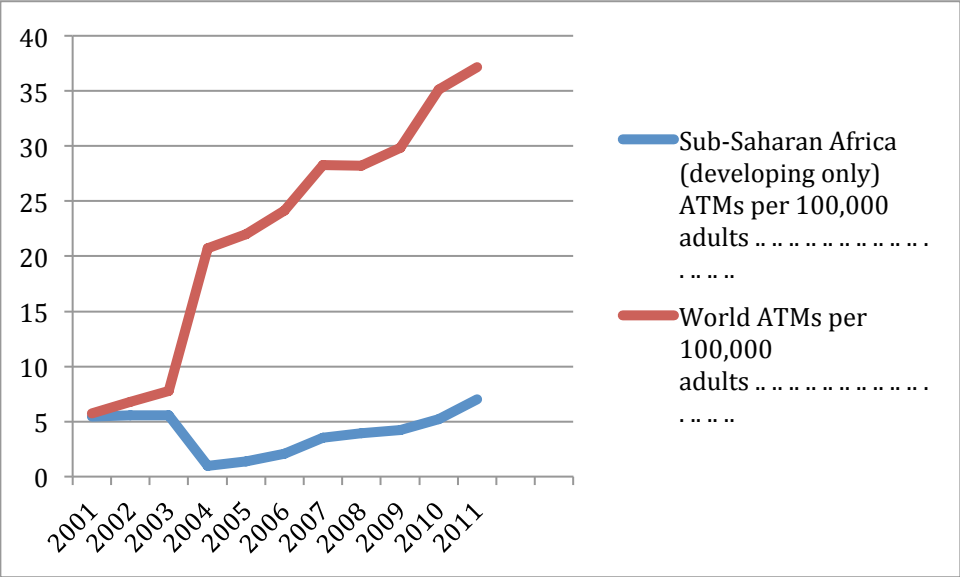


Figure 4 ATMs per 100,000 adults

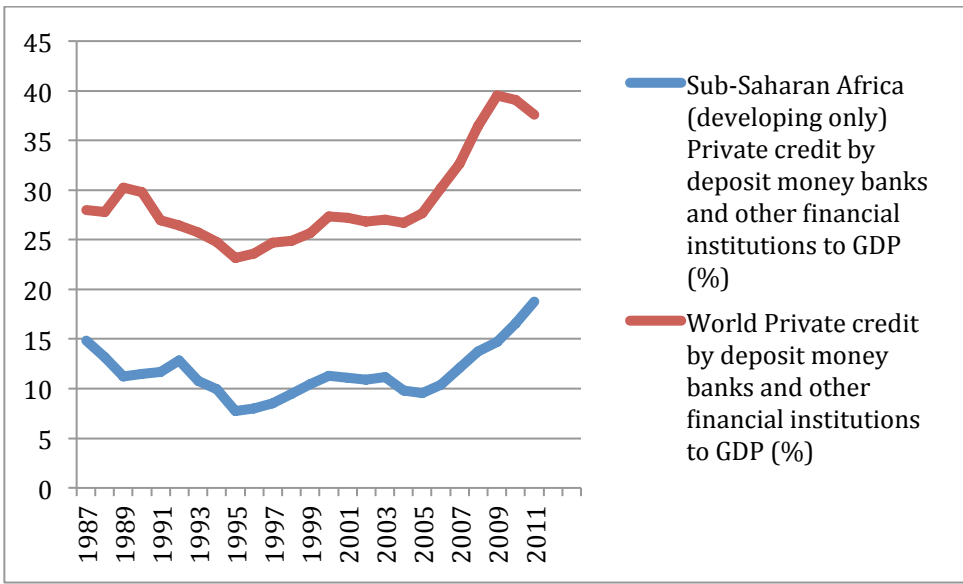


Figure 5 Private credit by deposit money banks and other financial institutions to GDP (%)

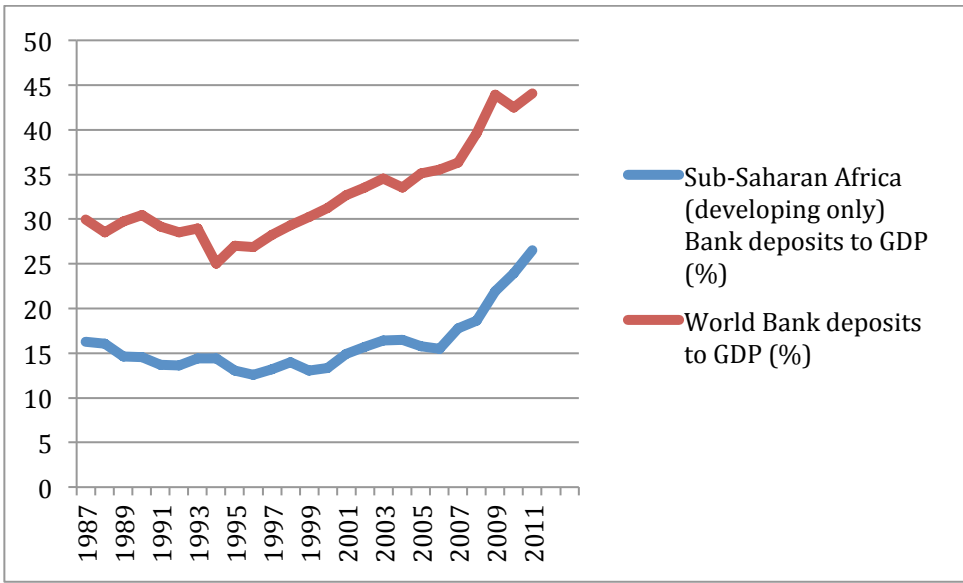


Figure 6 Bank deposits to GDP (%)

