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Tarna Abdoul Hamid Silue

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Centre d'Etudes et de Recherche sur le Développement International (CERDI)

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DIGITAL FINANCIAL INCLUSION AND TAX POLICIES

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sous la direction de :

Monsieur Jean-François BRUN et Monsieur Zié BALLO

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Université Clermont Auvergne
École Doctorale des Sciences Économiques, Juridiques, et de Gestion
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A ma mère et mon père, Mariam et Lassina SILUE,

A Fatima, Jamila et Noura

A Soulmate

DECLARATION

L'Université Clermont Auvergne et le CERDI n'entendent donner aucune approbation ou improbation aux opinions émises dans cette thèse. Ces opinions doivent être considérées comme propres à leur auteur.

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RESUME

Dans les pays en développement, l'inclusion financière est un véritable enjeu, car elle permettrait d'atteindre certains des Objectifs de Développement Durable (ODD), notamment la réduction de la pauvreté ou des inégalités de revenus et de genre.

Avec l'essor du numérique, l'accès aux connexions à haut débit et la démocratisation des téléphones portables, des services financiers tel que le " Mobile Money " a émergé. Ces services financiers numériques sont présentés comme un moyen d'atteindre rapidement et complètement l'objectif d'inclusion financière dans les pays en développement. Les principaux fournisseurs de ces services financiers dans les pays en développement sont les opérateurs de réseaux mobiles, qui sont fiscalement considérés comme faisant partie d'un secteur à forte valeur ajoutée. Ainsi, l'objectif des administrations fiscales est de capter la majeure partie de cette valeur ajoutée, quitte à soumettre ces opérateurs à des codes fiscaux spécifiques. Or, l'introduction de taxes sur les services financiers numériques sur la base de cet argument de la valeur ajoutée sectorielle pourrait nuire à la capacité des opérateurs à investir en fonds propres et à développer une activité financière.

Ainsi, l'objectif de la présente dissertation est de contribuer significativement à la littérature existante sur l'inclusion financière digitale dans les pays en développement, en particulier les pays africains. La première partie, composée des chapitres 2 et 3, traite des enjeux économiques de l'inclusion financière digitale dans les pays en développement. Elle examine l'impact de l'accessibilité et de la disponibilité du Mobile Money sur les objectifs de politiques économiques. Quant à la seconde partie, composée aussi de deux chapitres (chapitre 4 et 5), elle analyse l'impact de la fiscalité sur l'utilisation des services financiers numériques.

Le chapitre 2 se concentre sur la relation entre la croissance économique et l'inclusion financière dans les pays en développement. L'idée ici étant que l'inclusion financière conduit à une accumulation de capital humain et technologique qui a un impact sur la croissance économique des pays. L'originalité de l'analyse est de rendre compte de la contribution du mobile money à la croissance économique. Pour ce faire, une réflexion empirique fondée sur un modèle de croissance endogène dynamique permet d'identifier la nature de la relation entre l'inclusion financière (formelle et digitale) et la croissance. En se basant sur un panel de 57 pays en développement pour une période allant de 2007 à 2017, le modèle suggère un impact positif de l'inclusion financière sur la croissance. Il révèle également que la contribution à la croissance de l'inclusion financière digitale via le mobile money est supérieure à celle de l'inclusion formelle avec les banques commerciales dans les pays en développement. Ces résultats soulignent la nécessité de la mise en place par les gouvernements de politiques d'encouragement des entreprises de télécommunications à investir et à promouvoir cette activité digitale.

Le chapitre 3 quant à lui appréhende le mobile money comme facteur déterminant à la création d'entreprise en Afrique. La question est de savoir si la disponibilité du mobile money sur le continent a permis aux populations de se procurer à elles-mêmes revenu et subsistance à travers l'entreprenariat. Le chapitre trouve que le mobile money contribue à l'expansion de l'entreprenariat dans les pays africains. Ainsi, en accroissant l'entreprenariat, le mobile money participe indirectement à la réduction du chômage qui est resté à un niveau relativement élevé malgré la croissance élevé qu'a connu le continent durant ces vingt dernières années. Alors, il est capital que les acteurs étatiques introduisent et renforcent des politiques visant à accroitre la disponibilité des services financiers digitaux pour les individus qui ont l'intention de se lancer dans l'entrepreneuriat ou ceux qui gèrent des entreprises. En plus, sachant que

l'entreprenariat offre la chance à certaines personnes d'avoir une activité génératrice de revenu et de sortir de la pauvreté, il est important que les gouvernements mettent en place des programmes visant à promouvoir l'esprit d'entreprise chez les individus en particulier les jeunes.

Le Chapitre 4 examine l'impact de la fiscalité sur l'utilisation des services financiers digitaux avec pour cas d'étude le Kenya. L'étude consiste à évaluer l'incidence fiscale de l'accise introduite en 2013 et augmentée en 2018 sur l'utilisation du Mobile Money avec le service M-Pesa. On note que l'impact de l'accise sur la valeur moyenne transactions est négative et ne se produit pas immédiatement. Ensuite, l'analyse souligne le fait qu'en dépit de la taxe, les consommateurs utilisent davantage le service M-Pesa pendant les périodes de crise, d'inflation et de récession économique. Ceci étant dit, les résultats obtenus révèlent le rôle déterminant joué par les taxes dans les décisions des consommateurs concernant les services financiers digitaux tel que le Mobile Money. Il est donc primordial que toute mise en place ou révision d'une taxe concernant ces services fasse l'objet au préalable d'un examen contrôlant les comportements de consommations des utilisateurs propre au pays.

Le chapitre 5 s'inscrit dans la continuité du chapitre 4, l'idée étant d'évaluer à la fois l'impact direct et indirect (passant par le Mobile Money même) de la taxe sur la demande de cash dans les pays africains. On fait l'hypothèse que la demande de cash se fait au détriment de l'adoption de la monnaie électronique sur le continent. Il ressort que la taxe entraîne une augmentation de la demande de cash et par déduction décourage l'adoption de la monnaie électronique. Cependant, en présence de la taxe, l'utilisation du mobile money a un impact négatif sur la demande d'argent liquide. En effet, l'utilisation du mobile money concernera davantage les paiements et la microfinance, des activités qui nécessitent nécessairement l'utilisation de la monnaie

électronique. Les résultats observés soulignent la nature embarrassante de la nouvelle taxe.

Pour aller plus loin, un chapitre complémentaire présenté en annexe s'intéresse à l'impact des Technologies de l'Information et de la Communication (TIC) sur la croissance économique des pays développés et en développement.

Mots clés : Inclusion financière; Services Financiers Digitaux; Politiques Fiscales; Croissance Economique; Entreprenariat; Afrique

JEL Codes : G2; H22; L26; O4; O55

SUMMARY

In developing countries, financial inclusion is a challenge, as it would help achieve some of the Sustainable Development Goals (SDGs), in particular the reduction of poverty and income and gender inequalities.

With the rise of digital technology, access to broadband connections and the democratization of cell phones, financial services such as "Mobile Money" have emerged. These digital financial services are touted as a way quickly and completely to achieve the goal of financial inclusion in developing countries. The main providers of these financial services in developing countries are mobile network operators, which are for tax purposes considered as part of a high value-added sector. Thus, the objective of tax administrations is to capture most of this value-added, even if it means subjecting these operators to specific tax codes. However, the introduction of taxes on digital financial services based on this sectoral value-added argument could harm the ability of operators to invest in equity and develop a financial activity.

Thus, the objective of this paper is to make a significant contribution to the existing literature on digital financial inclusion in developing countries, particularly African countries. The first part, consisting of chapters 2 and 3, deals with the economic issues of digital financial inclusion in developing countries. It examines the impact of mobile money accessibility and availability on economic policy objectives. The second part, also composed of two chapters (chapter 4 and 5), analyzes the impact of taxation on the use of digital financial services.

Chapter 2 focuses on the relationship between economic growth and financial inclusion in developing countries. The idea here is that financial inclusion leads to an accumulation of human and technological capital that has an impact on the economic growth of countries. The originality of the analysis is to account for the contribution of

mobile money to economic growth. To do so, an empirical reflection based on a dynamic endogenous growth model allows us to identify the nature of the relationship between financial inclusion (formal and digital) and growth. Based on a panel of 57 developing countries for a period from 2007 to 2017, the model suggests a positive impact of financial inclusion on growth. It also reveals that the contribution to growth of digital financial inclusion via mobile money is higher than that of formal inclusion with commercial banks in developing countries. These results underscore the need for governments to put in place policies to encourage telecommunications companies to invest in and promote this digital activity.

Chapter 3 considers mobile money as a key factor in business creation in Africa. The question is whether the availability of mobile money on the continent has enabled people to provide themselves with income and livelihood through entrepreneurship. The chapter finds that mobile money is contributing to the expansion of entrepreneurship in African countries. Thus, by increasing entrepreneurship, mobile money indirectly contributes to the reduction of unemployment, which has remained at a relatively high level despite the high growth the continent has experienced over the last twenty years. Therefore, it is crucial that state actors introduce and strengthen policies aimed at increasing the availability of digital financial services for individuals who intend to engage in entrepreneurship or run businesses. In addition, given that entrepreneurship offers a chance for some people to have an income-generating activity and escape poverty, it is important that governments put in place programs to promote entrepreneurship among individuals, especially youth.

Chapter 4 examines the impact of taxation on the use of digital financial services with Kenya as a case study. The study assesses the tax impact of the excise tax introduced in 2013 and increased in 2018 on the use of mobile money with the M-Pesa service. It is noted that the impact of the excise on the average transaction value is negative and

does not occur immediately. Second, the analysis highlights the fact that despite the tax, consumers use M-Pesa more during periods of crisis, inflation and economic recession. That said, the results reveal the critical role that taxes play in consumers' decisions about digital financial services such as mobile money. It is therefore essential that any introduction or revision of a tax on these services be subject to a prior review of country-specific user behavior.

Chapter 5 follows on from chapter 4, the idea being to assess both the direct and indirect (via mobile money itself) impact of the tax on the demand for cash in African countries. It is assumed that the demand for cash is at the expense of the adoption of electronic money on the continent. It is found that the tax increases the demand for cash and therefore discourages the adoption of e-money. However, in the presence of the tax, the use of mobile money has a negative impact on the demand for cash. Indeed, the use of mobile money will be more related to payments and microfinance, activities that necessarily require the use of e-money. The observed results highlight the embarrassing nature of the new tax.

To go further, a complementary chapter presented in the appendix looks at the impact of Information and Communication Technologies (ICT) on economic growth in developed and developing countries.

Keywords: Financial inclusion, Digital Financial Services; Tax policies; Economic growth; Entrepreneurship; Africa

JEL Codes: G2; H22; L26; O4; O55

CONTENTS

Déclaration V

Remerciements VII

Résumé 1

Summary 5

Contents 8

List of Tables 11

List of Figures 13

General introduction 15

1 Measuring Economic Development 16
2 Poor Countries ; Rich Countries 17
3 Poor People ; Rich People 19
4 Financing for development 21
4.1 Public or Private 22
4.2 Personal Resources 24
5 Financial Inclusion, a development issue 26
6 Contributions of the thesis 30
7 Outline of the thesis 32
Bibliography 34

Part i: Digital Financial Inclusion, A Real Economic Development Stake: Implications For Growth And Employment 41

Financial Inclusion And Economic Growth: Evidence In The Digital Environment Of Developing Countries 42

1 Introduction 43
2 Empirical Strategy 48
2.1 Data 48
2.2 Model Specification 49
3 Empirical Results 52

4 Robustness Test 54
5 Conclusion 56
Bibliography 58
Appendix to chapter 2 62
1 Supplementary Figures 62
2 Supplementary Tables 70

Mobile Money Services Adoption and Entrepreneurship in Africa 74

1 Introduction 76
2 Data and Identification Strategy 82
3 Econometric Strategy and Results 86
3.1 Econometric Strategy 86
3.2 Estimation Results 89
4 Heterogeneity Tests 92
4.1 Effect According to Firm Size 92
4.2 Effect According to Environmental Entrepreneurship 94
5 Conclusion 98
Bibliography 99
Appendix to chapter 3 103
1 Supplementary Tables 103

Part ii: Tax Environment And Its Implications For Digital Financial Inclusion In African Countries 106

The Pass-Through of Mobile Money Taxation on Transactions Value in Kenya 107

1 Introduction 108
2 Country overview of Kenya 110
3 Kenya's M-Pesa 112
4 Previous studies on the pass-through 115
5 Estimation method 118
6 Estimation results 120
7 Conclusion 128
Bibliography 129

E-money, Financial Inclusion and Mobile Money Tax in Sub-Saharan African Mobile Networks 134

1 Introduction 135
2 Telecom Taxation Regime 140
3 Mobile Money Users 143
4 Empirical Evidence 147
4.1 Data 147
4.2 Model Specification 148
4.3 Results 150
4.4 Sensitivity 152
4.5 Robustness 153
5 Discussions 154
6 Conclusion 156
Bibliography 158

General conclusion 161

To Go Further! 166

ICT and Economic Growth in Developed and Developing Countries: A Panel Data Approach 167

1 Introduction 168
2 Data, variables and method 170
3 Empirical results 174
3.1 Baseline results 174
3.2 Return to ICT 176
4 Additional Analysis 178
4.1 Heterogeneity 178
4.2 GMM Estimation 181
5 Conclusion 183
Bibliography 184
Appendix to extension 187
1 Supplementary Tables 187

LIST OF TABLES

Table 1. Sample Countries 49

Table 2. Descriptive Statistics 52

Table 3. Impact of Formal and Mobile Inclusion on Growth 70

Table 4. Sensitivity Test for Robustness 71

Table 5. Stability Test for Robustness 72

Table 6. Overview of the dependent and independent variables 85

Table 7. Main results 92

Table 8. Results by firm size and sector of activity 94

Table 9. Results considering environment entrepreneurship 97

Table 10. Probit estimation results 103

Table 11. OLS estimation results 104

Table 12. Key figures of Kenya 112

Table 13. Taxes on mobile services in eleven countries 142

Table 14. Sample Countries 147

Table 15. Summary Statistics 148

Table 16. Currency demand estimations 151

Table 17. Sensitivity of variables of interest 153

Table 18. Robustness tests 154

Table 19. Summary statistics and sources 170

Table 20. Effect of ICT on growth 175

Table 21. Returns to ICT 177

Table 22. Effect of ICT on growth: case of developed countries 179

Table 23. Effect of ICT on growth: case of developing countries 180

Table 24. Effect of ICT on growth: GMM estimation 182

Table 25. List of developed countries 187

Table 26. List of developing countries 188

Table 27. Heterogeneity by income sub-group 189

LIST OF FIGURES

Figure 1. Banking rate in developing countries 27

Figure 2. Mobile phone subscriptions per 100 inhabitants 29

Figure 3. Relation between Financial Growth, Financial Inclusion and Consumption Growth 45

Figure 4. Relation between Financial Growth, Financial Inclusion and Capital Growth 46

Figure 5. Scree plot of eigenvalues for the synthetic index with PCA 62

Figure 6. Index's variables loading to component 1 and 2 63

Figure 7. Observation loading to component 1 and 2..... 64

Figure 8. Correlation between Formal Inclusion and Economic Growth 65

Figure 9. Correlation between Mobile Inclusion and Economic Growth 66

Figure 10. Trends in Active Mobile Money Account and Financial System Deposit.. 67

Figure 11. International Comparison with Indicators of Formal Inclusion..... 68

Figure 12. Mobile Inclusion According to Continent 69

Figure 13. Main reasons establishment use Mobile Money for financial transactions 79

Figure 14. Mobile Money usage status by firm size 83

Figure 15. Average changes in Safaricom M-Pesa's transaction charges 115

Figure 16. Linear impulse responses result..... 122

Figure 17. Nonlinear impulse responses: Inflation level 124

Figure 18. Nonlinear impulses responses: GDP per capita growth rate..... 126

Figure 19. Nonlinear impulse responses: seasons..... 127

Figure 20. African Countries with Tax on Mobile Money Activities..... 139

Figure 21. Business usage frequency of Mobile Money..... 144

Figure 22. How often household send or receive Mobile Money..... 145

Figure 23. Most used means of sending and receiving money 146

Figure 24. Correlation between Investment and GDP..... 172

Figure 25. Correlation between Consumption and GDP 172

Figure 26. Correlation between ICT uses and GDP 173

GENERAL INTRODUCTION

The birth of development economics as a discipline dates back to the post-World War II period, with the decline of colonial empires. The question of development was already present at the creation of the World Bank and the International Monetary Fund following the Bretton Woods agreements in 1944. This new economic discipline is interested in the specificities of countries qualified as "poor". It is therefore established based on a geographical border according to the degree of wealth.

Development economics seeks to provide answers to three concerns:

- How is development measured?

- Why are some countries poor and others rich?

- Why are some people poor and others rich?

The study of these three questions is all the more important because the classification of countries according to their level of development has economic implications (developing countries benefiting from grants, occasional credits at zero interest) and because poverty influences the conditions under which individuals make decisions and thus the nature of their decisions

1 Measuring Economic Development

The measurement of development has undergone many changes from the 1950s to the present day. In the 1950s, economic development was equated with economic growth. In such a context, the aggregates of national accounting are used to measure the development of an economy. The GDP became the ultimate indicator of development and has remained so to this day. It is used to measure the economic progress of a country, to assess the gap to be closed and to make international comparisons. At that time, the main difficulty for a country aspiring to development was to achieve technical capital; consequently, the need to finance an economy was measured according to the twin deficits theory (Mundell 1963; Fleming 1962).

From the end of the 1960s to the beginning of the 1980s, social concerns emerged. The economist Abramovitz (1959) had long before this period questioned the use of GDP as a measure of the general well-being of a society. For him, long-term changes in the growth rate of well-being could not be measured, even approximately, by changes in the growth rate of production. Subsequently, economists such as Pearson (1969), the limits of development models based on the primacy of capital. Several simple social indicators have been constructed to measure development and to integrate a number of concerns. These indicators include access to drinking water, the malnutrition rate (FAO), life expectancy at birth and the literacy rate.

Then came the 1980s with the wave of structural adjustments. Social indicators gave way to macroeconomic indicators. Henceforth, developing countries had to reduce their budget or trade deficits, lower their inflation rates and improve their balance of payments. Only that from the end of the 1980s to the beginning of the 1990s, it was the

end of the adjustments that were the subject of much criticism. As for the World Bank, it developed a particular interest in poverty.

Thus, from the 2000s, development indicators measure poverty, inequality, gender and the environment. The United Nations will develop the Millennium Development Goals (MDGs), which will be followed by the Sustainable Development Goals in 2015. The Stiggliz commission gives a certain number of recommendations, which ask in the measurement of development to consider more the aspect of income than production, to widen the notion of income to non-market activities, to use micro data in particular following a survey.

From the above, we can see that the measurement of development remains highly contextualized in the sense that the evolution of this measure is linked to the context in which development is apprehended. However, based on the recent Nobel Prize award to Banerjee, Duflo and Krener, the level of poverty remains the main instrument for measuring development.

2 Poor Countries ; Rich Countries

To the question of why some countries are poor while others are rich, development economics provides both economic and non-economic causes. The basis of the theory dealing with the economic causes of underdevelopment rests on the work of Lewis (1954) with the theory of dualism, which refers to the coexistence of a subsistence sector and a capitalist sector. For the latter, developing economies would be characterized by a surplus of unproductive labor in the subsistence sector. Under these conditions, these economies would manage to develop, and move from a dual economy to an integrated economy, through a mechanism of transferring surplus labor from the subsistence sector to the capitalist sector thanks to opportunity costs.

Underdevelopment has been considered as backwardness. The most famous author defending this reasoning was Rostow (1960) with his 5 stages for economic development. He argues that the backwardness of the developing countries results from the fact that the diffusion of technical progress and the industrial revolution has not yet reached these countries. We can therefore already deduce that the development of these economies will go through a phase of industrialization. Industrialization allows the generation of economic growth in order to catch up (Maddison, 2001; Maddison, 2007; Szimai 2012).