4.2 How does it work?

In March 2007 a mobile phone operator in Kenya, Safaricom, initiated M-Pesa. M-Pesa is a money transfer system. The primary function of M-Pesa is to reduce the costs of making remittances, especially across large distances. Users of M-Pesa have an account stored on their mobile phones. To get such an account, individuals must register at an authorized M-Pesa retail agent outlet. Next, users can deposit money

and send balances to other users via SMS. They could also send money to sellers of goods and services. It isn't required for the receiver to have an account, but a higher fee will be charged. It is also possible for users to keep a balance on their accounts. In this way, users make it a primitive bank account, though they do not get any interest. Morawczynski and Pickens observed that users do keep balances on their accounts. (Morawczynski & Pickens, 2009) M-Pesa has spread quickly among both customers and agents. Mas and Morawczynski investigated why M-Pesa could grow so rapidly in Kenya. (Mas & Morawczynski, 2009) Although M-Pesa is not a bank, it fills in a niche in the financial market. M-Pesa could function as a substitute for bank accounts, because it is accessible in urban as well as in rural parts of the country, while this is not the case for regular banking services. The demand for these kinds of money-transfer services is driven by the rural-to-urban migration for it is not uncommon for the male head to seek employment in the city. Before M-Pesa, people used to send money home by giving it to friends or family members. This is a risky method, because everything could happen on the way. M-Pesa fills in the gap in the domestic remittance market. Their conclusion is that the success of M-Pesa cannot be ascribed to one specific factor. It is the entire system that best explains its success.

M-Pesa is easy in use. It is an application that runs from the user's phone. The figure below gives an overview on how the service works. Every time they want to send or store money they need to visit an authorized M-Pesa agent. Customers can make three basic transactions; deposit money, withdraw money or transfer money. Deposit money is not an option in the menu, for it is a transaction the agent makes. Charges are collected from the users' accounts when the money is sent and when the cash is withdrawn. The withdrawal fees are differentiated based on registration. Sending money to a registered user is less costly than sending it to a non-registered user. There is no charge for making a deposit. Compared with Western Union and Postapay, M-Pesa is not more expensive. Actually after a certain amount, around 20.000 Kenyan Shilling¹, it is even cheaper to use M-Pesa for your transaction. (Jack & Suri, 2011) For more information about M-Pesa, see Jack and Suri (2011) and Mas and Morwczynksi (2009).

¹ This is almost \$200.00 using the current exchange rate.

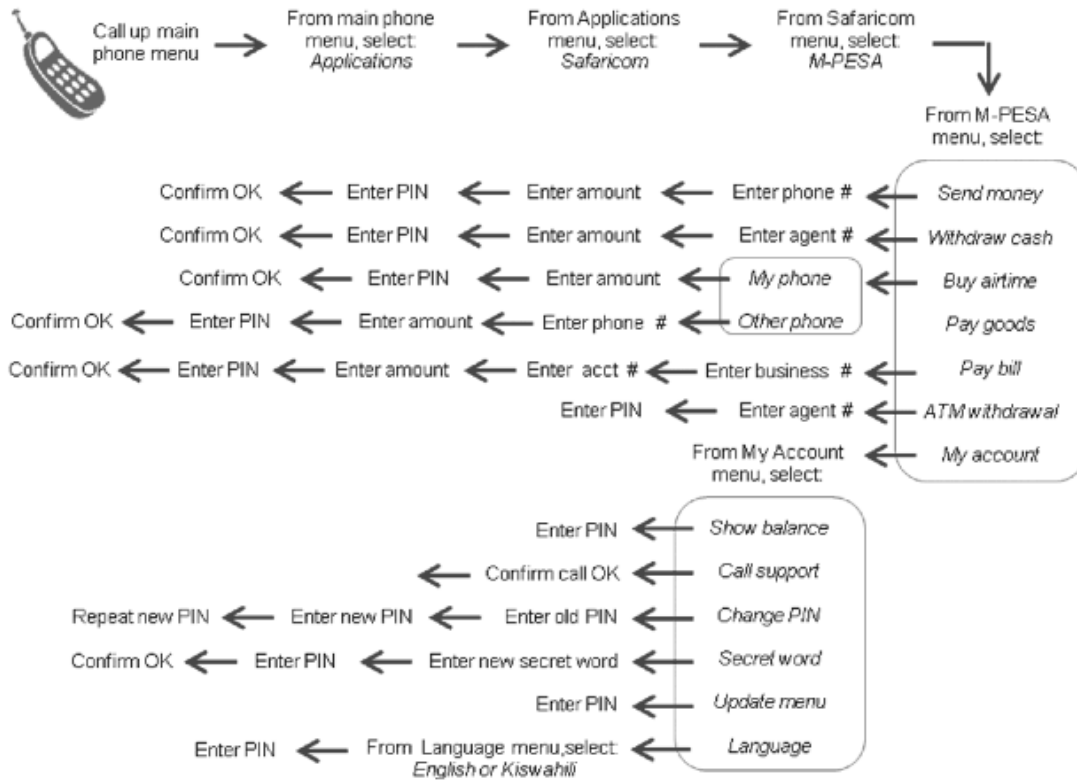


Figure 7 M-Pesa Phone Menu Structure

Tanzania launched its own version of M-Pesa in 2008. This service didn't have the same effect. In the graph below you can see the value of payments in Kenya and in Tanzania. It is clear that the service better catches on in Kenya than in Tanzania.

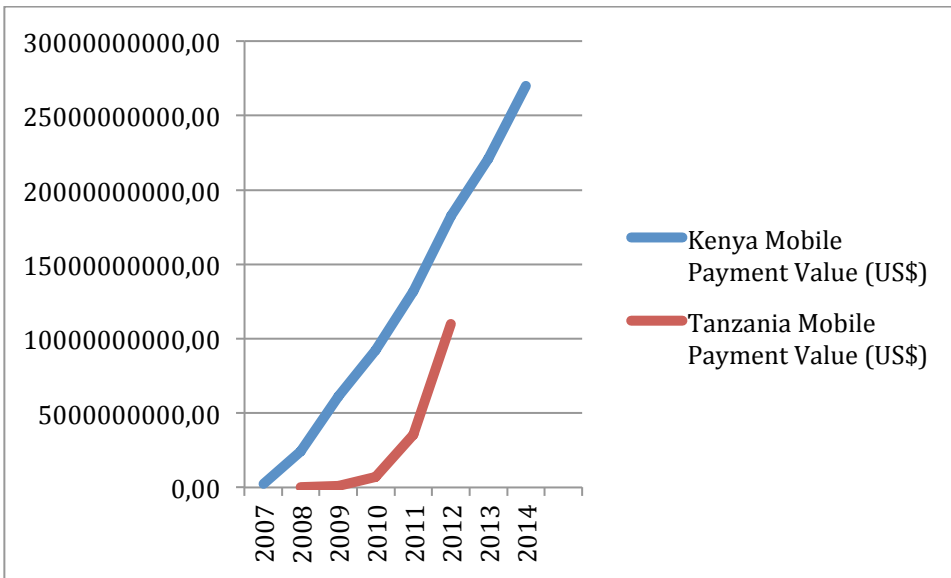


Figure 8 Value of Payments made by M-Pesa

4.3 Economic impacts of M-Pesa

There is already done some research on the economic impact of M-Pesa. Most of this research is on household or community level.

Impacts on household level

Jack and Suri (2011) identified some potential economic effects of M-Pesa at the household level. M-Pesa makes trade possible. Customers can pay their electricity or water bills, pay school fees and buy airtime. M-Pesa could increase household savings, for M-Pesa provides a saving mechanism. M-Pesa might increase the investment in human and physical capital. It is more likely that people are sent to the city or to another location for a high-paying job, since sending money is less risky. As a consequence of the ease of sending money, M-Pesa could weaken incentives for rural households to work or innovate. It is much easier to expect remittances. For their research they undertook a household survey in Kenya. They interviewed households and a year later they conducted a follow-up survey. The information is about household composition, household wealth and assets, consumption, remittances and positive and negative shocks. They also managed to get information about the use of financial services, particularly the use of M-Pesa. M-Pesa is used by households with a wide diversity of demographic, educational and economic characteristics. Users say the service is cheap, save, reliable and fast.

In 2011, Mbiti and Weil examined how M-Pesa is being used in Kenya. (Mbiti & Weil, 2011) They pay attention to the question whether M-Pesa is just a way to transfer money or if it is more than that, providing financial access for those who are unbanked. They find that M-Pesa doesn't serve as a substitute for banks. The increase of M-Pesa leads to greater bank use. Besides, the introduction of M-Pesa led to decreases in the prices of competitors. The results also suggest that people use M-Pesa as a saving instrument instead of informal tools. There isn't any change visible in the use of formal saving methods. M-Pesa also increases employment. This applies for farm labour, non-farm labour and self-employment. According to the results of this paper, but also among the others, M-Pesa does have some economic effects. The question remains whether M-Pesa (or mobile banking) contributes to economic growth.

M-Pesa also has its impact in the agricultural sector. Kirui et al. documented the impact of M-Pesa on smallholder agriculture. (Kirui, Okello, & Nyikal, 2012) They used cross-sectional data collected from 379 households in Kenya. They found that the services of M-Pesa in rural areas help to resolve the uncommon market failure of access to financial services. They also found that use of M-Pesa increased the household farm incomes.

Impact on community level

Since there are studies done on household level, Plyler et al. studied the economic effects of M-Pesa at community level. (Plyler, Haas, & Nagarajan, 2010) The effects were not mutually exclusive; they were twist together, producing overall community effects. Increased money circulations is one of the highest-ranked effects. This is due to a greater volume of money that flows into and out of the communities. Businesses could extend, because there was a growing demand for goods and services. This growth in demand is due to the increased money circulation. There is an improved money security in terms of reduced attacking and thefts. Food security is also an important effect. There is more variety of foods and an increased agricultural productivity.

5. Data

This section describes the data used for the empirical analysis. More specifically the measures of economic growth, data on the use of mobile banking and a number of controlling variable used in growth regressions.

Most of the data are from the World Bank, more specific the collection World Development Indicators. This collection contains data of 249 economies with coverage from 1960 till 2014. The data concerning the use of mobile payments is from the website of the Central Bank of Kenya and the Central Bank of Tanzania.

I want to show whether there is a correlation between the rise of mobile payments and the economic growth in the countries. Therefore I do a panel data analysis, which means that I observe the same relationship of the same countries at more than one point in time. I observe them from 1990 till 2014.

5.1 Sample Countries

Examining the relationship between mobile banking and economic growth, I focus on 38 countries. The countries are all part of the Sub-Saharan Africa. Due to different growth patterns between high income countries and low income countries, I removed all the upper middle income and high income countries. Due to a lack of data I couldn't take Somalia and South-Sudan into account. The sample countries are listed in table 1.

Table 1 List of all the sample countries

Benin	Cote d'Ivoire	Madagascar	Sierra Leone
Burkina Faso	Eritrea	Malawi	Sudan
Burundi	Ethiopia	Mali	Swaziland
Cabo Verde	The Gambia	Mauritania	Tanzania
Cameroon	Ghana	Mozambique	Togo
Central African Republic	Guinea	Niger	Uganda
Chad	Guinea-Bissau	Nigeria	Zambia
Comoros	Kenya	Rwanda	Zimbabwe
Congo (Democratic Republic)	Lesotho	Sao Tomé and Príncipe	
Congo (Republic)	Liberia	Senegal	

In the figure below is the annual economic growth per capita for Kenya, Tanzania and the average of the other developing Sub-Saharan African countries. Before 2007 and 2008 there are some different patterns, but after these years it looks more alike.