For some economists, the observation of poor countries results from the existence of relations of domination and dependence between countries. Myrdal (1959) considers underdevelopment as an inequality of resource distribution. In fact, the market leads to an economy moving away from equilibrium through the effects of backwardation and propagation. Thus, free trade would favor the developed countries, which would develop more, and would ruin the poor countries, which would specialize in disadvantageous primary activities. According to Prebisch (1963), underdevelopment is the product of the relationship of domination in the relations of production. The rich countries organize the exchanges according to their interests. The international trade system has allowed rich countries to maintain their hegemony over the poor countries.

As for the theoretical non-economic causes of underdevelopment, we can identify historical, political, institutional and legal factors. Historically, Europe's desire for conquest and expansion led to colonization. Today, many poor countries are counted among those that were colonized during this period. For some researchers, colonization is to blame because long before it these colonized countries had developed an advanced civilization with the creation of compasses, the practice of mathematics.

However, after this episode of colonization, these great civilizations entered phases of decline making them poor economies. For Acemoglu et al (2001, 2002) show, that Africa's relative poverty at the end of the twentieth century is due to European settlement for extractive purposes during colonization.

In the wake of the negative impact of colonization are institutions. North (1981, 1989, and 1990) already indicated that the fundamental cause of the development of an economy lay in the choice of its institutions, in the sense of the rules of play in society. The way people decide to organize themselves in society conditions development. Sachs (2003) and Carstensen and Gundlach (2006) demonstrate that the institutions present in poor countries are one of the main reasons for their underdevelopment.

3 Poor People ; Rich People

The question of income inequality between populations is a subject of great interest in economics, even beyond development economics. The classics, led by Smith (1776) and Ricardo (1891), indicated that income inequalities between individuals were the result of production relationships. Indeed, the relations of production determine the social relations that lead to the creation of three social classes, namely landowners, capitalists and workers. In such a context, one found oneself with the workers at the lowest level of the hierarchy while the latter provided all the wealth of the economy. Access to capital and land determines the income that individuals can aspire and thus their living conditions. For Smith and Ricardo, social relations defined in this way would lead to a harmonious society, whereas for Marx, these relations would rather lead to a conflictual society, as workers could not bear to continue being exploited.

However, development economics has provided some answers to the question of income inequalities. Kuznets (1955) is one of the theorists who have contributed enormously to this field of research. In particular, he was interested in the question of whether the level of development of a country determines the level of inequality among its population. Kuznets' hypothesis is that inequality arises from the moment the economy begins to develop by embarking on a process of industrialization. Inequalities will concern two classes, namely farmers and workers, who will have the highest incomes. Thus, at the beginning of industrialization, the incomes of workers will increase in relation to those of farmers, and these differences will continue to grow with the appearance of a growing specialization among workers. Following this line of reasoning, inequalities are shown to arise from the specializations of individuals. We can continue the analysis by indicating that individuals' specializations may be constrained by access to financial resources that will allow individuals to finance training for specialization. Indeed, income inequality can influence the behavior of income groups but also the interactions between these different income groups (Voitchovsky, 2005). Does the profile of income inequality matter for economic growth? Inequality can influence the behavior of income groups insofar as inequality means an increase in the income of the rich. The rich, by saving more in financial institutions, have the economic power to lobby against policies that are contrary to their interests, such as investments in public health and education. The result would be poor people who are unable to benefit from good education and health facilities that would allow them to leave their situation of poverty.

Second, inequality can affect the interactions between different income groups because in an unequal society, the network of social relations of individuals is generally restricted to their income group. Under these conditions, the poor will not be able to

help or expect help from individuals in their network who are themselves poor to find work or get loans. Similarly, wealthy groups may use their social networks to exclude outsiders from economic opportunities and keep them to themselves.

These facts can lead to mechanisms of self-perpetuating poverty that were first suggested by Nurkse (1953). For Nurkse, poverty is self-perpetuating because of a series of vicious circles. He distinguishes three vicious circles that make it impossible for the poor to hope for a better situation, all other things being equal. According to the first circle, poverty translates into low income, which leads to low savings, which does not allow for investment or low investment, which results in low capital accumulation that does not allow for an increase in productivity and therefore income.

The second circle stipulates that the low income through which poverty is translated lead to insufficient food, which in turn will lead to low productivity of the poor, which will result in low income.

Finally, in the third vicious circle, low income leads to weak demand, which in turn leads to narrow markets, which in turn leads to a lack of opportunities, which in turn leads to a low level of investment, which does not allow for increased productivity and income. In order to break these vicious circles, Nurkse advocates an influx of external resources that will allow the stock of technical capital and productivity to increase. Thus, with the increase in capital and productivity, one can observe an increase in income, demand and then internal investment, which allows the poor to see their conditions improve and to put the country on the path to development.

4 Financing for development

Development economics is not only a positive approach. Indeed, the latter makes normative proposals that lead to practical recommendations. The normative proposals

relate to the financing of development. Indeed, the process of economic and social development is conditioned by the obtaining of financial resources, whether public or private and personal. Schumpeter (1982) emphasizes that access to finance is a determining factor in the development of an economy. Indeed, these resources will make it possible to finance the innovation that promotes the impetus of the economic system. Financial resources are at the heart not only of the growth process, but also of the process of more important structural transformations.

4.1 Public or Private

The fiscal space available to economies to finance their development is based on three essential components, namely domestic public resources, external and internal financing resources and improved efficiency of public spending.

Domestic public resources are more concerned with tax revenues insofar as taxes do not have to be paid back, not all countries have exploitable natural resources and the exploitation of natural resources is likely to have negative effects (as in the case of Dutch disease). In this respect, knowing that tax revenues come with a social cost, it is necessary that they be based on an effective, even efficient and equitable tax system in order to optimize the mobilization of these revenues. However, these conditions are too often not met in developing countries. Indeed, a large share of tax revenue in developing economies comes from tariffs, which are not basically tax mobilization instruments but rather trade policy instruments for protectionism (Baunsgaard and Keen, 2010). Tariffs serve to protect infant industries by introducing distortions. Second, VAT, a neutral tax with strong tax mobilization potential, is weakly enforced and often misapplied in developing economies. Poor implementation of the VAT collection mechanism leads to the VAT becoming a sales tax that relatively increases the tax burden on the consumer and reduces tax revenues. Unfortunately, this is

generally the case in developing economies, even though the VAT has a large tax base. Finally, we have a corporate tax that evolves in economies marked by a large informal sector. Albertini et al (2020) estimate the rate of informal employment at 20% in Eastern Europe, over 60% in Central America and over 80% in West Africa and Southeast Asia. In the end, we end up with a minority that ends up paying the tax. The current debate is whether to continue to tax the company or rather the owners of these companies, because in the end the company is only an instrument.

The mobilization of external and internal financing resources is based on grants, loans, money creation and Foreign Direct Investment (FDI). Grants are usually the source of a relationship of political dependence. They can be very vulnerable, especially if the donor is more unstable than the recipient is. In addition, developing countries have had to deal in recent years with the failure of foreign donors to keep their promises.

As for borrowing, it assumes the existence of a developed and efficient banking system. However, the government must borrow to some extent because there are dangers to borrowing. When borrowing is national, it can crowd out private investment. Whether the borrowing is domestic or international, interest rates can rise and increase debt service. As for seigniorage, it is an important resource. However, this instrument requires caution because it generates inflation that affects the poor more when it is used beyond the demand for cash.

FDI leads to an increase in the capital stock of the receiving country, which should lead to an increase in productivity. In doing so, the receiving country does not have the possibility to direct it to sectors that are deemed crucial for poverty reduction. In addition, there may be downward tax competition (Wildasin 1986; Wilson 1986) and

the granting of multiple exemptions by developing countries in order to attract the most FDI.

Finally, the most important issue in managing fiscal space is the efficiency of public spending. Although there are significant constraints and obstacles, including the presence of entrenched systems of corruption and an addiction to mismanagement (Banerjee 1997; Olken and Pande 2012), the efficiency component of fiscal space is promising in many developing countries.

4.2 Personal Resources

The idea here is to provide poor people with financial resources that will enable them to take control of their own destiny. This approach is commendable and has the merit of being able to mobilize surplus domestic savings over the long term. To date, the two components of this approach are microfinance and migrant remittances.

Microfinance is generally seen as a means of achieving better allocation of capital, encouraging and monitoring investments. This concept reinforces the spirit of enterprise and productivity by relying on notions of self-resilience or the Gandhian concept of swadeshi (Rist 1996). Microfinance, in addition to adding value to individual and national incomes, contributes to higher levels of physical capital accumulation in the sense that it supports (micro)entrepreneurs and their families and allows for an allocation of savings to education that facilitates and allocates savings (Lopatta and Tchikov 2017). In doing so, knowing that microfinance is a means of savings and insurance, its impact in terms of reducing the level of unemployment through job creation is relativized in practice. In addition, with the recent growth in the institutionalization of microfinance programs, there is a risk that these new institutions will focus on the profitability of capital, thus diverting it from the poorest and from its main objective of fighting poverty. Indeed, Cull et al (2007) provide

empirical evidence that microfinance institutions that have managed to achieve profitability while having a meaningful business relationship with poor and low-income borrowers are the exception. Few institutions are able to achieve both the ultimate promise of microfinance and a return on capital.

Remittances are an instrument for poverty alleviation in that they contribute to an increase in the income level of recipient households, which are generally poor households in developing countries. Thus, developing countries with higher labor migration have relatively lower poverty rates because of the remittances they receive (Adams and Page 2005) In addition to providing access to amenities, these remittances are a resiliency factor for migrant families following agricultural shocks and armed conflicts (Azam and Gubert 2004; Lindley 2009). This being said, the positive impact of remittances in terms of poverty reduction is not necessarily proven for two reasons. First, given that, migration has to be financed and that in the current context the financial costs of migration are high, individual migrants in developing countries are now coming from wealthy households (Ebeke and Le Goff 2010). Thus, remittances do not go to poor households but rather to households that further increase income inequality. Second, in order to increase the funds received from migrants, recipient countries may specialize in exporting migrants, causing a kind of Dutch disease that has a negative impact on their economies. This would also result in funds being allocated solely to consumption, thereby excluding education spending, for example (Adams et al 2008).

In a context marked by insufficiently efficient tax systems, the failure of foreign donors to keep their promises, unsustainable financing and the questioning of the positive impact of certain resources on development, the question of financing for development is still as acute as ever (Monterrey Conference in 2002; Doha Conference

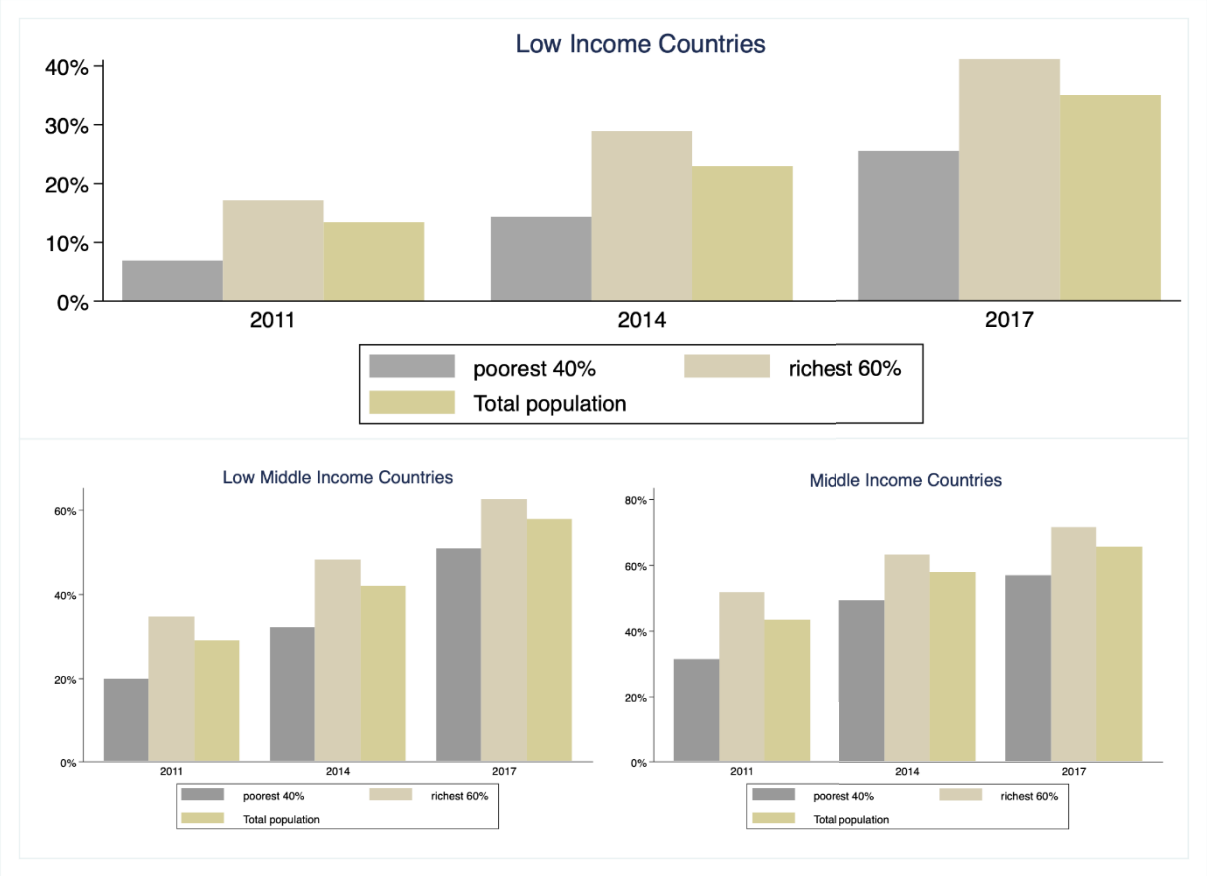
in 2008; Addis Ababa Conference in 2015). It is now more crucial than ever to understand how financial resources and mechanisms can contribute to poverty reduction and how development can be financed more effectively.

5 Financial Inclusion, a development issue

According to Triki and Faye (2013), financial inclusion is defined as "all initiatives that make formal services available, accessible, and affordable to all segment of the population. Access to basic financial services means access to a basic current account, credit, savings, insurance, and transfers. Thus, the institutions providing these services will be commercial banks, cooperatives, financial and monetary institutions, insurance companies and with the recent technology boom, mobile network operators. This concept therefore encompasses everything related to bancarization, microfinance and microcredit. Access to a transaction account is a first step towards broader financial inclusion, as a transaction account allows individuals to store money, send, and receive payments. A transaction account can also serve as a gateway to other financial services. The World Bank's Universal Financial Access 2020 initiative focuses on ensuring that citizens around the world have access to a transaction account.

Financial inclusion is a real development issue in the sense that it provides a new alternative to developing countries for financing development and participates beyond the financial aspect in achieving the objective of social inclusion. Indeed, according to GSMA (2019), the financially excluded populations are women, the poor and the disabled. This financial constraint is often an obstacle for them to access basic services such as health, education, electricity and employment. Second, financial inclusion, by promoting access to finance, enables individuals to pursue personal or professional projects and businesses to invest, innovate and hire.

Figure 1 shows the evolution of the level of banking in developing countries. In 2017, less than 40% of the working population had a bank account. The poor represent the stratum of the population most excluded from the banking system, regardless of the level of development. Financial inclusion would therefore be an issue for both emerging and developing countries. In doing so, countries at relatively higher stages of development have relatively high rates of banking.



Source: Global Findex, World Bank; Author's calculation

As mentioned above, financial inclusion is not just about formal banking inclusion. Indeed, the last 20 years have seen the emergence of new digital financial services such as mobile money and online banking. Digital financial services are defined as all financial services that can be accessed through digital channels, including transfers, payments, credit, savings and insurance. Digital services have a strong potential for financial inclusion, especially in developing countries. These services have the advantage of reducing informational costs, transaction costs, and allowing households to have better risk sharing (Jack and Suri 2014).

A perfect example is M-PESA, a cell phone payment, money transfer and micro-finance service launched by the Vodafone Group. The service was initially launched in March 2007 in Kenya, and is now expanded to other countries such as Ghana, Mozambique, Lesotho and Tanzania.

The conditions seem to be right for these services to be successful in developing countries. Figure 2 shows the progress of cell phone subscriptions per 100 inhabitants in developed and developing countries from 2005 to 2020. Overall, there is a steadily increasing trend. In doing so, while this growth is increasingly slowing in developed countries, it is increasingly rapid in developing countries. These rapid subscriptions in developing countries bode well for the adoption of digital financial services that require a cell phone. The global spread of cell phones and digital financial technology in general have facilitated the expansion of access to low-cost, low-risk financial services to populations and businesses excluded from the traditional system.

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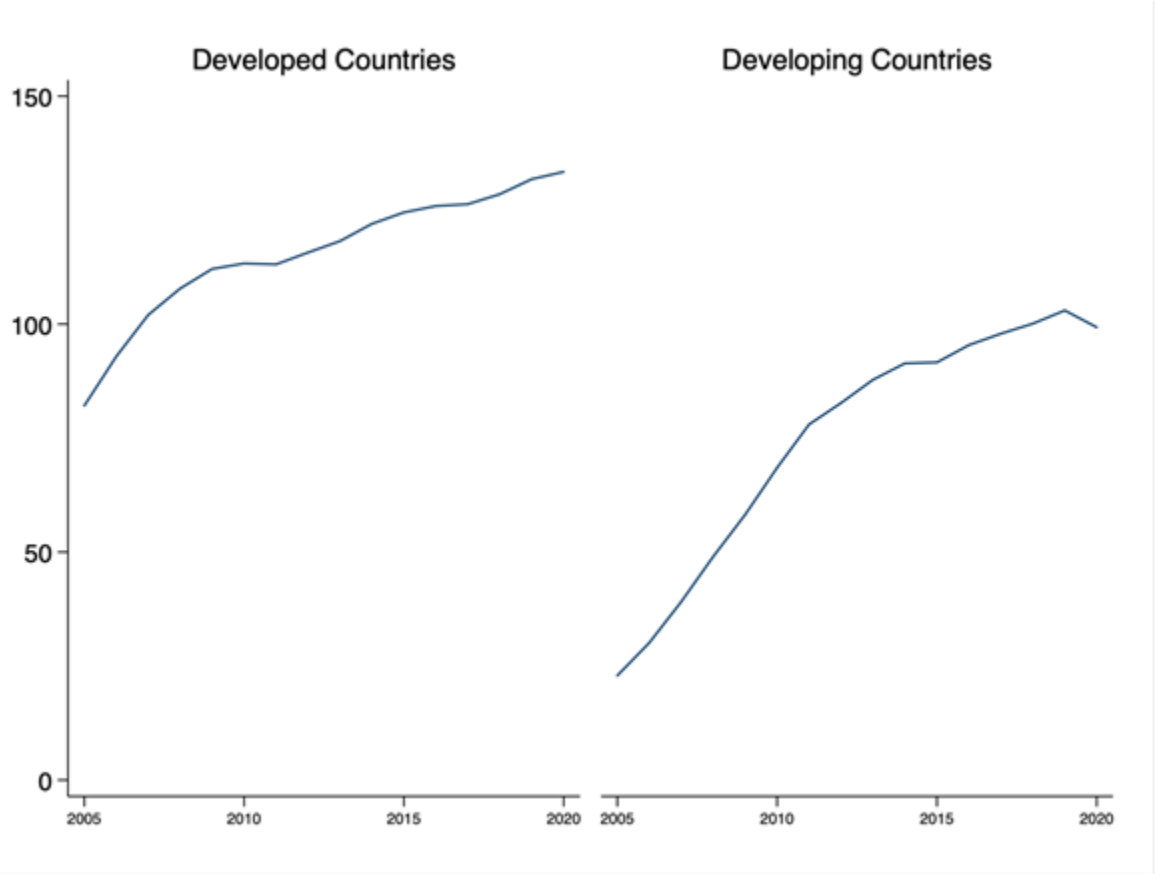

Source: ICT indicators, International Telecommunication Union (ITU)
Author's calculations

□

However, NRMs are among those companies that are relatively more taxed. The justification put forward for this is that these firms operate in high value-added sectors. Rota-Graziosi and Sawadogo (2020) provide evidence that the tax burden borne by a mobile network operator is relatively higher than that of a gold mining company in some African countries. The comparative tool used to support such a claim is the average effective tax rate (AETR), which is designed to take into account both general and sectoral taxes. In doing so, unlike sectors such as mining, which generate exogenous value added, the mobile communications sector generates endogenous value added that decreases with government connections and pro-competitive policies (Faccio and Zingales, 2017). Under these conditions, the legitimacy of some taxes specific to the mobile communications sector may be questioned. Second, the tax

burden borne by mobile network operators could undermine the provision of lower-cost digital financial services and the ability of these companies to invest in these services with their own funds. These facts could therefore be an obstacle to the advancement of financial inclusion processes in developing countries.