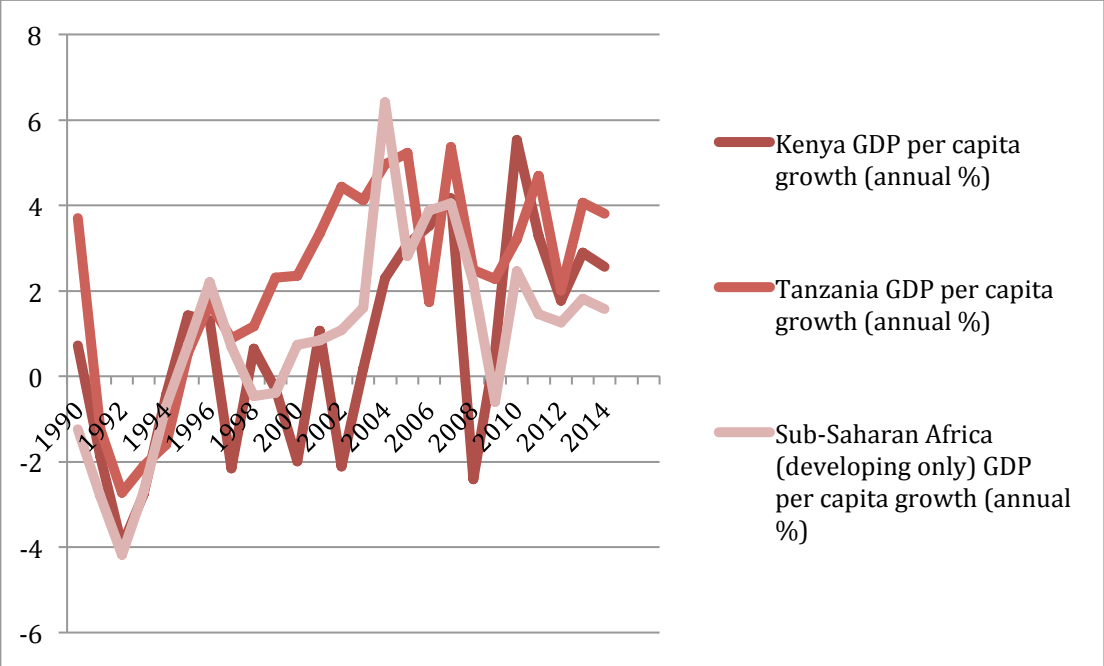


Figure 9 Annual Economic growth per capita

There are 4 countries from the sample with mobile payment systems; Kenya, Tanzania, Congo (Democratic Republic) and Mozambique. Congo and Mozambique have mobile banking since respectively November 2012 and May 2013. There is no data available for these countries regarding mobile payments. I removed all the data of 2013 and 2014 concerning Congo and Mozambique. There is however data available for Kenya and Tanzania, since they use mobile banking since March 2007 and April 2008. All the data up to 2014 is available, for Tanzania the data is available up to 2012. Therefore I remove all the remaining data of 2013 and 2014 for Tanzania as well.

The available data on mobile payments is the number of agents, the number of customers, the number of transactions and the value of the transactions in the local currency. To make the value of the transactions useful, it needs to be converted in

US dollars. I use the official exchange rates from the World Bank. (World Bank, 2015)
 The rates are calculated as an annual average based on monthly averages.

Table 2 Exchange rates local currency to US Dollars

	2007	2008	2009	2010	2011	2012	2013	2014
Kenya	67.32	69.18	77.35	79.23	88.81	84.53	86.12	87.92
Tanzania	1,245.04	1,196.31	1,320.31	1,409.27	1,572.12	1,583.00	1,600.44	1,654.00

* Local currency units relative to the U.S. dollar

5.2 Model Specification

The predictor variable is *the use of mobile payments*, value of transactions in million US dollars. The dependent variable is *economic growth*. This variable will be the growth of real per capita GDP, constant dollars [GDPPC]. I can quantify the relationship between economic growth and the use of mobile banking while controlling the effect of some additional variables. These variables are the following:

Although the impact of *population growth* has been debated, I expect this relation to be negative [POPGR]. If the population is growing, a part of the investment goes to new workers instead of raising the capital per worker. The population growth is measured as an annual percentage. *Fertility rates* are related with the population growth. Fertility is an endogenous variable, because research shows the rate declines with measures of prosperity. (Barro, 1996) The rate represents the number of children that would be born to a woman [TFR].

Another determinant for economic growth are the *savings*. The exogenous growth model shows the rate of savings is an important determinant for economic growth. The higher the savings are, the more economic growth there is. The measurement for savings is the gross domestic savings as a percentage of GDP [GDS/GDP].

Based on the paper of Romer, I could take literacy into account as a measure for *human capital*. Unfortunately, there isn't enough data to take this variable. Besides I could choose for the variable expenditure on education as a percentage of GDP to

measure human capital. The paper of Oketch showed that enrollment doesn't capture the quality of education. Expenditure therefore is a better measure. Unfortunately I don't have enough data on this measurement either. Therefore I am going to take primary and secondary school enrollment rates (gross) as a proxy of human capital [Primary school and Secondary school]. This is also what Barro (1996) did. The gross enrollment ratio is the ratio of total enrollment, regardless of age. I am aware of the fact that the quality of education differs between countries and that these variables are not comprehensive as indicators for human capital. Besides, a high ratio doesn't per se reflect a successful education system. It is possible that there are a lot of overage children enrolled in each grade because of for example late entry.

I won't take *inequality* into account. There is only a little relation between income inequality and rates of growth and investment. (Barro, *Inequality and Growth in a Panel of Countries*, 2000) Besides, I don't have enough data of the Gini Index.

For the determinant *health* I take the variable life expectancy. This is the most common variable to measure health, according to previous research. (Gyimah-Brempong & Wilson, 2004) Life expectancy at birth indicates the average number of years a newborn infant would live.

The relationship between *regime type* and economic growth is weak. I won't take this measurement into account. I do take *domestic investment* into account. The paper of Tiruneh (2006) showed a significant effect between domestic investment and economic growth in Africa specifically. This is also an endogenous determinant, for it could stimulate economic growth by job creation and improvements in infrastructure. Domestic investments show that people expect a higher return on their investment if they invest in domestically than abroad. This could relate to domestic opportunities for growth. The World Development Indicators define domestic investment as gross capital formation (% of GDP) [GDI/GDP].

Government Consumption is an important variable for economic growth. A lot of papers show the negative effect this variable has on economic growth. This variable is used as a proxy to measure the level of privatization. The lower the size of the private sector will be, the higher the level of government consumption. (Tiruneh,

2006) The proxy is measured by all the government current expenditures in million US dollars for purchases of goods and services, including expenditures on national defence and security.

In the paper of (Alfaro, Chanda, Kalemli-Ozcan, & Sayek, 2004), is also controlled for institutional stability and quality in the economies. Unfortunately the data from the International Country Risk Guide (ICRG) isn't available for me, so I couldn't use the same variables. Instead I will use inflation as a measure for macroeconomic stability.

I also control for *FDI*. FDI is measured as net inflows from foreign investors divided by GDP [FDI/GDP]. Despite the fact that some research shows no significant relationship between FDI and economic growth, I choose to take this variable. I am not aware of the financial development of every country in my sample, so FDI might have a significant relation.

The same applies for *credit*. Credit is a measurement for the financial deepening. Beck et al. (2004) use it as an indicator for financial development. Though others argue this ratio of private credit to GDP isn't enough to say something about the development of the financial sector. It does say something about the availability of finance according to Cihák et al. (2013). Credit is important as a link in money transmission. Therefore I will use the domestic credit to private sector as a percentage of GDP as a control variable [DC/GDP].

Trade is especially important for developing countries. Most of the time these countries specialize their exports in just a few primary products. Trade is used to measure the *economic openness*. Trade is the sum of exports and imports of goods and services, measured as a share of GDP [TRADE/GDP].

Inflation is important as a measure for macroeconomic / price stability. Although the effects are more visible in the long-term, I want to take inflation into account. The paper of Bittencourt et al. (2013) shows that there is a negative significant relation between economic growth and inflation. It is more recent than the other papers I discussed earlier. Besides, Barro (1996) argues that small changes in growth rates, could have dramatic effects over long periods. Since I take 25 years into account, inflation might be a determinant.

5.3 Data limitations

The data I collected has limitations. I already pointed out that the proxy for the variables might be insufficient. Besides, the World Bank has given some explanations that the statistical systems in the developing African countries are still weak. The definitions of variables differ among countries. As you shall see in the analysis of the descriptive statistics, there is a lot of variation in the variables between countries. This could be contributed to the sources of data.

6. Empirical analysis

Before any regressions, it is useful to look at the relationship between GDP and mobile payments by a simple scatterplot. For this scatterplot I excluded the data if there were no mobile payments made.

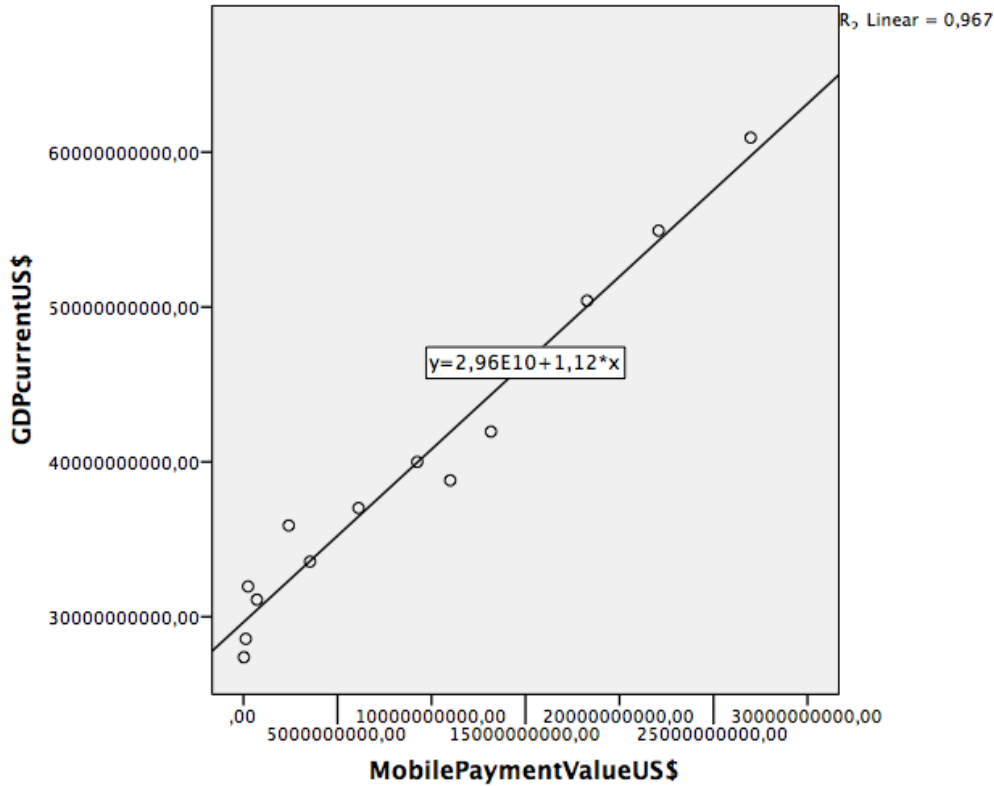


Figure 10 The relation between current GDP and Mobile Payments made

The scatterplot shows that there is a relationship between the two variables. There are no obvious outliers. There also seems to be some general trend in the data, shown by the line. Higher values of mobile payment are associated with a higher GDP.