Thus, a simplified, consistent and stable tax framework should promote full financial inclusion that will reduce poverty, enable investment and increase productivity. First, simplicity is essential to ensure the legibility and transparency of the tax system and to facilitate its application. Second, homogeneity avoids discretionary decisions and de facto partly discourages rigorous tax optimization by firms. Finally, with regard to stability, it should be noted that economic operators focus their efforts on lobbying for new protection rather than on restructuring their activities only when they are not convinced of the sustainability of the new direction of the country's financial strategy.

6 Contributions of the thesis

This thesis is of both academic and political interest. From an academic point of view, it contributes to the economic literature and to the debate on financing for development. Indeed, given that digital financial inclusion is a recent concept, the theoretical literature is more concerned with the impact of financial development and formal financial inclusion on macroeconomic and microeconomic aggregates (Schumpeter, 1982; Goldsmith, 1969; Levine, 2005; Ji et al, 2014; Karpowicz, 2016). It is only since the 2000s that work has emerged addressing financial inclusion as a tool for financing development. The ensuing debate pits the dominant positive view and the negative view. The positive view argues that financial inclusion has a positive impact on economic development (Mihasonirina and Kangni, 2011; Swamy, 2014;

Lenka and Sharma, 2017; Sethi and Acharya, 2018; Kim et al, 2018). In contrast, the negative view supports a negative impact on the basis that the financial development needed to have a positive impact is not yet achieved in these countries (Pearce, 2011; Barajas et al, 2016; Arestis et al 2018). In doing so, little academic work assesses the developmental financing opportunities offered by digital financial services. The results of our work point to a positive impact of digital inclusion on economic development in developing countries. We find a positive impact of digital financial inclusion, but also formal financial inclusion, on economic growth and employment.

From a policy perspective, it should be noted that since 2010, more than 55 countries have made commitments to financial inclusion and have launched or are in the process of developing a national (Kenya) and regional (WAEMU) strategy. Thus, for these strategies to succeed, it is essential that countries have strong political commitment and coordination among relevant public and private actors and are able to create an enabling environment and broad-based policies that promote responsible financial access, financial capability, innovative products, and high-quality data to inform strategy development. The thesis assesses the impact of tax measures on advancing the digital financial inclusion process in African countries. Based on these impact assessments, we make policy recommendations that these countries can implement to create an enabling environment for the success of their total financial inclusion strategies while improving their level of tax resource mobilization.

7 Outline of the thesis

In short, this thesis aims to advance knowledge on financial inclusion, adoption of new technologies, and the tax impact on the use of digital services from a development finance perspective in developing countries.

To this end, the objectives of our dissertation are expressed in two parts. The first part of this dissertation addresses the economic issues of digital financial inclusion. We examine the role played by the use of digital financial services in achieving two economic policy objectives in developing countries. Specifically, we look at the relationship between the Mobile Money and economic growth and the relationship between Mobile Money and entrepreneurship in African countries. Therefore, the first chapter of this section revisits the relationship between financial inclusion and economic growth by presenting separately the contribution of traditional financial inclusion and digital financial inclusion with Mobile Money (chapter 2). The rationale for choosing the objective of economic growth is that growth allows for the financing of the economy and, above all, for considering social needs (education, justice, health, etc.). The second chapter (chapter 3) examines whether Mobile Money contributes to entrepreneurship in Africa. Entrepreneurship contributes to the achievement of the objective of full employment that, in addition to ensuring high productivity, would partly reduce the high concentration of unemployment in certain already disadvantaged categories of the population (young people, low-skilled, ethnic minorities). Entrepreneurship thus has the merit of reducing the differences and tensions between social groups that can eventually constitute a source of political instability harmful to the economy as a whole (social cohesion, delinquency).

The second part of this thesis is devoted to the impact of the tax environment on the evolution of digital financial services. Indeed, knowing that the main providers of digital financial services in African countries are Mobile Network Operators, a large number of African governments have introduced excise taxes to tax these digital services. The argument put forward for the introduction of a tax is the realization of value added by the operators in the provision of these services. Thus, the first chapter (chapter 4) of this second part will examine the impact of taxation on the use of digital financial services in Kenya. Specifically, it will assess the Pass-Through of the excise introduced in 2013 and increased in 2018 on the use of mobile money with the M-Pesa service. The chapter also analyzes the level of use of Mobile Money consumers following the tax according to the level of inflation, the evolution of the economic growth rate and the seasons (festive periods, school opening). To conclude this section (chapter 5), the second chapter, which follows on from chapter 4, assesses both the direct and indirect (with Mobile Money) impact of the tax on the demand for cash in African countries. We assume that the demand for cash is at the expense of the adoption of electronic money.

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PART I:

DIGITAL FINANCIAL INCLUSION, A REAL ECONOMIC DEVELOPMENT STAKE: IMPLICATIONS FOR GROWTH AND EMPLOYMENT

Financial Inclusion And Economic Growth: Evidence In The Digital Environment Of Developing Countries

Abstract

The paper focuses on the relationship between economic growth and financial inclusion in developing countries. One of the main innovations of the analysis is to report on the contribution to growth of new digital financial services such as mobile money. In order to do this, we realize an empirical estimation using Generalized Method of Moments (GMM) with 57 countries over the period 2007-2017. We evaluate impacts of traditional and digital inclusion on growth. The results confirm the positive impact of financial inclusion on growth. For formal inclusion, estimators reveal that the financial system deposits contributes to growth in developing countries. Concerning digital inclusion, we note that active mobile money account has a higher positive impact on growth than that of traditional inclusion.

Keywords: Endogenous growth, financial inclusion, Mobile Money, GMM system

JEL Code: O16, O30, O40, G21, G23, C23

1 Introduction

The development of an economy refers to the set of technical, social and cultural transformations that accompany the growth of production. In other words, economic development is a set of positive evolutions in the structural changes of a country.

In this way, the process of economic and social development is conditioned from the outset by the availability of financial resources. Thus, the question of financing development arises: Where to obtain sufficient resources to finance development? This is where the financial system comes into play, particularly commercial and investment banks. Indeed, through their financial intermediation function, banks collect savings and grant credits to major actors in the development of the economy (State, Industries, SMEs). The contribution to the development of this activity of the banks was very early underlined in economy.

Schumpeter (1982) already argued that this link is reflected in the impact of bank credit on economic growth. He points out early that "financial services such as savings mobilization, project evaluation, risk management, advice to managers of industrial and commercial companies, supervision and simplified settlement of domestic and international transactions... are essential for technological innovation and development". King and Levine (1993) reinterpret Schumpeter's idea by emphasizing the importance of innovation through the pace of capital accumulation and factor productivity. From this point of view, financial systems would make it possible, on the one side, to channel savings towards more productive uses and, on the other side, to diversify the various risks associated with productive activity. Levine (2005) pushes the reflection on causality by underlining the existence of a coevolution of finance and growth. In his view, the financial system would be able to provide different services at

different steps of economic development, as the system would have to evolve if growth was to continue.

That being said, while it is clear that banks play a fundamental role in mobilizing resources for development, it should be noted that the mobilizing capacity of banks remains constrained by the level of accessibility of the population to the banking system. In fact, bank penetration rates are still low in most developing countries. A significant portion of national savings thus escape the banking system. Among this unbanked population in developing countries, there is a minority that voluntarily decides to invest in assets or hoards its assets in cash. Among the unbanked population, there is a majority who are excluded because of high collateral levels and lack of financial literacy. The banking system in developing countries is thus less efficient since national savings are not invested for the benefit of growth through the financing of public spending, individual projects and business projects.

In this context, financial inclusion is now presented as a new financing stake for developing countries. The financial inclusion is the provision of low cost basic financial and banking services to all agents of the economy, the latter having on average a utility in these services offered.

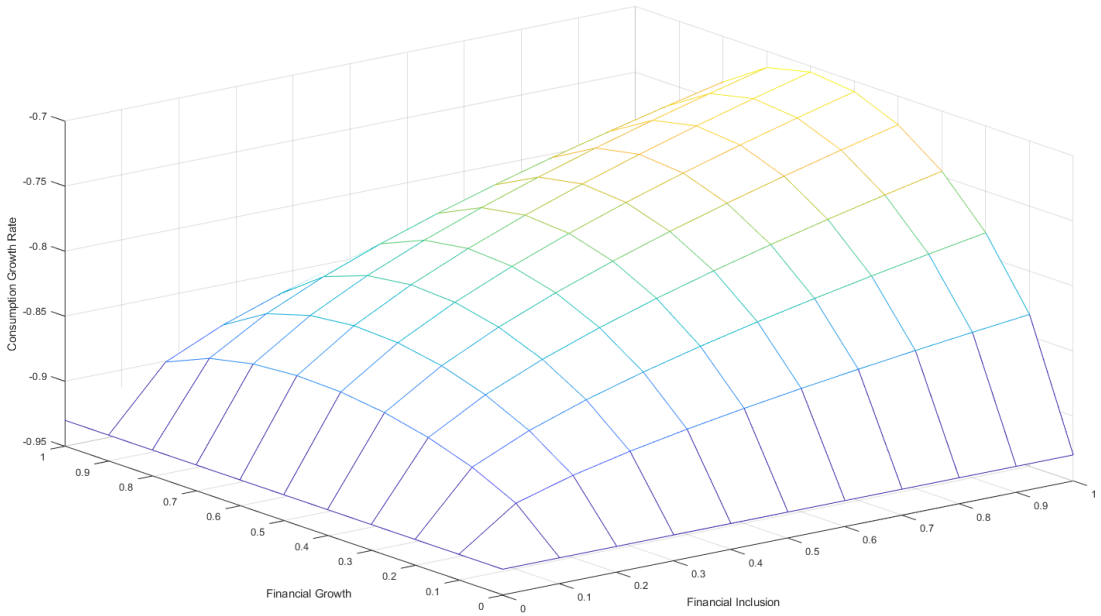
Financial inclusion has been identified as an enabler for some objectives[1] of the 17 Sustainable Development Goals adopted by the United Nations in September 2015 until 2030. The theoretical argument is that financial inclusion lead to economic growth. This economic growth comes from the stimulation of consumption through the accumulation of human and technological capital. Thus, previously financially excluded individuals, once included, will have access to resources that will allow them

[1] Financial Inclusion contributes to the poverty elimination, the reduction of gender inequalities, the reduction of hunger and then some more

to invest in their education and health, which in turn will lead to increased labor productivity. Productivity being stimulated, the country has the capacity to innovate and/or to incorporate innovations into the production process, and growth is generated.

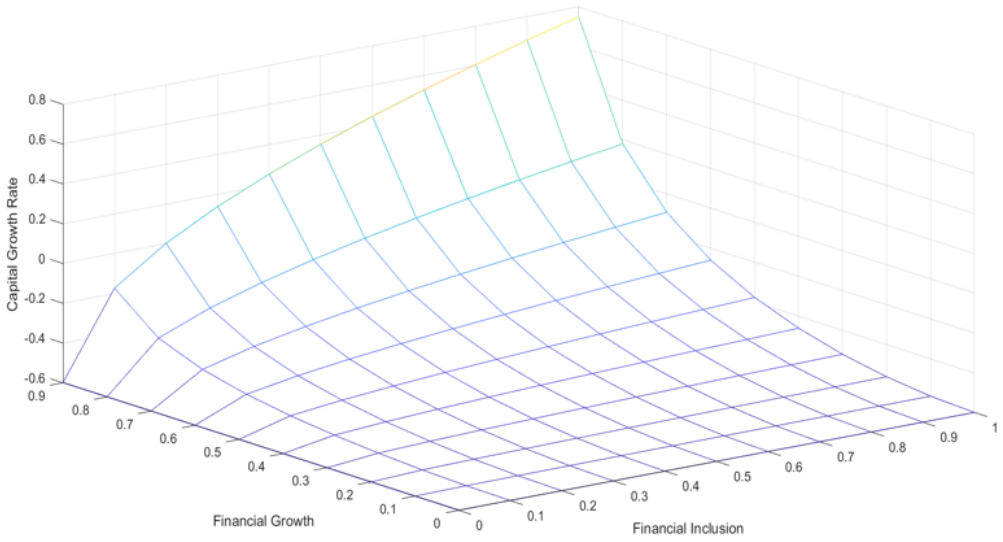
As far the accumulation of technological capital as concerned, individuals once included will be able to invest in research and development which leads to the birth of new processes allowing an improvement in productivity and a decrease in unit costs of production. It should also be noted, of course, that the self-sustaining character of growth resides in the fact that the accumulation processes described are generators of positive externalities.

Figure 3. Relation between Financial Growth, Financial Inclusion and Consumption Growth



Source: Authors' calculations. Based on Eggoh and Villieu (2013) model

Figure 4. Relation between Financial Growth, Financial Inclusion and Capital Growth



Source: Authors' calculations. Based on Eggoh and Villieu (2013) model

Thus, the World Bank Group is committed to financial inclusion through the Universal Financial Access 2020 initiative. The objective of this initiative is to ensure that everyone in the world has a current account to deposit money but also to send and receive payments.

The objective of this chapter is therefore to examine the impact of financial inclusion in developing countries on its economics growth. Specifically, how both formal and especially digital financial inclusion affects wealth accumulation in these countries ? To the best of my knowledge, there is no article that has studied this issue as I do in the existing literature. Almost all of the existing empirical deals mainly with the impact of formal inclusion on growth in developing counties. This literature can be grouped into two main categories. The first includes studies finding that financial inclusion has a

significant positive effect on economic growth (Mihasonirina and Kangni, 2011; Inoue and Hamori, 2016; Lenka and Sharma, 2017; Pradhan et al., 2017; Kim et al., 2018; Sethi and Acharya, 2018). The idea put forward is that access for all to banking and financial services at a lower cost leads to an increase in the level of growth (Swamy, 2014).

Secondly, there are a relatively smaller number of empirical studies that point to a negative impact of financial inclusion on economic growth (Naceur and Ghazouani, 2007; Pearce, 2011; Bhattarai, 2015; Barajas et al., 2016). This negative effect of formal inclusion, or even insignificant at times, can be explained by the presence of fragile financial system, insufficient financial instruments and inappropriate policies in developing countries (Arestis et al., 2018).

In doing so, the purpose of this paper is twofold. As a first step, it will provide an economic analysis on the role of financial inclusion in economic growth in some developing countries. This contributes to the enrichment of the literature linking financial inclusion and growth in developing countries.

In a second step, I highlight the major involvement of mobile network operators in the progress of the inclusion process in these countries. Indeed, the recent digital revolution in developing countries has led to the emergence of digital financial services whose main providers in these countries are telecommunication companies. Telecommunications companies provide microfinance and remittance services, particularly in African countries. One example is M-Pesa, a microfinance and money transfer system launched by the Vodafone group in Kenya and Tanzania. Services thus enable individuals excluded from the traditional financial system to benefit from basic financial services such as deposits and money transfers. However, there is no research

on the impact of this digital financial inclusion on economic growth. Our study will aim to cover this issue in order to fill this gap.

To achieve the objectives, the rest of the analysis will follow the following plan. In section 2, we will discuss the data and the econometric model used to estimate the relationship between finance inclusion and economic growth in developing countries. The section 3 presents the mains results obtained. In section 4 we realise the robustness check. Finally, we conclude with Section 5.

2 Empirical Strategy

2.1 Data

The emprical analysis will work with a panel of 57 developing countries for the period 2007-2017. Mobile money services really started in developing countries in the 2007s, thus dictating the study period. Indeed, I recall that the major innovation of the analysis, besides providing a theoretical analysis, is to account for the impact of digital financial services on growth.

The countries included in the database come from Africa, Latin America, Eastern Europe and Oceania. The data were retrieved from the Penn World Table (pwt) 9.1, the Financial development and structure database designed by Beck et al, the ICT regulatory tracker and the database of the World Bank. I do not use the Financial Acces Survey and the Global Findex because these databases have respectively too many missing observations and do not provide a continuous time horizon observations for mobile money.

Table 1 provides the countries included in the sample.

Table 1. Sample Countries

Albania	Ghana	Mozambique
Angola	Guatemala	Myanmar
Armenia	Guinea	Namibia
Bangladesh	Guinea-Bissau	Niger
Benin	Haiti	Nigeria
Botswana	India	Pakistan
Burkina Faso	Indonesia	Paraguay
Cambodia	Jamaica	Philippines
Cameroon	Jordan	Romania
Central African Republic	Kenya	Rwanda
Chad	Lesotho	Senegal
Congo, Rep,	Madagascar	South Africa
Côte d'Ivoire	Malawi	Sudan
Dominican Republic	Malaysia	Tanzania
Ecuador	Maldives	Thailand
Egypt, Arab Rep,	Mali	Togo
Eswatini	Mauritania	Uganda
Fiji	Mauritius	Zambia
Gabon	Mexico	Zimbabwe

2.2 Model Specification

In this part, we conduct an empirical analysis that highlights the potential impact of financial inclusion on economic growth.

We seek to present separately the contributions of two financial agents. These are Commercial Banks and Mobile Network Operators. In fact, these two agents are the main actors in the financial inclusion process in developing countries. Commercial Banks are essentially financial institutions that materialize the formal financial system

of any country and they are the main providers of deposit, savings and credit services. Mobilr Network Operators are main providers of Mobile Money services. These services include money transfers, micro-financing and deposits. Nevertheless, money transfer remain the service most used by the population.

For empirical analysis, following Mihasonirina and Kangni (2011), Waverman et al. (2005) , we use a dynamic panel model to study the relationship between financial inclusion and economic growth. The endogenous growth model can be defined as follows:

$$\gamma_{i,t} = \alpha y_{i,t-1} + \beta_{10} X_{i,t} + \beta_{11} X_{i,t-1} + \Gamma Z_{i,t} + \eta_i + \mu_{i,t} \qquad (2.18)$$

where i and t respectively represent individual and time indices, $\gamma_{i,t}$ the economic growth , $y_{i,t-1}$ the initial level of GDP per capita, $X_{i,t}$ the financial inclusion variable whose first-lag $X_{i,t-1}$ is also a regressor, $Z_{i,t}$ the matrix of control variables, η_i a country-specific fixed effect and $\mu_{i,t}$ the error term in the equation.

To estimate our dynamic panel model, I use the panel dynamic generalized method of moment (GMM) estimator proposed by Blundell and Bond (1998).The GMM estimator in the system, combines the first difference equations with the level equations. One advantage of this methodology is that it controls for endogeneity biases related to financial inclusion indicators and other control variables. Indeed, with first difference estimator I eliminate individual specific effects and by integrating the level equations I obtain unbiased results in finite samples when the instruments are weak. The instruments in the first difference equation are expressed in levels, and vice versa. I also choose this model because of our time dimension that not long. For example, I

can't run Dynamic Ordinary Least Square (DOLS) or Pooled Mean Group (PMG) which need more than fifteen years.