Table 3 presents the descriptive statistics for economic growth, mobile payments and the control variables. There is considerable variation in the share of FDI in GDP across countries, ranging from -82.89% in Liberia (1996) to 91.007% also in Liberia (2003). This could indicate that something happened causing foreign investors to take their money out of the country. There was a civil war going on in the country from 1989 till 1996, but this is way too speculative to say anything meaningful about

it. The high inflation (26,765.86%) is from the Democratic Republic Congo in 1994. Lesotho is accountable for the high level of trade, 209.89% in 2002. Sao Tome and Principe has a low government consumption, while Nigeria has the highest. Rwanda has known a negative population growth in the early nineties. The high population growth of 10.26% was in Rwanda in 1998.

Table 3 Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
GDPPC	932	583.59	479.17	50.04	2,797.67
Mobile Payment	944	121	1,446	.00	26,977
Primary School	736	89.17	27.07	21.72	161.12
Secondary School	505	28.77	17.01	5.16	95.67
GDI/GDP	926	18.68	11.31	-2.42	79.35
FDI/GDP	888	3.95	8.71	-82.89	91.007
TFR	909	5.63	.99	2.292	7.773
Government consumption	627	1,143	2,465	24	23,776
Inflation	929	55.36	901.25	-29.17	26,765.86
TRADE/GDP	913	66.298	33.12	10.75	209.89
POPGR	944	2.58	1.13	-7.60	10.26
GDS/GDP	871	5.83	16.67	-87.53	59.31
DC/GDP	867	14.23	10.17	.198	103.63
Life expectancy	909	52.94	6.73	26.76	74.87

4.1 Growth and Mobile Payments

The purpose of this empirical analysis is to examine whether mobile payments have a significant influence on economic growth. The scatterplot from the previous paragraph assumes a relation between mobile payment and economic growth. I choose to do a multiple regression instead of a partial correlation, because with the regression analysis it is possible to look into the interdependence of the independent variables. I won't use the stepwise method, because it could be influenced by random variation in the data. In this method it could happen that an important variable is left out because of what already has been put in the model. To prevent this, I use the forced entry method, so that all variables are forced into the model simultaneously.

Regression with time fixed effects

I used the correlation matrix to look for the relation between variables and the outcome. There are no substantial correlations ($r > .9$) between the variables. The highest correlation is between secondary school enrollment and the fertility rate ($r = -.655$), which is significant ($p = .000$). Another high correlation is between the fertility rate and the trade of GDP ($p = -.650$), which is also significant ($p = .000$). The correlation between the primary and secondary school enrollment is $.519$. This correlation is significant ($p = .000$). These values could indicate that the variables are measuring the same things. There could be collinearity. Secondary school enrollment ($r = .554$), trade ($r = .553$) and the fertility rate ($r = -.525$) correlate best with economic growth.

Table 4 presents results based on the regression. At a significance level of 10%, mobile payments have a negative effect on economic growth. This was not what I expected, since M-Pesa has a lot of economic impact on household and community level.

School enrollments are both significant. Secondary school enrollment is the biggest predictor for this model. Based on previous research, I expected these variables to have little impact on economic growth. The poor quality of education in the Sub-Saharan African countries could explain the negative relation between primary school enrollment and economic growth.

FDI does not appear to have a significant association with economic growth. This was foreseeable. Recent literature shows that FDI only contributes to economic growth if there is a certain level of financial development. Since the developing countries in Sub-Saharan African lack this level of financial development, FDI cannot stimulate economic growth.

Government consumption doesn't have a significant relation with economic growth in this model. I expected to find a negative relationship, since a lot of papers showed that high government consumption does have a negative effect on economic growth. Inflation, as a proxy for macroeconomic stability, also doesn't have a significant effect. The view in the literature on this determinant is divided.

Table 4 Regression Results - Growth and Mobile Payments

(Constant)	1123.895*** (341.379)
Mobile Payment	-.024* (.000)
Primary School	-3.526*** (.835)
Secondary School	11.946*** (1.918)
FDI/GDP	-3,467 (2.487)
TFR	-135,846*** (32.283)
Government consumption	.008 (.000)
Inflation	-.004 (.011)
TRADE/GDP	6.554*** (.660)
POPGR	-1.022 (21.155)
GDS/GDP	12.506*** (1.165)
DC/GDP	6.384** (2.715)
Life expectancy	-6.131 (4.276)
GDI/GDP	-5.802*** (1.944)
R-Squared	.716
No. observations	324
Durbin-Watson	.373
Year fixed effects	Yes
Country fixed effects	No

Dependent Variable: GDPPC

Standard errors are reported in parentheses. *, ** and *** indicate significance at 10, 5 and 1% respectively.

Trade, as a proxy for the level of openness of a country's economy, is positively correlated with GDPPC and its coefficient is significant at the 1% level. This does not correspond with findings in previous papers.

The impact of the population growth has been debated in the literature and in this analysis it doesn't have a significant effect. The fertility rates, which are related with the population growth, do have a negative significant effect. Lower fertility rates could be associated with a higher level of prosperity. (Barro, 1996) This is in line with previous research.

The impact on economic growth of the gross domestic savings as a share of GDP appears to be positive and significant. Savings are important in the exogenous growth model and the financial system has its influence on the savings.