Economic growth is captured through the logarithm of the country's GDP per capita growth rate. The financial inclusion is measured by two variables which are the logarithm of the financial system deposits to GDP and the logarithm[2] of active Mobile Money account.The first one captures the level of Commercial Banks formal inclusion[3] and the second expresses the digital inclusion.

Concerning active Mobile Money account, based on the GSMA's State of the Industry Report on Mobile Money of 2018, I have identified three determinants for the number of active Mobile Money accounts. These are the number of mobile subscriptions; access to electricity[4] and enabling regulation which has a tangible influence on the adoption and use of Mobile Money services. Thus by using mobile subscriptions, access to electricity and regulation we build a synthetic index with PCA[5], this index allowing us to measure the number of active Mobile Money accounts.

Population growth rate, inflation rate, openness rate and government expenditures labor are our four control variables. Table 2 indicates the summary statistics of variables

[2] All these variables are expressed in logarithms to provide an elasticity analysis

[3] It would have been better to use depositors to avoid the formal inclusion overestimation knowing that an individual can make more than one deposit. We use deposits than number of depositors because of missing data for some countries of our sample

[4] Population use mobile money to pay electricity and water bills

[5] PCA means Principal Components Analysis. The figures concerning the construction of the index are presented in the appendix of the chapter

Table 2. Descriptive Statistics

Variables	Observations	Mean	Std. Dev.	Min	Max
GDP per capita growth rate (log)	570	0.0220799	0.0435327	-0.4593397	0.4786493
Initial GDP per capita (log)	570	8.3089	0.9039889	6.392678	10.09818
Population growth rate	570	0.0205858	0.010919	-0.010667	0.0551331
Inflation rate	570	0.0140312	0.1435726	-0.6598689	2.388937
Openness rate	627	-0.079580	0.1449723	-0.6091282	0.6253507
Government expenditures	627	0.1631975	0.0663236	0.0151194	0.4060143
Financial system deposits (log)	619	3.286671	0.6797125	0.8164545	4.858567
Active mobile money account (log)	625	1.341744	0.3847388	0.0899879	1.958363
Mobile cellular subscriptions (log)	627	4.187808	0.6684843	0.4054651	5.334167
Deposit money bank assets (log)	619	3.317805	0.7454707	1.022286	4.960848
Private credit by deposit money banks (log)	618	3.023796	0.7613919	0.7920645	4.787427

3 Empirical Results

Table 3 presents the results of the impact of financial inclusion on economic growth, particularly the impact of the inclusion of the traditional and digital financial sectors. The first column reports the baseline growth model. The signs of control variables are broadly consistent with theoretical predictions.The negative and significant coefficient of initial GDP per capita verifies the convergence hypothesis. In addition, as shown by past studies, without a sufficiently sustained pace of technical progress population growth negatively affects the product per capita growth (Blanchet, 2001). The results of the baseline regression also suggest that government expenditure favors growth while. By the way, the inflation rate capturing macroeconomics instability impacts positively growth. Indeed, inflation damages growth only above a certain threshold which depends mainly on the structure of the economy.

In column 2, I introduced the traditional finance inclusion variable in the baseline model. In doing so, it is noted that an increase in the level of inclusion measured by the financial system deposits to GDP leads to an increase in GDP per capita. Then, in column 3 the first-order lag is introduced in addition to traditional finance inclusion variable. I include the first-order lag in the specification in order to judge the impact of advancing the financial inclusion process on growth. Then, I find that if traditional finance inclusion still has a positive impact on growth, its lag has a negative impact. These results reflect the fact that improved access to financial services increases growth. Indeed, including individuals in the system generally leads to productive investment. This translates into an increase in GDP per capita. A better access to deposit ensures that everyone can access financial services and generates monetary opportunities that are allocated to the most profitable projects. Formal financial inclusion generates growth through the creation of opportunities for individuals excluded from the system.

For digital inclusion, following the same procedure as for traditional inclusion, the estimates of the model are presented in columns 4 and 5 respectively.

There is a positive impact of the mobile inclusion on GDP per capita growth.The rise of digital finance creates opportunities for individuals and businesses that have been excluded from the formal banking system. Digital finance improves living conditions by offering financial services such as transactions accounts, credit and insurances. Nevertheless, mobile inclusion coefficients on growth are higher than that of the formal finance. This is due to the use that people have of Mobile Money accounts in these developing countries. Indeed, with the facilities implemented by new technologies, people can use their Mobile Money account to make low-cost bill payments, tuition

fees [6], money transfers in rural areas and large disbursements. Also, main financial services proposed by Telecoms are accessible to the entire population, the cost of access being the price of the telephone chip, which happens to be low. There is therefore no cost to create a mobile account for money transfers and other financial services. Populations benefit greatly from services and there are still individuals with often high financial potential[7] who do not use services.

4 Robustness Test

To test the robustness of our results, I conducted estimates to check the sensitivity of the coefficients on financial inclusion. Table 4 shows forecasts for formal and mobile inclusion by changing our interest variables. The traditional inclusion is captured by two new variables, namely the deposit money bank to GDP and the private credit by deposit money banks to GDP. Columns 1 and 2 present results with the deposit money bank while columns 3 and 4 show those of the private credit by deposit money banks. From the latter, traditional finance coefficients stay significant, positive for the variable and negative for its lag.

Concerning the digital inclusion, I change in columns 5 and 6 our index by the mobile cellular subscriptions. Digital inclusion still have a positive impact on growth and an improvement of financial access increases growth.

I also test the stability of the financial inclusion coefficient to the sample composition. Based on the country's geographical area, I am able to classify our

[6] Bill and tuition fees are mainly consisting of electricity bill, water bill, medical emergencies, school and university fees

[7] We are referring to individuals who may regularly make large financial transfers

countries into two groups: Africa and Other[8]. I strictly run regression on the sample of African countries[9].

In doing so, table 5 presents the impact of the financial inclusion on growth in African countries. Formal financial inclusion contributes to growth in African countries except that the elasticity is less than that obtained without restriction of the sample. Even though the coefficient on the lag of formal inclusion retains its negative sign, I can't surely affirm that improved access to traditional finance has increased economic growth in African because this coefficient is not significant (column 3).

When we take a look on digital inclusion in Africa, results seem interesting in that they reveal not only that improved access to digital finance has increased growth, but also that digital inclusion has an elasticity high (column 5) than that general elasticity obtained from table 3. This result underlines the fact that digital inclusion appears like a real growth issue for African countries. Nevertheless, it should be noted that the digital inclusion has also for Africa higher positive impact on growth than those of traditional inclusion.

Thus, these results reveal a certain heterogeneity between countries according to their geographical area. Therefore, the coefficients estimated for the entire sample must be carefully interpreted. Indeed, as demonstrated by the theoretical model presented above, the benefits of financial inclusion do not have the same magnitude. This magnitude depends on country-specific factors. So, to the extent that the data allow, it would be useful to take these specific factors into account.

[8] Countries belonging to Other's group are from Asia, Europe, Latin America, Middle East and North Africa

[9] Estimates could not be made for the other group because there were not enough observations. This did not allow us to perform the tests of self-correlations and proliferation of the instruments in order to validate the results obtained with the GMM.

5 Conclusion

This paper examines the impact of financial inclusion on economic growth in developing countries with a large rise in digital financial services. To reach this objective, considering a panel of 57 developing countries during 2007-2017, I distinguish impact of formal inclusion and digital inclusion on growth with the GMM estimator in system. Concerning formal inclusion, the results of the estimations reveal that financial system deposits contributes to economic growth in developing countries. As for digital inclusion, measured by the number of active Mobile Money accounts, being confronted with an inaccessible data we constructed an index based on the determinants of active accounts. The GMM estimators present a positive impact of digital inclusion on growth.

The findings of this paper underline that digital inclusion, which is mainly provide by telecommunications companies in developing countries, contributes more to growth than formal inclusion. Policies in developing countries should encourage telecommunications companies to invest and to promote this activity of financial inclusion. Reflections could focus on the regulation of this sector. Indeed, restrictive regulatory frameworks can negatively affect activity expansion to the extent that restrictive regulation raises costs for consumers and limits the roll out of new services. According to GSMA, 2018 regulatory developments appeared encouraging at first glance, yet their layers of complexity reveal increasingly restrictive requirements. To illustrate, the telecommunication sector, which is already one of the highest taxed in Sub-Saharan Africa, witnessed in 2018 the introduction of taxes on mobile money

transactions throughout the region. This new tax feeds debates in regards to the impact it could have on digital inclusion.

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APPENDIX TO CHAPTER 2

1 Supplementary Figures

Figure 5. Scree plot of eigenvalues for the synthetic index with PCA

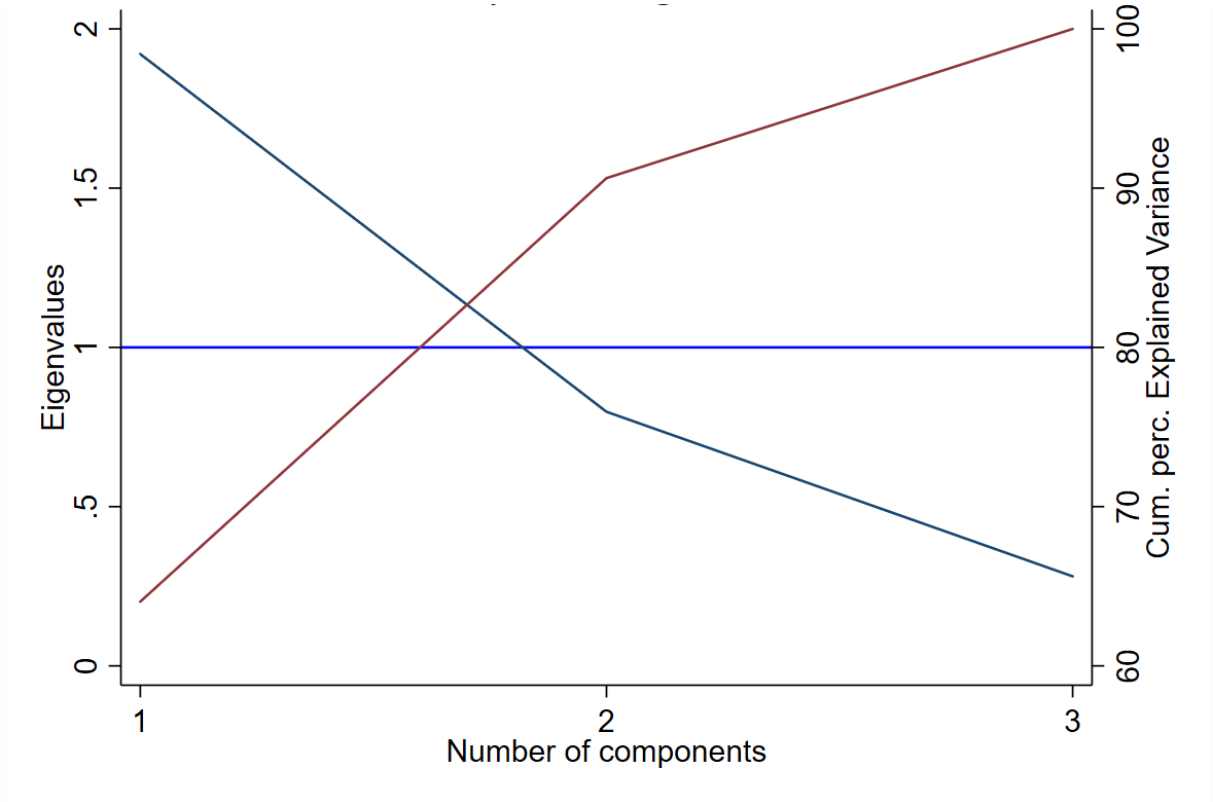


Figure 6. Index's variables loading to component 1 and 2

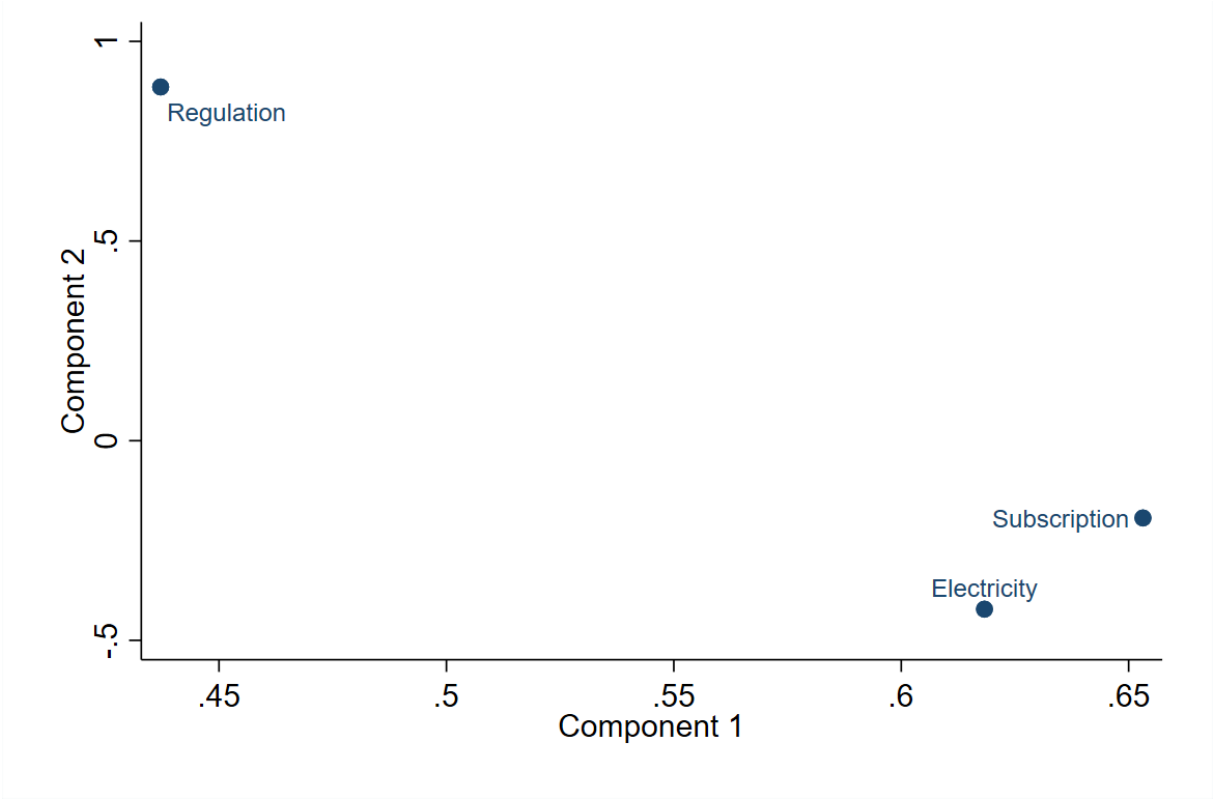


Figure 7. Observation loading to component 1 and 2

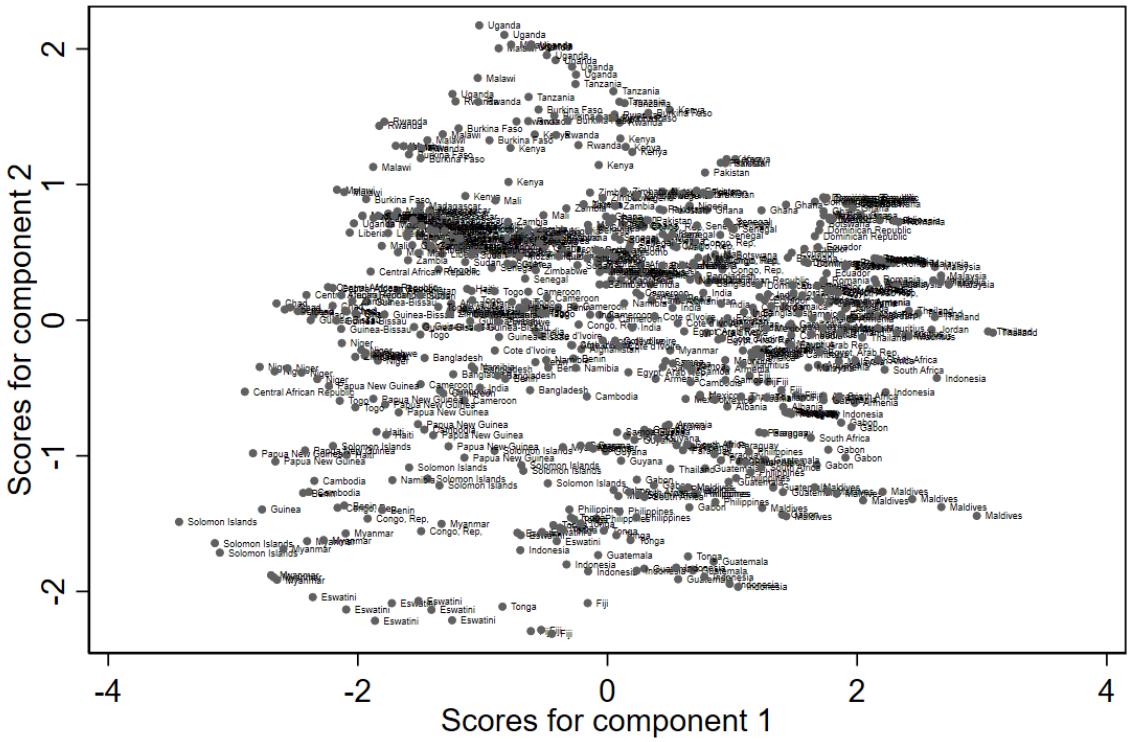


Figure 8. Correlation between Formal Inclusion and Economic Growth

Figure 9. Correlation between Mobile Inclusion and Economic Growth

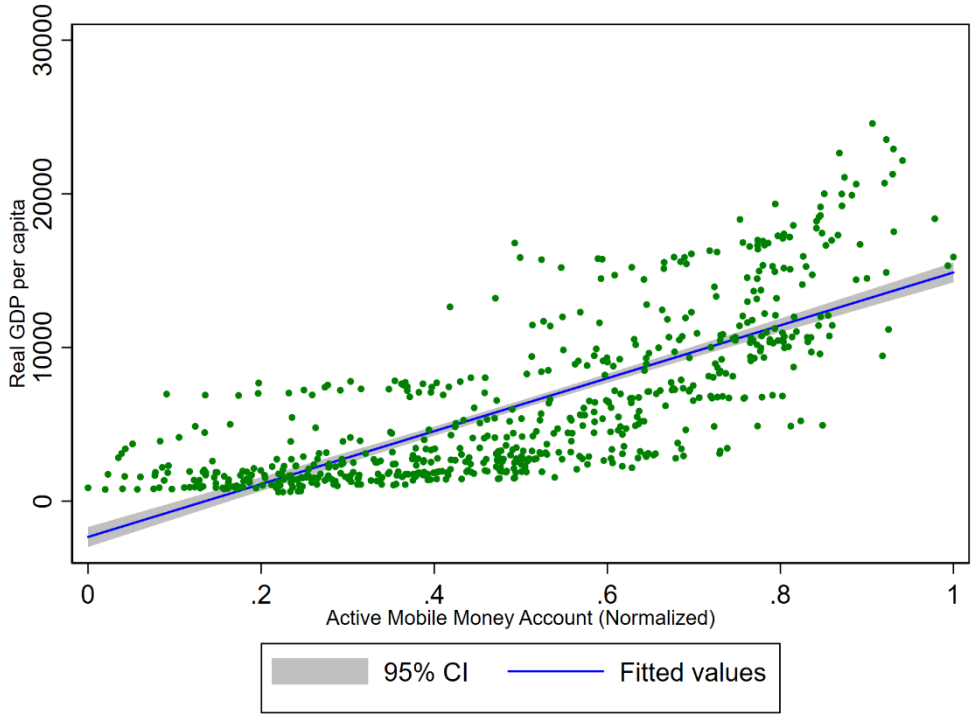


Figure 10. Trends in Active Mobile Money Account and Financial System Deposit

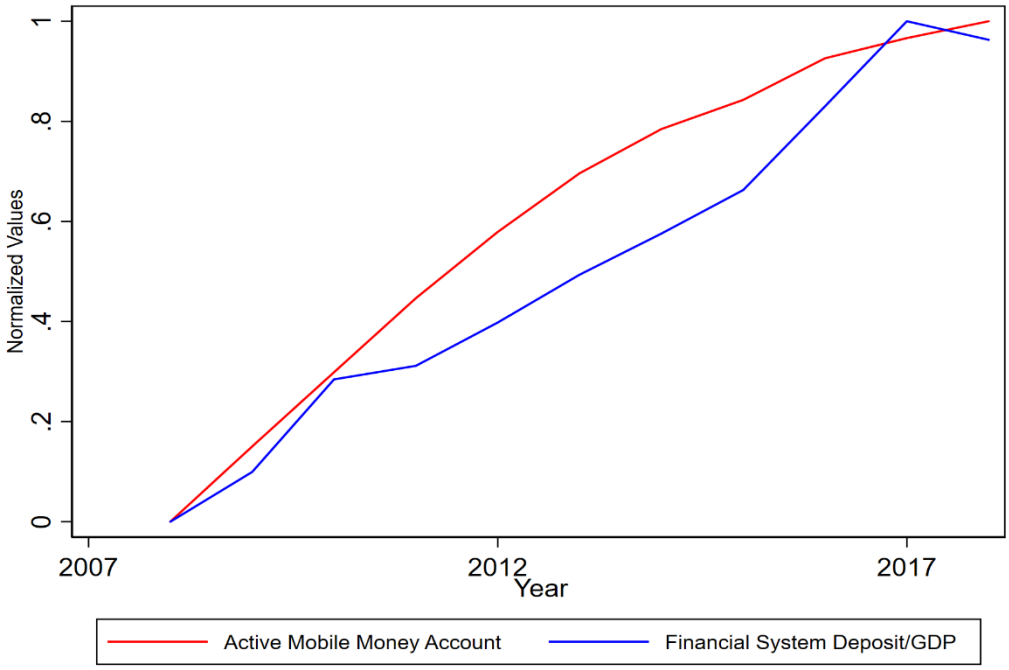


Figure 11. International Comparison with Indicators of Formal Inclusion

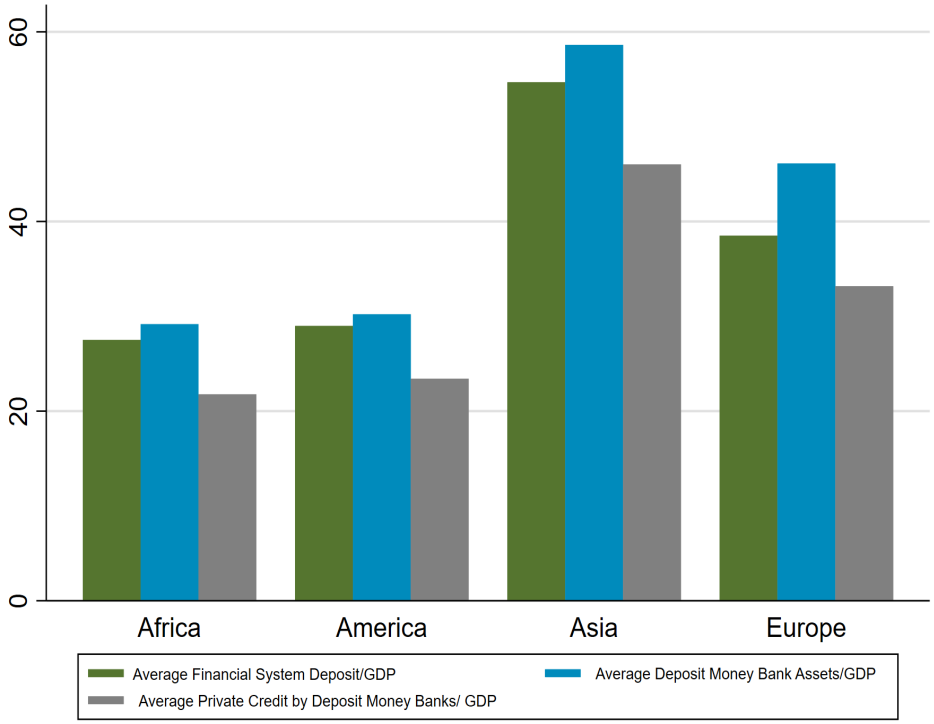
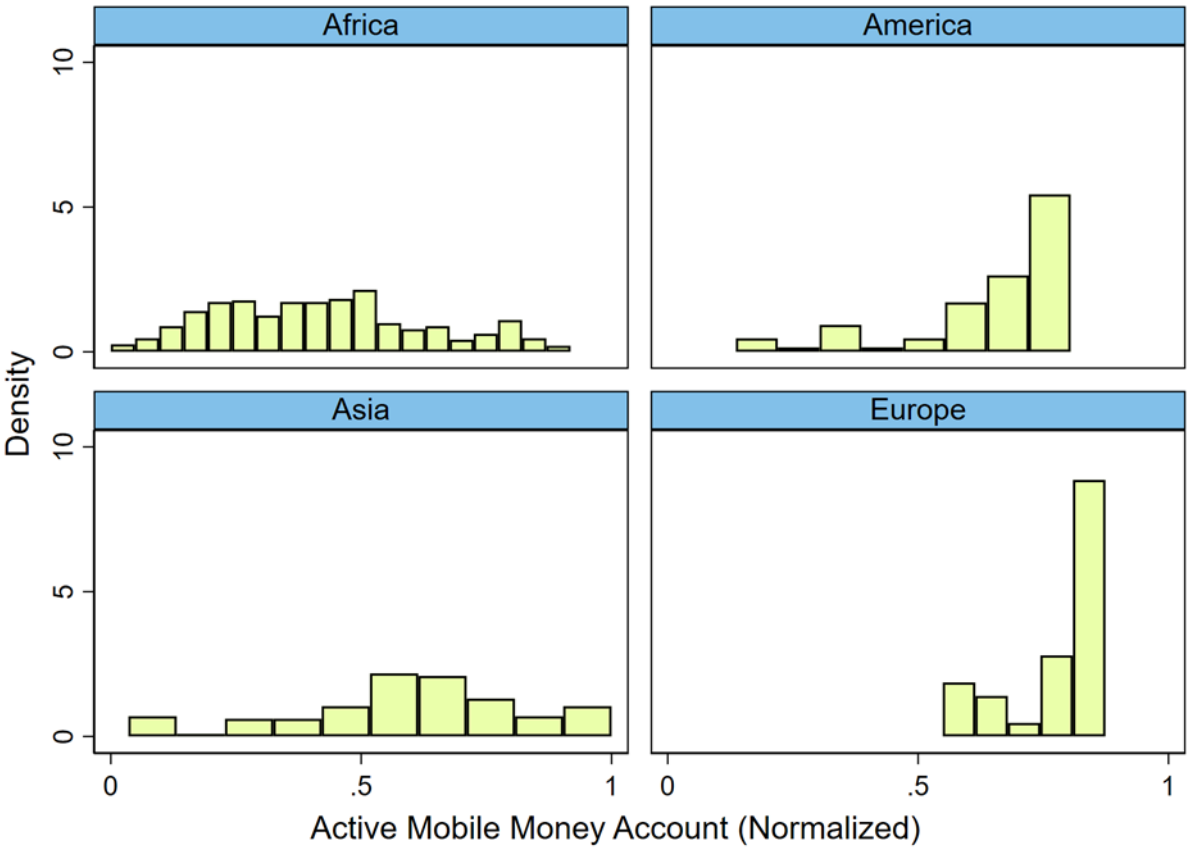


Figure 12. Mobile Inclusion According to Continent



2 Supplementary Tables

Table 3. Impact of Formal and Mobile Inclusion on Growth

	(1)	(2)	(3)	(4)	(5)
Initial GDP per capita (log)	-0.0122***	-0.0375***	-0.0503***	-0.0199***	-0.0429***
	(0.00239)	(0.0130)	(0.0118)	(0.00410)	(0.00604)
Financial system deposits (log)		0.0236**	0.0911**		
		(0.0112)	(0.0362)		
L.Financial system deposits (log)			-0.0541*		
			(0.0284)		
Active mobile money account (log)				0.0349***	0.557***
				(0.0112)	(0.0759)
L.Active mobile money account (log)					-0.443***
					(0.0649)
Population growth rate	-0.848***	-1.464***	-1.725***	-0.780***	-1.115***
	(0.139)	(0.410)	(0.347)	(0.140)	(0.199)
Inflation rate	0.0304***	0.0350***	0.0422***	0.0306***	0.0546***
	(0.00511)	(0.01000)	(0.0109)	(0.00501)	(0.0107)
Openness rate	0.00585	0.0785**	0.102***	0.0228**	0.0867***
	(0.00863)	(0.0355)	(0.0342)	(0.0106)	(0.0183)
Government expenditures	0.0666**	0.126*	0.155**	0.0506**	0.0935***
	(0.0259)	(0.0655)	(0.0684)	(0.0246)	(0.0298)
Constant	0.129***	0.271***	0.333***	0.147***	0.214***
	(0.0183)	(0.0794)	(0.0680)	(0.0209)	(0.0308)
Observations	513	503	501	512	511
Number of countries	57	57	57	57	57
Hansen test (prob.)	0.108	0.340	0.280	0.106	0.368
AR2 (prob.)	0.430	0.361	0.360	0.440	0.488

Notes: Standard errors in parentheses; * p < 0.10, ** p < 0.05, *** p < 0.01

Table 4. Sensitivity Test for Robustness

	(1)	(2)	(3)	(4)	(5)	(6)
Initial GDP per capita (log)	-0.0349***	-0.0353***	-0.0404***	-0.0206***	-0.0492***	-0.0559***
	(0.00898)	(0.0105)	(0.00916)	(0.00211)	(0.00666)	(0.00509)
Deposit money bank assets (log)	0.0253***	0.148***				
	(0.00640)	(0.0447)				
L.Deposit money bank assets (log)		-0.113***				
		(0.0422)				
Private credit by deposit money banks (log)			0.0266***	0.0381***		
			(0.00654)	(0.00541)		
L.Private credit by deposit money banks (log)				-0.0195***		
				(0.00461)		
Mobile cellular subscriptions (log)					0.0452***	0.213***
					(0.0111)	(0.0202)
L.Mobile cellular subscriptions (log)						-0.140***
						(0.0146)
Population growth rate	-1.261***	-1.026**	-1.456***	-0.740***	-1.825***	-1.791***
	(0.352)	(0.441)	(0.334)	(0.124)	(0.243)	(0.204)
Inflation rate	0.0369***	0.0535**	0.0337***	0.0401***	0.0340***	0.0375***
	(0.0104)	(0.0240)	(0.0103)	(0.00382)	(0.00726)	(0.00602)
Openness rate	0.0598**	0.0438	0.0785***	0.0449***	0.0882***	0.108***
	(0.0261)	(0.0379)	(0.0276)	(0.00939)	(0.0163)	(0.0164)
Government expenditures	0.0853*	0.0768*	0.0973*	0.0400**	0.103**	0.0811***
	(0.0464)	(0.0444)	(0.0544)	(0.0166)	(0.0405)	(0.0226)
Constant	0.243***	0.204***	0.297***	0.146***	0.261***	0.189***
	(0.0614)	(0.0779)	(0.0623)	(0.0149)	(0.0283)	(0.0237)
Observations	503	501	502	500	513	513
Number of countries	57	57	57	57	57	57
Hansen test (prob.)	0.246	0.489	0.243	0.121	0.113	0.120
AR2 (prob.)	0.369	0.484	0.389	0.396	0.387	0.302

Notes: Standard errors in parentheses; * p < 0.10, ** p < 0.05, *** p < 0.01

Table 5. Stability Test for Robustness

	(1)	(2)	(3)	(4)	(5)
Initial GDP per capita (log)	-0.0395***	-0.0298***	-0.0357***	-0.0182***	-0.0416***
	(0.00677)	(0.00438)	(0.00398)	(0.00253)	(0.00361)
Financial system deposits (log)		0.0283***	0.0363***		
		(0.00506)	(0.00969)		
L.Financial system deposits (log)			-0.00443		
			(0.00996)		
Active mobile money account (log)				0.0303***	0.619***
				(0.00551)	(0.0455)
L.Active mobile money account (log)					-0.505***
					(0.0426)
Population growth rate	-1.952***	-0.106	-0.185	0.0729	-0.483**
	(0.601)	(0.283)	(0.194)	(0.148)	(0.240)
Inflation rate	0.0165	0.0333***	0.0264***	-0.00819	0.00139
	(0.0114)	(0.00971)	(0.00617)	(0.00793)	(0.0130)
Openness rate	0.0727**	0.0395***	0.0623***	-0.0137	0.0665***
	(0.0333)	(0.0141)	(0.0186)	(0.0111)	(0.00730)
Government expenditures	0.132**	0.0364	0.0454	0.0297	0.0415**
	(0.0518)	(0.0349)	(0.0315)	(0.0243)	(0.0200)
Constant	0.366***	0.166***	0.203***	0.116***	0.186***
	(0.0492)	(0.0250)	(0.0275)	(0.0143)	(0.0214)
Observations	306	297	295	306	306
Number of countries	34	34	34	34	34
Hansen test (prob.)	0.137	0.276	0.245	0.239	0.551
AR2 (prob.)	0.319	0.274	0.253	0.334	0.382
Africa	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses; * p < 0.10, ** p < 0.05, *** p < 0.01

MOBILE MONEY SERVICES ADOPTION AND ENTREPRENEURSHIP IN AFRICA

Abstract

The study analyses the causal relation between the mobile money adoption and usage and small and medium entrepreneurship in Africa. The idea is that this digital financial service could improve access to financing which is a key factor in the creation, survival, and growth of businesses. Using survey firm-level data from the World Bank Enterprise Survey on 15 African countries and a logit estimation, we find that Mobile Money is contributing to the expansion of SMEs creation. Furthermore, the impact of Mobile Money on entrepreneurship is direct. It does not imply an improvement in the entrepreneurial environment across the main societal and individual determinants of entrepreneurs' environmental orientations. More interestingly, we find that MM contributes more to small business creation in the service sector followed by manufacturing. These results highlight the importance for governments to introduce and strengthen policies to increase the availability and usage of digital financial services for individuals who intend to engage in entrepreneurship or run businesses, especially youth and women. In addition, the results showed that tax rates and corruption were the main obstacles to entrepreneurship for SMEs, efforts should be made by governments to create progressive tax systems that would encourage the creation of new businesses while adopting measures to reduce corruption.

Keywords: Mobile Money, Entrepreneurship, logit modelling, development, Africa

JEL Code : G23, L26, O33, O55

1 Introduction

During the last twenty years, African economies have registered a regular increase of their GDP level under lighting an improvement of economic activities. This sustainable increase is mostly the result of the increased production of the continent's main export products, the realization of infrastructure investments and the resilience of household spending despite shocks as 2009 financial crisis and Ebola. According to Moghalu (2014), the various factors listed are the facts of a prudent fiscal policy and sound macroeconomic management that have stabilized economic conditions, lowering the user cost of capital, and putting downward pressure on the real exchange rate.

However, this generated growth is not inclusive, thus inequality and unemployment have remained high (Lim, 2019). Indeed, the idea of inclusive growth would be one that ensures on the one hand that everyone can participate in the growth process, both in terms of making decisions to organize their progress and participating in the growth itself; and on the other hand, a fair sharing of its benefits from growth (Ranieri and Ramos, 2013). This has not been the case for African economies, so lack of opportunity and unemployment, especially among youth; remain high. According to the African Development Bank, the unemployment rate in many African economies is still staggering, often exceeding 50%. When unemployment represents a significant fraction of the working population and of certain already disadvantaged categories of the population (young people, low-skilled, ethnic minorities), it implies low consumption and accentuates the differences and tensions between social groups that can eventually constitute a source of political instability detrimental to the whole economy.

Much work identifies youth unemployment as the source of increased crime, gang proliferation (Bennell, 2000; Arowosegbe, 2009) and rebellion in Africa (Bricker and Foley, 2013; Onuoha, 2014). According to Chigunta (2017), the idleness and frustration of some African youth predisposes them to risky behaviors, including exposure to drugs and the risk of HIV infection. Therefore, given these deplorable social, economic, and political consequences, it is imperative that employment policies are implemented.

Entrepreneurship is thus presented as a solution to the challenge of unemployment in Africa. The growing interest in entrepreneurship stems from its role and potential for job and income creation. In addition, in a context that most African economies have large informal sectors condemning many of their workers to vulnerable employment and poverty (Afdb et al., 2012), entrepreneurship can provide development and resilience in these economies.

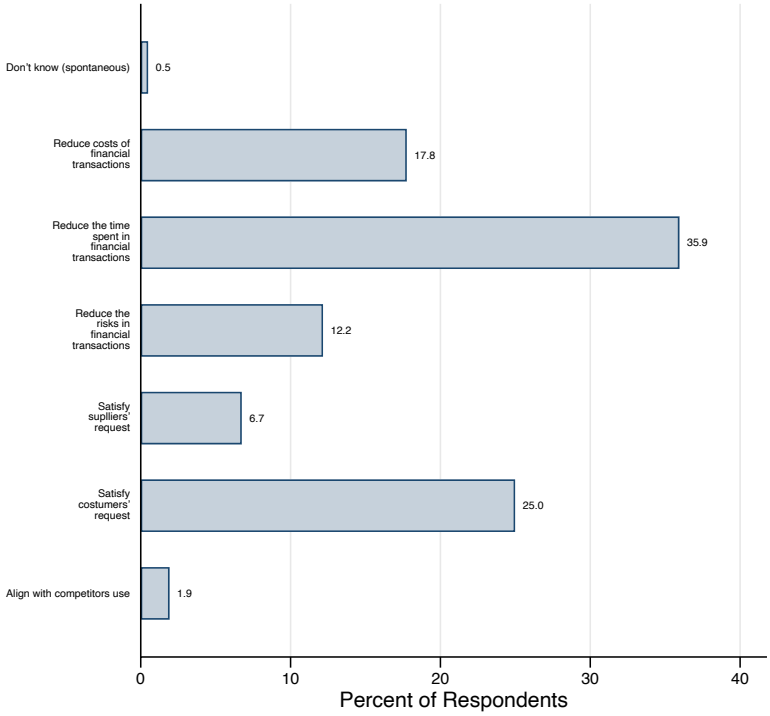
Addressing the possibility of entrepreneurship as a possible solution to unemployment in Africa, Chigunta (2017) suggests that optimism about the entry of young people into entrepreneurship may be justified because more young entrepreneurs seek and achieve livelihood independence than non-entrepreneurs. The Global Entrepreneurship Research Association (2017) finds that economies with high levels of women's entrepreneurial activity develop resilience in times of financial crisis and economic downturn. Zoltan (2006) highlights the fact that entrepreneurship that is beneficial to economic growth in developing countries is not found in agriculture and very small industry.

However, the environment for entrepreneurship is still deficient on the continent because while there is a relevant policy, legal and regulatory framework for the promotion of job creation and entrepreneurship development in many countries, the necessary synergies to facilitate concerted action are lacking and unique barriers to entrepreneurship persist. In this logic, one of the main obstacles to date remains limited access to financial resources. Only 23 percent of adults on the continent have a bank account in a financial institution (Demirgüç-Kunt and Klapper, 2012). The groups mainly excluded from the financial system are the poor, women, and youth. However, with the recent technology boom that has led to the advent of new digital financial services such as Mobile Money (MM), the financing constraint can be solved in these countries. Indeed, recent literature indicates that MM represents the financial service in developing countries to enable them to quickly reach the goal of full financial inclusion of their excluded population (Mihasonirina and Kangni, 2011; Swamy, 2014).