Private credit is used as a measurement for financial development in a lot of papers. I find it to have a significant and positive effect on economic growth at the 5% level. It goes to far to state anything about the financial development of the sample countries, but I could say that better access to financial services stimulates economic growth.

Life expectancy was used as a proxy for health. It does not appear to have a significant relation with economic growth. Previous research showed a significant relation, but other proxies for health are used as well.

The estimated coefficient of the share of gross domestic investments in GDP is negative and significant at the 1% level. Based on the paper of Tiruneh (2006) I expected a positive effect.

The Durbin-Watson statistic has a value of .373, which means that it is highly possible that there are serial correlations between errors. The value is close to zero, meaning the residuals are positive correlated. Collinearity could give some problems; the standard errors of the b coefficients increase, the size of R is limited and it is hard, almost impossible, to know which variable is the important one. The VIF values are all below 10 (the highest one is secondary school enrollment, 2.719) and the tolerance statistics are above .2 (the smallest one is also secondary school enrollment, .368).

Another important action is to check the residuals for evidence of bias. I have a sample of 324, so it is reasonable to expect around 16 cases to be outside the limits. Examining the Casewise Diagnostics, only 12 cases are outside the limits. It is striking that 6 of these cases concerns Swaziland.

The histogram is symmetrical and bell-shaped. The normal P-P plot shows up deviations from normality as deviations from the diagonal line. The residuals are normally distributed.

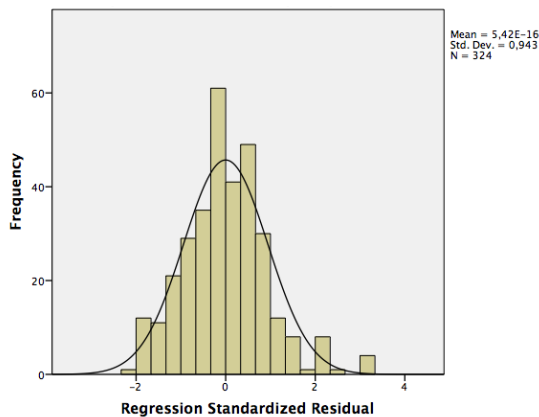


Figure 11 Histogram with dependent variable GDPCC

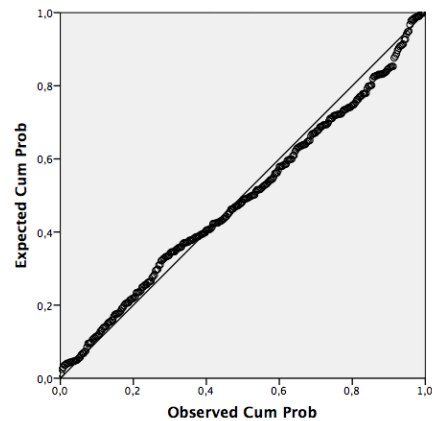


Figure 12 Normal P-P plot with dependent variable GDPCC

The scatterplot doesn't look like a random array of dots. This means that the assumption of homoscedasticity hasn't been met. This means that the error variance differs between the observations.

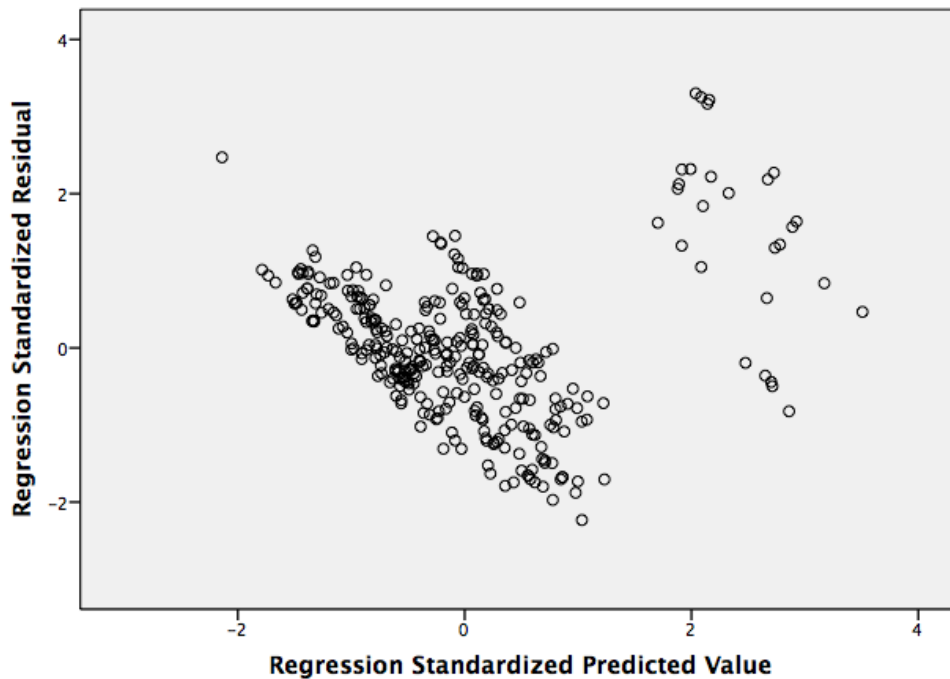


Figure 13 Scatterplot with dependent variable GDPPC

If I leave secondary school enrollment out of the model, I don't have any concerning correlations between the variables (the highest values is $r = .394$). This is between the variables Life expectancy and Domestic credit to private sector. Still my Durbin-Watson statistic stays low, .336. I don't have any VIF values above 2. I do however have 23 cases which are outside the limits. Despite the fact that I have 458 observations and that it is allowed to have 23 cases outside the limits, the values are even up to 4.183. Those cases concern Swaziland. The R square is only .663, the adjusted R square is .636. Leaving out secondary school enrollment doesn't improve the model.

Regression with time and country fixed effects

Some of the problems concerning serial correlations between errors exist because there are systematic differences in growth pattern between countries. Including country fixed effects and running the regressions gives the outcomes as shown in table 5.

Table 5 Regression Results - Growth and Mobile Payments with Country fixed effects

(Constant)	1514.448*** (92.850)
Mobile Payment	-.003 (.000)
Primary School	.348 (.272)
Secondary School	-2.900*** (.716)
FDI/GDP	.797* (.476)
TFR	-40.491** (16.635)
Government consumption	-.002*** (.000)
Inflation	.007*** (.002)
TRADE/GDP	-.859*** (.216)
POPGR	.803 (3.563)
GDS/GDP	2.118*** (.361)
DC/GDP	3.836*** (.752)
Life expectancy	-7.193*** (1.135)
GDI/GDP	-1.015** (.424)
R-Squared	.995
No. observations	324
Durbin-Watson	1.291
Year fixed effects	Yes
Country fixed effects	Yes

Dependent Variable: GDPPC

Standard errors are reported in parentheses. *, ** and *** indicate significance at 10, 5 and 1% respectively.

The R-square becomes .995 and the Durbin-Watson is 1.291. The VIF values though increase immense; 17.365 for secondary school enrollment, 14.960 for trade and 43.483 for the fertility rates. The correlation matrix shows high correlation between the fertility rates and secondary school enrollment ($r = -.655$) and between the fertility rates and trade ($r = -.650$). The correlation between the primary and secondary school enrollment is still present ($r = .519$). These correlations are all significant ($p = .000$).

The coefficients of the independent variables have different values and also the significance level as well as the positive/negative relation for some variables change. Secondary school enrollment ($r = .554$), trade ($r = .553$) and the fertility rate ($r = -.525$) stay correlated best with economic growth. Not all the tolerance statistics are above .2. Secondary school enrollment, fertility rates and trade are .052, .022 and .067 respectively.

Comparing the coefficients and the positive/negative relationship of the variables with economic growth, it is clear that the differences are huge. Variables that were significant before, aren't significant anymore (for example primary school enrollment). Variables that first had a positive effect, now have a negative effect (for example secondary school enrollment, trade and domestic investments). FDI however becomes significant at a 10% level.

I can only prove whether there is a correlation. With the given data, testing for causality is not possible.

7. Conclusion and recommendations

Since sending money in a developing country is costly, access to financial services is not possible for everyone and the use of mobile phones has grown enormously, mobile payments are filling in a niche in the market. In the past few years mobile payments in Kenya and Tanzania increased. On household and community level the positive effects of mobile banking are clearly visible. The effects of mobile banking on country level haven't been discussed before. Therefore I examined the relation between this rise in mobile payments and economic growth.

After discussing some determinants of economic growth, which I used as control variables in my empirical analysis, I focused on the development of the financial sector. The development of the financial sector is an important endogenous variable as a determinant for economic growth. The financial sector is complex and therefore it is hard to have a good measurement of this variable. A shortcoming of most studies is that they only focus on one aspect of financial development, while the different aspects could be defined as financial depth, access, efficiency and stability. The financial development in Sub-Saharan Africa is deprived on many levels, compared with other developing countries. Not only the access to financial services for the rural population is underdeveloped, but also the stock market, bond market and the amount of credit are poorly developed.

Studies about the variables measuring the development of the financial sector give different results. FDI only contributes to economic growth, if the development of this sector is at a certain level. In my analysis FDI didn't contribute to economic growth significantly. This might be due to the lag of financial development in the Sub-Saharan African countries. Trade is another determinant and according to the literature, it shouldn't have a significant impact on economic growth. However, I find that trade is one of the main explanatory variables for economic growth. Remittances were not a control variable in my analysis. According to the literature, it depends per country what the effects on economic growth are. Development of the financial sector is important, for it benefits the whole population. Financial development boosts the incomes of the poor disproportionately. The main conclusion is that, in order to stimulate economic growth with the financial sector, the sector needs to be at a certain level of development. The lag of development of

the financial sector limits an economy's ability to take advantage of FDI and trade.

Research about M-Pesa shows that M-Pesa has economic impacts on household and community level. The population without access to financial services, are able to transfer money via M-Pesa without having a bank account. In theory, M-Pesa would contribute to a more developing financial market and thus to a higher economic growth. The empirical analysis however shows a significant negative effect between mobile payments and economic growth. Taking country fixed effects into account, there is no significant relation. It should be kept in mind that both models have some problems with heteroscedasticity.

Consistent with other similar empirical research I did find that school enrollment has a significant effect on economic growth. This is also the case for the fertility rate, trade, domestic savings, domestic credit and domestic investment. I expected to find the relation between FDI and economic growth insignificant. The relation between government consumption and economic growth was also not significant.

I still tend toward the belief that mobile banking does stimulate economic growth. The fact that I couldn't get a model, might be attributed to the fact that my data is incomplete. This is a limitation of my thesis. Another limitation is that the requirement of homoscedasticity isn't met. Answering the main question, the most I can say it that the thesis indicates there could be a correlation between mobile payments and economic growth. I cannot say anything whether economic growth stimulates mobile payments or mobile payments contribute to economic growth.

For further research it would be interesting to examine the impact M-Pesa has on the development of the financial sector. In this thesis I could only take some measurements for financial development. It would be interesting to have some more information about the contribution M-Pesa has on this sector.

Another suggestion would be to include other important variables, for example political instability. A lot of countries in Sub-Saharan Africa have a recent history of civil wars and coup d'etat. I expect this kind of endogenous variables to be significant. Especially since levels of economic growth differ between the developing countries in Sub-Saharan Africa.

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