The objective of this chapter is to examine the effects of the recent increase in digital financial inclusion in Africa on small and medium entrepreneurship. More specifically, does MM services adoption and usage contribute to the expansion of small and medium enterprises (SMEs) in African countries? The idea is to investigate the capacity of MM to provide adequate tools to enable people living on the continent to become the architects of their own development through entrepreneurship using data from the World Bank Enterprises Survey (WBES). The figure below presents the reasons why surveyed enterprises in our sample use MM for their financial transactions. First, we observe that MM facilitates financial transactions by saving time and reducing costs incurred in financial transactions. Second, since MM is quite widespread in the different populations that have adopted it, enterprises also adopt it

to satisfy consumer demands. Third, 12.2% of the companies in our sample claim to find a solution with MM to reduce risks in financial transactions. Other reasons include suppliers' request satisfaction and alignment with competitors' use of MM.

Figure 13. Main reasons establishment use Mobile Money for financial transactions



Source: Authors' calculations, World Bank Enterprise Surveys, http://www.enterprisesurveys.org.

A small number of papers have looked at the relationship between MM and entrepreneurship without following our methodology, covering our study area, and posing a problem like our own. Rahman et al (2020) consider a technological rather than an economic approach and examine through the UTAUT2[10] model how the acceptance and use of mobile financial services can contribute to the subjective well-being of micro-entrepreneurs in Bangladesh. Their results suggest that mobile

[10] UTAUT2 (Unified Theory of Acceptance and Use of Technology) is a model used in management to determine the factors affecting the adoption and use of technology. The model incorporates concepts such as performance expectations, social influence, hedonic motivation, price value and habit.

financial services usage behavior influences respondents' subjective well-being. Natile's (2020) study, meanwhile, contributes to the growing legal debate on digital financial inclusion that challenges the narrative of social entrepreneurship[11], namely the logic that business models can simultaneously address a social problem while making a profit. Looking at the Kenyan case with M-Pesa, she argues that M-Pesa treats digital financial inclusion more as a tool for development and private profit without helping to address the causes of financial exclusion, thus favoring MM providers and institutions involved in the social business of MM over improving the lives of the intended beneficiaries, the unbanked poor. Finally, Jussila's (2015) excellent dissertation identifies the success factors for the implementation of MM in Kenya, including the M-Pesa service, and assesses the impact and importance of the service for businesses and the types of customers who use the service. Jussila's study is based on literature reviews, empirical analysis based on experience and quantitative analysis of survey data (descriptive statistics, correlation coefficient).

Our paper thus contributes to the economic literature on several points. First, to our knowledge, our analysis is the first to analyze the causal effect of the adoption and use of MM services by firms on small and medium entrepreneurship. Second, our analysis combines primary data from the WBES with macroeconomic data to improve the quality of our estimates. Indeed, the WBES data comes from surveys specifically designed to provide standardized knowledge of the business environment faced by enterprises in developing countries. This has the advantage of allowing for better targeting of economic policies. Third, unlike the analysis of Natile (2020) and Jussila

[11] Social entrepreneurship is concerned with the entrepreneurship of digital financial service providers, not the consumers of the service

(2015), our sample is not limited to a single country but covers 15 African countries that have adopted MM services.

Using a logit estimation, we find evidence that MM increases the probability of starting a new business for SMEs. Digital financial service ensures equal opportunities to use essential financial services to be an architect of one's own well-being through entrepreneurship. Specifically, thanks to marginal effects estimation, we find that for a firm that has adopted MM services for its financial transactions, the probability of entrepreneurship increases by 5.5 percent. Moreover, the impact of MM on entrepreneurship is direct. It does not imply an improvement in the entrepreneurial environment through the main societal and individual determinants of entrepreneurs' environmental orientations. Our results remain robust to the inclusion of several control variables and to the use of alternative methods such as Probit and OLS estimations. Analyzing the heterogeneity in our results, we find that MM favors more the creation of small enterprises in the service sector followed by the manufacturing sector.

The rest of the chapter is organized as follows: The data are presented in Section 2. Section 3 lays out the methodology and the results. Section 4 concludes.

2 Data and Identification Strategy

The database used for our work is a combination of firm-level microeconomic data from the World Bank Enterprise Surveys (WBES) and macroeconomic data from the World Development Indicators (WDI). The manipulation was carried out following the guidelines of Imbens and Lancaster (1994) and Van den Berg and Van Der Klaauw (2001) to improve the estimates of our micro econometric model and to obtain unbiased estimators.

In doing so, regarding the observations from the business data, the analysis will be restricted to one category of business. Indeed, entrepreneurship is defined as any attempt to create a new business or project by an individual, a team of individuals or an unincorporated business (Global Entrepreneurship Research Association 2017, Organization for Economic Co-operation and Development 2011). Thus, to assess the likelihood that the creation of a new business is influenced by the usage of MM, our analysis will only look at firms with a creation date after the advent[12] of the digital financial service in the country in which the respondent is located. To measure entrepreneurship, we therefore create a dummy variable "Business Creation" which takes the value 1 when the date of creation of the business occurs after the advent of MM in the country of belonging and 0 otherwise. This permits us only to capture newly created firms since MM adoption in each of the 15 countries.

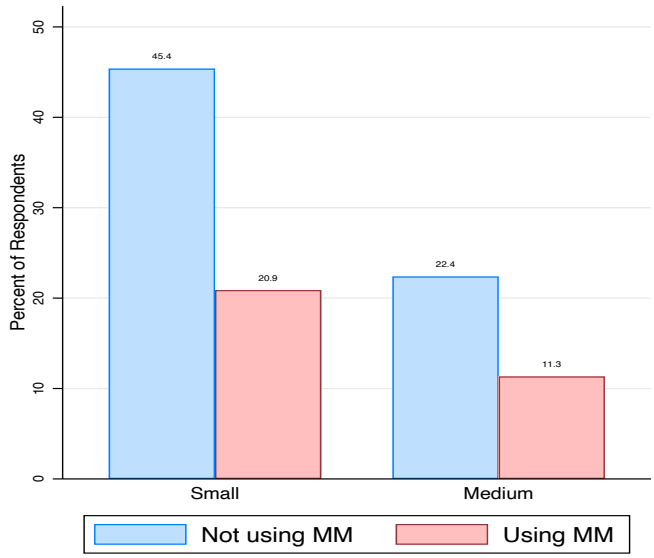
Concerning the measurement of the usage of digital financial services, we generate a dummy variable that takes the value 1 if the company answered that it uses MM for its

[12] MM services include transferring money, making, and receiving payments using the mobile phone. Mobile banking services such as Google Wallet are not included in the MM deployment criteria. Data on the year of service launch was retrieved from the GSMA's MM Deployment Tracker.

financial transactions and 0 if it mentions not using the service to carry out these transactions.

It is worth noting that MM is more likely to influence entrepreneurship for only SMEs. We therefore use a cross-sectional analysis with only small and medium sized firms in 15 African countries that were surveyed once in 2013, either 2016, 2017 or 2018. Figure 14 provides an overview of MM usage status by firm size across the studied countries. We remark that small-sized firms represent 66.3 percent of our sample, of which only 20.9 percent is using MM to carry out their financial transactions. In the medium-sized firms' group, 11.3 percent of the sample uses MM for their financial transactions. In our overall sample, the percentage of firms using MM is only 32.2 percent, and we can note that medium-sized firms relatively more use MM than small-sized firms do.

Figure 14. Mobile Money usage status by firm size



Source: Authors' calculations, World Bank Enterprise Surveys, http://www.enterprisesurveys.org.

The macroeconomic data, on the other hand, provide us with the control variables used in the literature as determinants of entrepreneurship and, which could not be covered by the business survey. We therefore retain Foreign Direct Investment (FDI), economic growth, GDP per capita, population growth, population density, unemployment rate and the country's level of high-tech exports as control variables. First, with respect to FDI flows, they are a dynamic source of growth through physical and human capital inflows. We thus expect a positive relationship between these investment flows and entrepreneurship. However, previous work to date finds a negative but insignificant coefficient. Second, for economic growth measured by the annual GDP growth rate, economic intuition points to a positive impact as countries enjoying an increase in national wealth can provide their population with technological innovations that can be used to promote entrepreneurship. In addition, GDP per capita should positively influence the environmental orientation towards entrepreneurship. The existing literature indicates that in countries with higher GDP per capita, households show a greater orientation towards entrepreneurship. With respect to demographic variables, one should already expect population growth to be partially statistically significant and negatively related to entrepreneurship development in Africa. Second, since population density is an indicator of the level of urbanization of the economy and market size, we should find a negative impact of the latter on the level of entrepreneurship. Concerning our last, two control variables, i.e., the unemployment rate and the level of high-tech exports, the literature remains divided with mixed results. In some studies, a significant weak positive influence is observed, while in others the relationship is significantly negative.

Table 6 provides an overview of the dependent and independent variables used in our study.

Table 6. Overview of the dependent and independent variables

Variable	Operationalization	Data source	References
Dependent variable (individual level)			
Business Creation	Firm created after the advent of MM (yes = 1/ no = 0)	Enterprise Survey – World Bank	
Independent variables (individual level)			
Mobile Money	Use MM for transactions (yes = 1/ no = 0)	Enterprise Survey – World Bank	
Control Variables (societal level)			
FDI	Net inflows in current US$	WDI World Bank	- Ahmed and Nwankwo (2013) and Atiase et al. (2018)
GDP Growth	Annual growth rate in %	WDI World Bank	- Ahmed and Nwankwo (2013) and Atiase et al. (2018)
GDP per capita	GDP per capita in US$	WDI World Bank	- Bergmann and Sternberg (2007) and Stephan et al. (2015)
Population Growth	Annual growth rate in %	WDI World Bank	- Ahmed and Nwankwo (2013) and Atiase et al. (2018)
Population density	Midyear population divided by land area in square kilometers	WDI World Bank	- Bruns et al. (2017)
Unemployment	Unemployment rate in %	WDI World Bank	- Staber and Bögenhold (1993) and Bergmann and Sternberg (2007)
High-technology export	Percentage of high-technology exports of all exports	WDI World Bank	- Ibeh (2003) and Hörisch et al. (2017)

3 Econometric Strategy and Results

3.1 Econometric Strategy

The logit regression model is used to examine a causal relationship between variables. In doing so, the regression is appropriately adopted to examine a relationship between a binary dependent variable, which can take the values 0 and 1 or Yes and No, and a set of independent variables. Its better adaptation, relative to ordinary least squares regression, better to predict binary variables comes from its non-linearity. Indeed, the logit model is based on a logistic cumulative distribution function of a random variable, thus forcing the predicted value to be between zero and one (Stock & Watson, 2010). Furthermore, the model does not assume that the independent variables are normally distributed. Logistic regression is truly applicable in our present analysis since our dependent variable, Business Creation, only takes the value 0 and 1; and since we have dependent variables of any type.

This being said, to be able to determine the expression of our logit model, we first focus on the expression of the probability that a business will be created after the arrival of the MM, a probability estimated in a range from 0 to 1. To do this, let us consider a linear regression model equation (3.1) and the associated probability function equation (3.2). Where BS, for Business Creation, is dichotomous while the dependent variables (variables of interest, control variables) can be purely continuous, dichotomous or both:

$$BS_i = \beta_0 + \beta_1 x_{1i} + \cdots + \beta_K x_{Ki} + \varepsilon_i \tag{3.1}$$

$$p_i = E[BS = 1|x_i] = \beta_0 + \beta_1 x_{1i} + \cdots + \beta_K x_{Ki} \tag{3.2}$$

where p_i is the probability that a business is created after the advent of MM knowing our independent variables x_i ; β_0,...,β_K the parameters and ε_i the error term.

The cumulative distribution function can now be written as:

$$p_i = \frac{1}{1+e^{-Z_i}} \tag{3.3}$$

where Z_i represents the linear combination associated with BS_i which can therefore be written as follows:

$$Z_i = \beta_0 + \beta_1 x_{1i} + \cdots + \beta_K x_{Ki} + \varepsilon_i \tag{3.4}$$

Then, based on the cumulative distribution function equation (3.3), we determine the expression for the odds, which is defined as the probability that the event will occur divided by the probability that the event will not occur. In our analysis, the odds are the probability that a business will be created following the arrival of the MM relative to the probability that a business will not be created after the arrival of the MM. To illustrate, if we assumed that the probability that a business is created p_i is 0.8, then the probability that the business is not created $1 - p_i$ will be 0.2. The odds, which is

the division of the probability of the event occurring divided by the probability of the event not occurring, would be 0.8/0.2=4. We would therefore say that the odds of a business being created after the advent of MM are 4 to 1 compared to not being created after the advent of MM.

The odds are determined as follows:

$$1 - p_i = \frac{1}{1+e^{Z_i}} \tag{3.5}$$

where equation (3.5) is the probability that the event does not occur. This allows us to determine the ratio

$$\frac{p_i}{1-p_i} = \frac{1+e^{Z_i}}{1+e^{-Z_i}} = e^{Z_i} \tag{3.6}$$

We can now determine the expression of the logit model, which is none other than the logarithm of the odds. Let L_i be the logit model written:

$$L_i = ln\left[\frac{p_i}{1-p_i}\right] = ln[e^{Z_i}] = Z_i = \beta_0 + \beta_1 x_{1i} + \cdots + \beta_K x_{Ki} + \varepsilon_i \tag{3.7}$$

The model parameters are estimated using the maximum likelihood method. Indeed, since the regression of the model passes a probability prediction, it can be fitted using the likelihood.

3.2 Estimation Results

Table 7 presents the main results of our analysis. In column 1, we only include our variable of interest mobile money usage. Its coefficient is positive and significant at the 1 percent significance level, revealing that enterprises that use mobile money for their financial transaction are more likely to be newly created. This result remains robust to the inclusion of all our control variables, country, and survey year fixed effects (columns 2-11). In all specifications, we display the marginal effect of the mobile money usage variable. In column 11 for example, it is equal to 0.055 and significant at the 1 percent level. For a firm that has adopted mobile money services for its financial transactions, the probability of entrepreneurship increases by 5.5 percent. In appendix, we use alternative estimation methodologies, i.e., Probit and OLS estimations and our results remain robust.

Across the countries studied, the signs of the control variables are broadly consistent with theoretical predictions guided by economic intuition. FDI has a positive and significant impact on entrepreneurship. Indeed, FDI consists of technical "know-how", managerial expertise, technological expertise, and capital. These elements fuel the entrepreneurial spirit and thus lead to a growth in the creation of enterprises.

The improvement of the economic environment captured here by economic growth and wealth per capita leads to a decrease in business creation. This result, which may seem counter-intuitive, is explained by the fact that the occurrence of opportunities on

the labor market when the economic situation is favorable dissuades individuals from creating their own activity and the opportunity cost of entrepreneurship then becomes high.

Population growth in the countries under consideration also discourages entrepreneurship and this is partly due to the relatively high level of unemployment in these countries. Indeed, population growth is supposed to have a positive impact on entrepreneurship. On the one hand, a growing population would imply by deduction, a growing share of entrepreneurs and on the other hand, population growth would induce a stimulation of the demand for goods and services that would capture the interest of entrepreneurs. In doing so, the negative result that we observe underlines the fact that the mechanisms described above only make sense when unemployment is established at a relatively low level. Thus, a demographic growth associated with a relatively high unemployment rate predicts a low growth of entrepreneurs.

The same negative result is found for population density. One possible explanation for this result is that less densely populated markets facilitate entrepreneurship by reducing competition among firms. The idea is that competition reduces the profit margins of firms, thus requiring a level of efficiency and innovation that individuals wishing to become entrepreneurs do not have. Density would therefore be favorable for experienced entrepreneurs and would discourage new entrepreneurs by increasing start-up difficulties.

Unemployment, on the other hand, decreases business creation. Indeed, when unemployment increases, the probability of survival of a business decreases knowing that the purchasing power of consumers decreases. Individuals prefer to look for a job to obtain a stable income and build up financial capital before starting a business. This result is very interesting in that it provides information on the motive for starting a business in our sample. Knowing that an increase in the unemployment rate reduces entrepreneurship, we could say that business creation in the countries considered is mainly driven by innovation or the development of new ideas. The companies studied were not created for reasons of necessity.

Finally, we find the negative impact of high-technology export on business creation. The view here is that an increase in the level of high-technology export implies the presence of an operating environment that is hostile to business creation. This has the immediate implication of reducing entrepreneurship in the territory, as would-be entrepreneurs are more likely to venture to other territories where the environment is more favorable.

Table 7. Main results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Mobile money usage	**0.6956*** **	**0.6911*** **	**0.6905*** **	**0.7091*** **	**0.5719*** **	**0.6006*** **	**0.4103*** **	**0.3606*** **	**0.3897*** **	**0.3058*** **	**0.3870*** **
	(0.07398)	**(0.07457)**	**(0.07457)**	**(0.07583)**	**(0.07664)**	**(0.07743)**	**(0.08280)**	**(0.08633)**	**(0.09393)**	**(0.09141)**	**(0.09396)**
FDI net inflows (log)		0.2530***	0.2732***	0.2328***	0.4843***	0.6099***	0.7972***	0.8045***	1.0700***	-0.0008	1.0052***
		(0.05549)	(0.06546)	(0.07090)	(0.08526)	(0.09650)	(0.10208)	(0.10629)	(0.18834)	(0.23169)	(0.33359)
GDP growth rate			-0.0166	-0.0248	-0.1254***	-0.1727***	-0.2289***	-0.3263***	-0.5853***	0.0707	-0.5531***
			(0.02836)	(0.02937)	(0.03374)	(0.03673)	(0.03917)	(0.05191)	(0.11273)	(0.07889)	(0.18764)
GDP per capita (log)					-0.4007***	-0.5231***	-0.2431	-0.2671*	0.3318*	0.8401***	0.3293
					(0.12833)	(0.13447)	(0.14869)	(0.15970)	(0.18129)	(0.31104)	(0.29817)
Population growth rate					-1.0061***	-1.1737***	-1.1484***	-1.4034***	-2.0009***	0.1841	-2.1024***
					(0.13266)	(0.14188)	(0.14666)	(0.16754)	(0.23094)	(0.21574)	(0.59545)
Population density						-0.0032***	-0.0059***	-0.0109***	-0.0144***	-0.0101***	-0.0152**
						(0.00096)	(0.00105)	(0.00136)	(0.00190)	(0.00216)	(0.00638)
Unemployment rate							-0.1631***	-0.2335***	-0.3012***	-0.2692***	-0.3103**
							(0.02655)	(0.03215)	(0.04225)	(0.06488)	(0.15171)
High-technology export								-0.7399***	-1.7226***	-2.4059***	-2.1101*
								(0.23385)	(0.47264)	(0.51087)	(1.17278)
Constant	-1.8763***	-7.1623***	-7.4897***	-6.7656***	-5.6531***	-6.4356***	-11.2110***	-8.8495***	-14.6753***	-5.8994	-13.1616***
	(0.04836)	(1.16676)	(1.29670)	(1.38319)	(1.37276)	(1.40175)	(1.71820)	(1.73309)	(2.67113)	(4.04954)	(4.82867)
Country FE	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	YES
Survey year FE	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES
Observations	5487	5358	5358	5358	5358	5358	5358	5090	4639	5090	4639
Log-likelihood function value	-2421.65	-2371.98	-2371.81	-2370.82	-2342.60	-2336.81	-2316.78	-2203.87	-2096.22	-2139.74	-2095.25
Pseudi-R2	0.018	0.022	0.022	0.022	0.034	0.037	0.045	0.055	0.065	0.082	0.065
Chi-squared	86.644	106.710	107.054	109.036	165.487	177.057	217.114	254.367	291.321	382.617	293.265
Model test p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Marginal effect (MM usage)	**0.095*** **	**0.095*** **	**0.095*** **	**0.097*** **	**0.077*** **	**0.081*** **	**0.055*** **	**0.049*** **	**0.055*** **	**0.040*** **	**0.055*** **
	(0.0100)	**(0.0101)**	**(0.0101)**	**(0.0103)**	**(0.0103)**	**(0.0104)**	**(0.0111)**	**(0.0116)**	**(0.0133)**	**(0.0119)**	**(0.0133)**

Standard errors in brackets. * p<0.1, ** p<0.05, and *** p<0.01.

4 Heterogeneity Tests

4.1 Effect According to Firm Size

Our results (table 8) show that the usage of mobile money services for financial transactions affects entrepreneurship at the level of small and medium-sized enterprises and regardless of the sector of activity. However, heterogeneities might exist since, by definition, small firms are different from medium-sized firms and do not face the same constraints as the latter. In addition, depending on the sector of activity, the objective and expected effect of mobile money services usage on entrepreneurship might be different. Therefore, in this section, we test for such heterogeneous effects by subdividing our sample into subgroups based on firm size and sector of activity. We consider three sectors of activity, i.e., manufacturing, services, and other sectors.

First, for firm size, columns 4 and 8 present the results. In both columns, we note that the effect of our variable "Mobile Money usage" is positive and significant at the 1

percent level with a higher marginal effect for medium-sized firms (0.063). The marginal effect for small firms is 0.046.

Second, concerning the sector of activity, columns 1 to 3 present the results for the overall sample. Again, our Mobile Money usage variable appears positive and significant for entrepreneurship in the manufacturing and service sectors only. As for the marginal effects, we note that the usage of mobile money services affects business creation in the services sector by 7.9% (column 2) and in the manufacturing sector by 4.2% (column 1). Thus, the usage of mobile money services affects entrepreneurship more in the service sector. This result could be explained by the fact that our sample's entrepreneurs in the services sector are generally the most excluded from the classical banking system. Indeed, entrepreneurship in the manufacturing sector generally requires a certain amount of capital and much more significant investments that often require affiliation or recourse to a classical financial institution.

Looking at the effect of mobile money usage on entrepreneurship in the different sectors by firm size, we find that small enterprises drive the significant effects previously observed in the manufacturing and service sectors. Indeed, for the latter, we observe that entrepreneurship's probability increases with mobile money services usage by 5.1 percent in the manufacturing sector (column 5) and 7.5 percent in the services sector (column 6). However, although the coefficients of our variable of interest appear positive for medium-sized firms, none of them is significant. This result could be explained by the fact that setting up a medium-sized business requires more financial resources than setting up a small business. Moreover, creating a medium-sized enterprise generally requires affiliation with a bank, unlike most small

enterprises. Mobile money services thus appear to be an additional option for these enterprises to expand their activity. In contrast, they appear to help small-sized firms to create and start their activity.

Table 8. Results by firm size and sector of activity

	Global sample			Small enterprises				Medium enterprises			
	Manufacturing	Services	Other	All sectors	Manufacturing	Services	Other	All sectors	Manufacturing	Services	Other
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Mobile money usage	**0.3926****	**0.4564****	**0.1599**	**0.3113*****	**0.4432****	**0.4195****	**0.0851**	**0.5106*****	**0.2133**	**0.8957**	**0.4289**
	(0.15715)	**(0.19305)**	**(0.15981)**	**(0.11469)**	**(0.20183)**	**(0.21178)**	**(0.19690)**	**(0.17130)**	**(0.26689)**	**(0.58538)**	**(0.28316)**
FDI net inflows (log)	1.0798**	0.7662	0.8247*	1.2437***	1.3522*	0.2881	1.0004*	0.5688	0.5307	0.1092	-0.3177
	(0.53673)	(0.80812)	(0.45710)	(0.43722)	(0.75396)	(0.94869)	(0.54947)	(0.53729)	(0.83140)	(1.25646)	(1.01810)
GDP growth rate	-0.4235	-0.5304	-0.4728*	-0.8482***	-0.8175**	-0.1696	-0.7179**	0.0696	0.2007	4.9541**	0.7361
	(0.28732)	(0.44637)	(0.25356)	(0.24256)	(0.40063)	(0.51222)	(0.29997)	(0.32561)	(0.47771)	(2.31629)	(0.59155)
GDP per capita (log)	-0.1586	1.1312	0.1857	0.5294	0.0413	0.6331	0.6104	0.0957	-0.2104	-3.6408*	-0.7224
	(0.45120)	(0.73204)	(0.41445)	(0.38643)	(0.62127)	(0.84710)	(0.51817)	(0.50322)	(0.80885)	(1.96549)	(0.88161)
Population growth rate	-1.8665**	-2.0559	-1.5395**	-2.8186***	-2.9308**	-1.0546	-1.9236***	-0.9323	-0.0056	7.3689**	-0.3325
	(0.80181)	(1.45524)	(0.61308)	(0.80436)	(1.17020)	(1.58702)	(0.73926)	(0.93087)	(1.21770)	(3.31008)	(1.37336)
Population density	-0.0104	-0.0188	-0.0119*	-0.0214**	-0.0177	-0.0113	-0.0164**	-0.0032	0.0015	-0.0624**	0.0054
	(0.00830)	(0.01538)	(0.00620)	(0.00867)	(0.01240)	(0.01674)	(0.00737)	(0.00986)	(0.01207)	(0.02830)	(0.01422)
Unemployment rate	-0.1143	-0.5174	-0.2681*	-0.4245**	-0.2020	-0.3501	-0.3722*	-0.1501	-0.0324	-1.4595**	-0.0370
	(0.20061)	(0.36802)	(0.16169)	(0.20650)	(0.30392)	(0.40523)	(0.19047)	(0.23100)	(0.27713)	(0.71048)	(0.37759)
High-technology export	-1.8069	-3.1264	-0.7663	-2.1171	-2.1007	-1.5738	-0.7046	-2.6932	-0.7696	-21.5321**	-2.3062
	(1.56694)	(2.78664)	(1.13751)	(1.58105)	(2.28291)	(2.94184)	(1.32759)	(1.91588)	(2.35284)	(8.77359)	(2.69232)
Constant	-14.0966*	-12.0787	-10.7402	-15.0915**	-15.4600	-4.9980	-14.0807	-10.3493	-11.9365	-3.5242	6.9698
	(7.84152)	(11.51979)	(7.30587)	(6.26879)	(11.17915)	(13.85855)	(8.73715)	(7.88230)	(11.96122)	(18.75956)	(16.61288)
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Survey year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	2149	916	1555	3085	1338	702	1031	1554	811	182	524
Log-likelihood function value	-781.21	-482.22	-778.12	-1437.68	-508.52	-378.13	-515.05	-622.25	-253.13	-84.12	-254.08
Pseudi-R2	0.077	0.052	0.077	0.078	0.110	0.061	0.081	0.079	0.062	0.122	0.099
Chi-squared	130.784	52.368	128.969	242.387	125.509	49.324	91.159	106.496	33.655	23.460	55.744
Model test p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.015	0.000
Marginal effect (MM usage)	**0.042****	**0.079****	**0.026**	**0.046*****	**0.051****	**0.075****	**0.014**	**0.063*****	**0.019**	**0.135**	**0.068**
	(0.0169)	**(0.0331)**	**(0.0259)**	**(0.0169)**	**(0.0231)**	**(0.0375)**	**(0.0318)**	**(0.0209)**	**(0.0236)**	**(0.0866)**	**(0.0445)**

Standard errors in brackets. * p<0.1, ** p<0.05, and *** p<0.01.

4.2 Effect According to Environmental Entrepreneurship

It is worth noting that there are some factors affecting entrepreneurship decision in many economies, especially in the African context. In our analysis, we focus on three factors, i.e., individuals' gender, taxation, market entry conditions, and corruption.

First, Santos and Cincera (2021), Canepa and Stoneman (2008); and Iammarino et al. (2009) highlight that financing constitute an important obstacle to innovation and entrepreneurial activities. For Fletschner and Kenney (2014), and GSMA (2019), women are the main categories excluded from the classical banking system in Africa/developing countries. MM has thus importantly contributed to the improvement of women financial in the region (GSMA, 2019). In this condition, it

appears important to investigate whether the adoption of MM by women leaders has contributed to increase entrepreneurship in Africa. We therefore consider three variables: "Female top manager" which takes the value 1 in the firm top manager is female and 0 otherwise, "Female owning more than 50%" which takes the value 1 if the main owner of the firm is female and 0 otherwise, and "Female owning 100%" which takes the value 1 if the owner of the firm is female and 0 otherwise. We then retain three specifications in which we include each variable and its interaction with "Mobile money usage". A significant effect of the interaction term means that the concerned group of entrepreneurs exhibits a different likelihood of entrepreneurship with respect to the usage of mobile money. Columns 1 to 3 of table 9 present the results. None of the interaction terms is significant, meaning that we cannot affirm that the usage of mobile money services by female "leaders" increases entrepreneurship. However, all the three variables are positive and significant highlighting the fact that female leadership increases the likelihood of entrepreneurship.

Second, Stenkula (2010), Henrekson and Johansson (2009), Thompson et al. (2011), Estrin et al. (2013), and Audretsch et al. (2021) argue that tax policy may affect entrepreneurship in the sense that taxes affect the after-tax return of entrepreneurs' activities. We consider two obstacles to entrepreneurship related to the tax environment: tax rates and tax administration. For the former, we create the variable "Obstacles: Tax rate" which takes the value 1 if the firm mentions tax rates as an obstacle to its activity and 0 otherwise. Concerning the latter, we create the variable "Obstacles: Tax administration" which takes the value 1 if the firm mentions tax administration as an obstacle to its activity and 0 otherwise. For each type of obstacle, we include its variable and its interaction with "Mobile money usage". The results are

presented in columns 4 and 5 of table 9. Only "Obstacles: Tax rate" is negative and significant at the 5 percent level (column 4) meaning that tax rates represent an obstacle to entrepreneurship in the studied countries. However, as we have not found any significant effect for the interaction terms, we cannot affirm that the usage of mobile money services by firms for which tax rates constitute an obstacle affect entrepreneurship.

Third, corruption that imposes some financial and non-financial costs for entrepreneurs is an obstacle to business creation (Audretsch et al., 2021; Tonoyan et al., 2010; Dreher and Gassebner, 2013). Indeed, corruption creates some unseen additional fees and reduces the funds available for investments in the activity. From a non-financial point of view, corruption requires taking time to make connections or negotiate bribes with bureaucrats in government when that time could have been used to create some value. Furthermore, Dreher and Gassebner (2013) explain that in some cases, bribery is required to obtain a business permit or license. In column 7, we include a variable "Obstacles: Corruption" which takes the value 1 if the firm mentions corruption as an obstacle to its activity and 0 otherwise and its interaction with our variable of interest. While the interaction term is not significant, corruption appears to be an obstacle to entrepreneurship and its effect is significant at the 10 percent level. We also include in column 6, a variable "Obstacles: Licensing & permits" which takes the value 1 if the firm mentions business licenses and obtaining permits as an obstacle to its activity and 0 otherwise and its interaction with the Mobile money usage variable. Nonetheless, none of the two variables is significant. We can then conclude that tax rates and corruption are the most determinant obstacle to entrepreneurship in the studied countries.

Table 9. Results considering environment entrepreneurship

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Mobile money usage	**0.3677*** **	**0.8305*** **	**0.7327*** **	**0.2625* **	**0.4099*** **	**0.3401*** **	**0.3518*** **
	(0.10040)	**(0.20634)**	**(0.19176)**	**(0.13520)**	**(0.13043)**	**(0.11525)**	**(0.11931)**
Female top manager	0.2285*						
	(0.13534)						
MM*Female top manager	0.1318						
	(0.21129)						
Female owning more than 50%		0.9466***					
		(0.20847)					
MM*Female owning more than 50%		-0.3632					
		(0.29071)					
Female owning 100%			0.7447***				
			(0.21400)				
MM*Female owning 100%			-0.1367				
			(0.30496)				
Obstacles: Tax rate				-0.0728**			
				(0.03192)			
MM use * Obstacles: Tax rate				0.0801			
				(0.05493)			
Obstacles: Tax administration					-0.0368		
					(0.03578)		
MM use * Obstacles: Tax adm					-0.0008		
					(0.05914)		
Obstacles: Licensing & permits						-0.0105	
						(0.03120)	
MM use * Obstacles: Licensing & p						0.0548	
						(0.05155)	
Obstacles: Corruption							-0.0473*
							(0.02690)
MM use * Obstacles: Corruption							0.0314
							(0.04493)
FDI net inflows (log)	0.9722***	1.1166*	1.0758*	1.0255***	1.0105***	1.0658***	0.9960***
	(0.33423)	(0.60961)	(0.60750)	(0.33636)	(0.33632)	(0.33931)	(0.33413)
GDP growth rate	-0.5401***	-0.6317*	-0.5831	-0.5814***	-0.5618***	-0.6071***	-0.5688***
	(0.18797)	(0.36499)	(0.36367)	(0.18910)	(0.18925)	(0.18997)	(0.18864)
GDP per capita (log)	0.3115	0.9598	0.8875	0.3470	0.3142	0.2959	0.3600
	(0.29882)	(0.58854)	(0.58697)	(0.30073)	(0.30065)	(0.30179)	(0.29907)
Population growth rate	-2.0843***	-3.0081**	-2.8402**	-2.1831***	-2.1187***	-2.1959***	-2.1277***
	(0.59615)	(1.27924)	(1.27533)	(0.59912)	(0.59939)	(0.59947)	(0.59738)
Population density	-0.0147**	-0.0289**	-0.0278**	-0.0147**	-0.0146**	-0.0147**	-0.0150**
	(0.00639)	(0.01376)	(0.01372)	(0.00640)	(0.00640)	(0.00639)	(0.00640)
Unemployment rate	-0.2996**	-0.5954*	-0.5680*	-0.3050**	-0.3008**	-0.2948*	-0.3095**
	(0.15194)	(0.32010)	(0.31929)	(0.15215)	(0.15223)	(0.15194)	(0.15199)
High-technology export	-2.0340*	-4.9245*	-4.8250*	-2.0700*	-2.0099*	-1.8882	-2.1183*
	(1.17406)	(2.54735)	(2.54419)	(1.18073)	(1.18225)	(1.17660)	(1.17772)
Constant	-12.6246***	-14.9337*	-14.3360*	-13.3200***	-13.1537***	-13.8364***	-12.9846***
	(4.84134)	(8.35510)	(8.32880)	(4.85969)	(4.85779)	(4.88222)	(4.83686)
Country FE	YES	YES	YES	YES	YES	YES	YES
Survey year FE	YES	YES	YES	YES	YES	YES	YES
Observations	4635	1473	1473	4589	4588	4585	4554
Log-likelihood function value	-2087.55	-658.26	-663.01	-2060.35	-2059.15	-2057.48	-2047.07
Pseudi-R2	0.067	0.099	0.093	0.069	0.068	0.068	0.067
Chi-squared	301.146	144.823	135.316	304.178	300.292	299.444	295.663
Model test p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Marginal effect (MM usage)	**0.052*** **	**0.118*** **	**0.104*** **	**0.037* **	**0.058*** **	**0.048*** **	**0.050*** **
	(0.0141)	**(0.0289)**	**(0.0271)**	**(0.0190)**	**(0.0183)**	**(0.0162)**	**(0.0168)**

Standard errors in brackets. * p<0.1, ** p<0.05, and *** p<0.01.

5 Conclusion

The present chapter investigates the relationship between MM services adoption and usage and the creation of SMEs in Africa. We find that MM is contributing to the expansion of entrepreneurship in African countries. Thus, by increasing entrepreneurship, MM indirectly contributes to the reduction of unemployment, which has remained at a relatively high level despite the high growth that the continent has experienced over the last twenty years. Furthermore, the impact of MM on entrepreneurship is direct. It does not imply an improvement in the entrepreneurial environment across the main societal (taxation, corruption, and market entry) and individual (gender) determinants of entrepreneurs' environmental orientations. More interestingly, we find that MM contributes more to small business creation in the service sector followed by manufacturing.

Our results have some important implications in terms of policy recommendations. First, it is crucial that state actors introduce and strengthen policies to increase the availability of digital financial services for individuals who intend to engage in entrepreneurship or run businesses. Second, given that entrepreneurship offers a chance for some people to generate income and escape poverty, it is important that governments implement programs to promote entrepreneurship among individuals, especially youth. Third, our results showed that tax rates and corruption were the main obstacles to entrepreneurship for SMEs. In this sense, efforts should be made by governments to create progressive tax systems that would encourage the creation of new businesses while adopting measures to reduce corruption. The full success of these recommendations requires coordination between the public and private actors involved and a strong political commitment from countries.

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APPENDIX TO CHAPTER 3

1 Supplementary Tables

Table 10. Probit estimation results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Mobile money usage	**0.3905*** **	**0.3848*** **	**0.3846*** **	**0.3906*** **	**0.3136*** **	**0.3287*** **	**0.2217*** **	**0.1867*** **	**0.2091*** **	**0.1630*** **	**0.2075*** **
	(0.04178)	**(0.04216)**	**(0.04216)**	**(0.04261)**	**(0.04369)**	**(0.04404)**	**(0.04714)**	**(0.04925)**	**(0.05356)**	**(0.05214)**	**(0.05359)**
FDI net inflows (log)		0.1330***	0.1473***	0.1296***	0.2411***	0.3028***	0.4154***	0.4375***	0.6319***	-0.0065	0.5812***
		(0.02968)	(0.03545)	(0.03939)	(0.04413)	(0.04881)	(0.05244)	(0.05518)	(0.10214)	(0.12154)	(0.18946)
GDP growth rate			-0.0116	-0.0142	-0.0602***	-0.0850***	-0.1175***	-0.1794***	-0.3408***	0.0415	-0.3148***
			(0.01574)	(0.01600)	(0.01761)	(0.01916)	(0.02019)	(0.02646)	(0.06115)	(0.04190)	(0.10545)
GDP per capita (log)					-0.2215***	-0.2907***	-0.1336*	-0.1599*	0.2025**	0.4875***	0.1914
					(0.07005)	(0.07352)	(0.07857)	(0.09078)	(0.10288)	(0.17170)	(0.16943)
Population growth rate					-0.4838***	-0.5760***	-0.5765***	-0.7423***	-1.1534***	0.0910	-1.1870***
					(0.07020)	(0.07532)	(0.07625)	(0.09289)	(0.12890)	(0.11826)	(0.32522)
Population density						-0.0017***	-0.0033***	-0.0062***	-0.0085***	-0.0056***	-0.0087**
						(0.00052)	(0.00057)	(0.00075)	(0.00107)	(0.00114)	(0.00349)
Unemployment rate							-0.0905***	-0.1332***	-0.1823***	-0.1535***	-0.1802**
							(0.01418)	(0.01813)	(0.02428)	(0.03444)	(0.08402)
High-technology export								-0.3888***	-1.0431***	-1.3645***	-1.2200*
								(0.12223)	(0.26003)	(0.26747)	(0.62805)
Constant	-1.1132***	-3.8894***	-4.1216***	-3.8038***	-2.8826***	-3.1549***	-5.9402***	-4.7813***	-8.7842***	-3.3124	-7.7365***
	(0.02594)	(0.62248)	(0.69818)	(0.76317)	(0.73180)	(0.73732)	(0.89023)	(0.93645)	(1.47776)	(2.10595)	(2.81179)
Country FE	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	YES
Survey year FE	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES
Observations	5487	5358	5358	5358	5358	5358	5358	5090	4639	5090	4639
Log-likelihood function value	-2421.65	-2372.62	-2372.35	-2371.84	-2348.52	-2342.96	-2321.83	-2208.05	-2097.21	-2137.56	-2096.17
Pseudi-R2	0.018	0.022	0.022	0.022	0.032	0.034	0.043	0.053	0.065	0.083	0.065
Chi-squared	86.644	105.442	105.990	107.001	153.634	164.769	207.019	246.005	289.338	386.988	291.429
Model test p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Marginal effect (MM usage)	**0.096*** **	**0.095*** **	**0.094*** **	**0.096*** **	**0.076*** **	**0.080*** **	**0.053*** **	**0.045*** **	**0.053*** **	**0.038*** **	**0.052*** **
	(0.0101)	**(0.0102)**	**(0.0102)**	**(0.0103)**	**(0.0106)**	**(0.0106)**	**(0.0113)**	**(0.0119)**	**(0.0135)**	**(0.0121)**	**(0.0135)**

Table 11. OLS estimation results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Mobile money usage	**0.1021*** **	**0.1010*** **	**0.1009*** **	**0.1031*** **	**0.0843*** **	**0.0884*** **	**0.0664*** **	**0.0583*** **	**0.0520*** **	**0.0437*** **	**0.0516*** **
	(0.01065)	**(0.01078)**	**(0.01078)**	**(0.01089)**	**(0.01104)**	**(0.01110)**	**(0.01161)**	**(0.01212)**	**(0.01237)**	**(0.01235)**	**(0.01238)**
FDI net inflows (log)		0.0303***	0.0324***	0.0272***	0.0514***	0.0633***	0.0856***	0.0906***	0.1073***	0.0171	0.0753
		(0.00686)	(0.00811)	(0.00893)	(0.00950)	(0.01016)	(0.01074)	(0.01132)	(0.01525)	(0.02659)	(0.05216)
GDP growth rate			-0.0018	-0.0027	-0.0135***	-0.0189***	-0.0254***	-0.0409***	-0.0319*	-0.0008	-0.0348
			(0.00371)	(0.00377)	(0.00405)	(0.00436)	(0.00447)	(0.00595)	(0.01916)	(0.00936)	(0.02549)
GDP per capita (log)					-0.0463***	-0.0607***	-0.0240	-0.0290	0.0672**	0.0324	0.0754
					(0.01638)	(0.01695)	(0.01788)	(0.02240)	(0.03198)	(0.03371)	(0.06569)
Population growth rate					-0.1238***	-0.1451***	-0.1422***	-0.1923***	-0.3977***	-0.0125	-0.4264**
					(0.01718)	(0.01835)	(0.01829)	(0.02334)	(0.08669)	(0.02797)	(0.17884)
Population density						-0.0004***	-0.0008***	-0.0015***	-0.0042***	-0.0007***	-0.0040**
						(0.00012)	(0.00014)	(0.00018)	(0.00053)	(0.00021)	(0.00171)
Unemployment rate							-0.0198***	-0.0311***	-0.0543***	-0.0155***	-0.0433***
							(0.00318)	(0.00429)	(0.00818)	(0.00570)	(0.01533)
High-technology export								-0.0934***	-0.3874***	-0.1502***	-0.3412***
								(0.02857)	(0.06362)	(0.04481)	(0.12426)
Constant	0.1328***	-0.4984***	-0.5322***	-0.4405**	-0.1869	-0.2143	-0.7978***	-0.4815**	-0.5919	-0.2545	-0.0093
	(0.00606)	(0.14345)	(0.15928)	(0.17262)	(0.16705)	(0.16711)	(0.19092)	(0.21159)	(0.37047)	(0.43873)	(1.02494)
Country FE	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	YES
Survey year FE	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES
Observations	5487	5358	5358	5358	5358	5358	5358	5090	5090	5090	5090
Adjusted-R2	0.016	0.020	0.020	0.020	0.029	0.031	0.037	0.048	0.086	0.078	0.086
Model test p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Marginal effect (MM usage)	**0.102*** **	**0.101*** **	**0.101*** **	**0.103*** **	**0.084*** **	**0.088*** **	**0.066*** **	**0.058*** **	**0.052*** **	**0.044*** **	**0.052*** **
	(0.0106)	**(0.0108)**	**(0.0108)**	**(0.0109)**	**(0.0110)**	**(0.0111)**	**(0.0116)**	**(0.0121)**	**(0.0124)**	**(0.0124)**	**(0.0124)**

PART II:

TAX ENVIRONMENT AND ITS IMPLICATIONS FOR DIGITAL FINANCIAL INCLUSION IN AFRICAN COUNTRIES

THE PASS-THROUGH OF MOBILE MONEY TAXATION ON TRANSACTIONS VALUE IN KENYA

Abstract

We study how mobile money transactions taxation introduced in 2013 has affected the mobile banking diffusion in Kenya. Considering Jordà's local projection, we find that the excise duty's effect on the average transaction value is negative and does not occur immediately. In fact, a 1 percent increase in the excise duty contributes to reducing the average transaction amount by up to 0.51 percent about one year after the shock. These findings have important implications in term of policy recommendation for governments as the financial inclusion process may be impacted.

Keywords: Mobile money, Diffusion process, Tax incidence

JEL Code: O33, C22, H22

1 Introduction

In 2005, the Mobile Network Operator (MNO) Safaricom finalized the development of the framework for the "M-PESA"[13] pilot as microfinance repayment tool. Then, the "M-PESA" pilot began in the town called Thika.[14] The pilot was so successful that Safaricom sought further authorization to convert from microfinance to mobile money (MM) transfer in 2006. The Central Bank of Kenya gave a no objection to the conversion and the first mobile money transfer was launched in 2007.

As a result, M-PESA was adopted by more than 50% of Kenya's adult population in only a few years after its launch. The innovation was so well received by the population that three-quarters of Kenyan households have at least one user. The rapid adoption of the product is due in part to its wide availability. Indeed, the rapid growth of a network of "M-PESA" agents and small businesses that provide cash-in and cash-out services accounts for this rate of adoption. As of March 2014, the number of "M-PESA" agents was estimated to be close to 120,000 for monthly transactions of $2 billion.[15] "M-PESA" is preferred over other payment methods for its simplicity, its acceptance of small transactions unlike banks, its speed, international recognition, and affordability. The service is since extended to other African countries such as South Africa, Mozambique, and Tanzania.

However, the Kenyan government introduced a tax on telephone financial transactions for the first time in 2013 through an excise duty at a rate of 10%. This

[13] "M" for mobile and "PESA" for money in Swahili.

[14] Thika is a town in the Central Province of Kenya.

[15] The statistics come from the database available on the website of the Central Bank of Kenya.

excise tax increased with the 2018 finance act, which set the new rate to 12%. Then, mobile service providers Safaricom, Telkom Kenya and Airtel Kenya all revised their tariffs upwards. Following the fare hikes, Kenyan public opinion has denounced the government's interventions as impeding financial inclusion, the adoption of innovation and negatively affecting the purchasing power of Kenyans, namely low-income earners (Ndung'u, 2019). Furthermore, Ndung'u (2019) argued that while the tax contribution related to mobile money represents less than 1 percent of Kenya's total tax revenues, its economic costs are important.

Focusing on the effect of such policy, we study how mobile money taxation can trigger mobile money transaction values using data from the Central Bank of Kenya. As the excise duty influences transaction costs, the value of transactions could be affected. Indeed, excise duty increases effective cost of service providers and this increase affect both consumer prices, the transaction costs paid by final consumers, and producer prices, the profit margin of producers. The cost increase leads to raise consumers' price (Delipalla and Keen 1992; Anderson et al 2001) and the magnitude of the increase in consumer prices depends on producers' reaction. Either the profit margin remains unchanged following the introduction of the tax and the tax is fully borne by consumers, or the producers lower their profit margin and bear part of the tax. Either way, the excise tax leads to an increase in tariffs, and this will have an impact on the level of use of the mobile money service.

To assess the effect of excise duty on the value of transactions, we use Jordà's local projection. The findings reveal that a 1 percent increase in the excise duty contributes to reducing the average transaction amount by up to 0.51 percent about one year after the shock.

The reminder of the chapter is structured as follows. Section 2 presents the economic and social context of Kenya. Section 3 shows the general information concerning M-Pesa. Section 4 presents literature review on the concept of economic pass-through. Section 5 introduces the local projection model and section 6 gives results concerning the effect of the excise duty on mobile money use with model estimation following Jordà's (2005) method. Section 7 concludes.

2 Country overview of Kenya

Kenya is a developing country located in Sub-Saharan Africa. More specifically, it borders Ethiopia to the north, Uganda to the west, Somalia to the east, South Sudan to the northwest, and Tanzania to the south-southwest. Like many other African countries, the country went through a colonial period first with Germany and then with the United Kingdom. The country gained independence from the British in 1963. According to the United Nations (UN), Kenya's population is estimated at 53.8 million with a density of 85.3 inhabitants per square kilometer. Urban areas have a high population density relative to sparsely populated rural areas. This is due to the fact that these urban areas have more infrastructure (education, health, roads).

Kenya has enjoyed a marked acceleration in economic growth over the past decade, averaging nearly 5.9 percent since 2010. The country's GDP per capita is USD 98.8 billion in 2020, for a GDP per capita of 1838.2. This wealth is mainly derived from the tertiary sector (exports, communication, trade) and the primary sector (production of coffee, corn, tea, flowers). These recent economic achievements make Kenya a major player in the economic development of East Africa. The World Bank now classifies it as a middle-income country. However, the country is still marked by a high level of informality. The formal sector accounts for nearly 45% of overall economic activity and

more than 80% of the active population (entrepreneurs, artisans, traders) according to the French Development Agency (AFD). The unemployment rate will represent nearly 5% of the active population in 2019. Young people are the group most affected by unemployment with a rate of 12.9%. There is also an unequal distribution of income with nearly 40% of the population still living below the poverty line. The country is marked by relatively high levels of corruption and crime.

In 2006, a year before the effective launch of mobile money in the country, the rate of bank penetration among the population was only 14%. The majority of the national population, 86%, was excluded from the traditional banking system. This low rate of bank penetration has led to difficult access to financing, especially for SMEs. In addition, at the same time, Kenya was experiencing some difficulties in terms of internet coverage and accessibility. To give a figure, only 3.6% of the Kenyan population was using the internet in 2006. This combination of banking and technological shortcomings has been the driving force behind the take-off of mobile money in the country with the M-Pesa project. According to the Central Bank of Kenya, the bancarisation rate in 2019 was 41%, placing the country in third place among African countries with the highest bancarisation rate, behind the Seychelles and South Africa, which occupy first (95%) and second (90%) place respectively.

Table 12. Key figures of Kenya

Region	Sub-Saharan Africa
Population	53.8 million (2020)
GDP (USD$)	98.8 billion (current USD$)
GDP per capita (USD$)	1,838.2 (current USD$)
Unemployment rate	5% (2029)
Inflation rate	5.4% (consumer price; annual)
Mobile Subscriptions (per 100 habitants)	103.8

Source: Data retrieved from World Development Indicators

3 Kenya's M-Pesa

Kenya is one of the pioneers in the launch and use of mobile money in Africa with the M-Pesa product. M-Pesa is a kind of e-wallet that was launched in Kenya by mobile network operator Safaricom, and has modeled a new form of financial transactions in Africa. According to GSMA, M-Pesa has been the world's most successful mobile money platform in terms of users and value of transactions in a country for the past few years. As mentioned in the introduction, the product has enjoyed rapid and significant success with the Kenyan population. This rapid success clearly shows that the product meets a need for financial inclusion that is present in the market. The product is specifically targeted at unbanked, semi-literate individuals who face physical and financial security issues. The basic concept of the product was to allow an individual to use his or her cell phone to transfer money quickly, securely and over long distances directly to another cell phone user. In doing so, the product will undergo

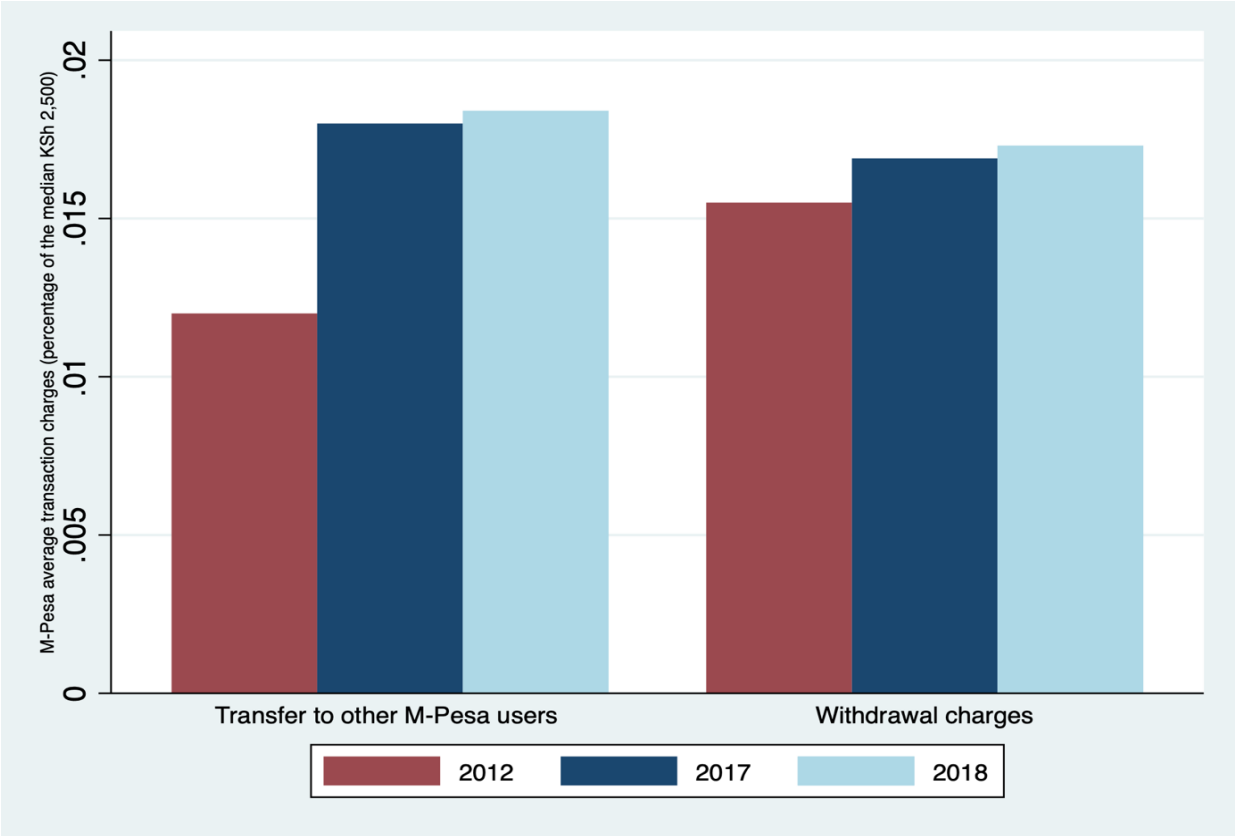
continuous improvement as it adapts to the dynamic needs of the people. The services offered by M-Pesa today are Person-to-Person (P2P) money transfers, Person-to-Government (P2G) money transfers, Customer-to-Business (C2B) money transfers, payment for goods and services, prepaid airtime purchase, and micro-banking. We believe that the future prospect of M-Pesa, as a digital financial technology, will be to define a fully-fledged digital financial system. In other words, mobile money in Kenya will be able to provide everything that is already offered by M-Pesa as financial services in the traditional banking system. This will include credit, deposit accounts where the contact is the identity (RIB in the traditional banking system), insurance and financial securities.

The M-Pesa product has economic and social benefits that include increasing financial inclusion in the country, reducing poverty, facilitating tax collection and improving public service delivery. In terms of financial inclusion, Kenya has seen its bancarisation rate increase from 14% to 41% from 2006 to 2019 thanks to mobile money. According to the Findex global database, 81.6% of the Kenyan population had access to a mobile money account. Thus, by increasing the level of financial inclusion, mobile money has contributed to sustainable poverty reduction in Kenya. Suri and Jack's (2016) work showed that access to the M-Pesa product both led to an increase in per capita consumption levels and lifted nearly 194,000 households (or 2% of Kenyan households) out of poverty. Finally, in terms of facilitating tax collection and improving public service delivery, the Kenyan government through two initiatives (eCitizen and Huduma) is leading efforts to digitize public services and payments via the P2G service provided by the M-Pesa product. For example, the Kenya Revenue Authority (KRA) launched the KRA M-service, a platform to access tax and customs services, in late

2014. The platform has enabled small taxpayers in the informal sector to meet their tax obligations (Ndung'u 2019).

In doing so, the introduction of an excise tax in 2013 on mobile money activities in Kenya could undermine the economic and social benefits of the M-Pesa product by reducing the level of usage. Indeed, while the tax is aimed at operators, it could ultimately be borne by consumers. Tax incidence theory states that taxes are not always borne by those on the front line and can be transferred to other parties (Besley and Rosen, 1999; Delipalla and Keen, 1992; Poterba, 1996). In addition, Ndung'u (2019) presented the evolution of average transaction fees by amount segments for M-Pesa transactions, highlighting that transaction fees increased after the introduction of the excise tax in 2013. We subsequently provide an empirical analysis to assess the impact of the tax on the level of usage of the M-Pesa product.

Figure 15. Average changes in Safaricom M-Pesa's transaction charges



Note: The data comes from Ndung'u (2019), presenting the average transaction fees for several segments. Our mean transaction value variable ranges from KSH 2,200 to 3,200. We, therefore, retain here for illustrative purposes the transaction fees for the KSH 1,001 - 5,000 range. For more details on the other segments, please refer to Ndung'u (2019).

4 Previous studies on the pass-through

In simple terms, cost pass-through describes the change in products or services prices resulting from a cost shock. This important economics concept is frequently studied in various fields. According to the literature, the main fields that have a strong interest in this concept are industrial organization, international economics and public economics. In industrial organization, the analysis of pass-through helps to understand merger assessment (Jaffe and Weyl, 2013) or welfare effects of price discrimination (Aguirre et al, 2010). Weyl and Fabinger (2013), operate pass-through as a tool to show that principles of tax incidence can be used to simplify and generalize

the analysis of optimal procurement of new markets and the welfare effects of third-degree price discrimination.

As for international economics, it is usually a question of judging the degree to that exchange rate changes are transmitted to import prices and then to final consumer prices (Campa and Goldberg, 2005). Researchers commonly refer to the term "exchange rate pass-through" (ERPT) to describe this topic. Dixit (1989) encourages researchers to examine the effects of exchange rate fluctuations on an industry where sunk costs are important for each firm. He assumed that the ERPT to domestic prices, in a competitive industry with home firms and foreign firms, is found to be close to one in the phases where foreign firms enter or exit, and near zero otherwise.

Finally, for public economics, pass-through is central to the theory of tax incidence. Delipalla and Keen (1992) compares ad valorem and specific taxation with two oligopolistic market structures with and without free entry. They use the mechanism of cost pass-through to conclude that ad valorem taxation dominates specific taxation from a welfare perspective. In the continuation of Delipalla and Keen's work, using the same process in an oligopolistic industry with differentiated products and price setting firms, Anderson et al. (2001) assume that ad valorem and unit excise taxes both may be passed on to consumers by more than 100 percent and an increase in the tax rate can increase short run firm profits.

In doing so, pass-through literature underlines an incompleteness of pass-through. Indeed, there are factors that prevent a complete or even over shifted price variation. Three main factors of pass-through incompleteness are, respectively, the strategic adjustment of markups due to cost shocks, the presence of certain costs that remain unaffected by the observed cost shock and the presence of price rigidities that restrict firms from optimally adjusting prices. Goldberg and Hellerstein (2008) assume that,

among these three channels, non-traded costs are the main source of incomplete pass-through, then markup adjustment followed by price rigidities. Nakamura and Zerom (2010) later proved that nominal price rigidities have a minor impact on the long-run pass-through.

Regarding empirical methods for the pass-through rate estimation, model choice varies across type of data[16], the nature of the relationship between costs and price[17] and the sample unit.[18] Nevertheless, because marginal costs and markups are non-observable, it remains difficult to measure in practice the cost pass-through. Fabra and Reguant (2014) study the pass-through of emission costs to wholesale electricity with rich micro-level data on Spain. Using an instrumental variables approach, they find that the effects of an increase in emission costs are almost fully passed through to electricity prices. This conclusion does not concur with the existing literature. For the authors, this result is due to small adjustment cost and that firms in this sector have weak incentives to adjust markups after the cost shock in presence of highly inelastic demand.

Then, Colavecchio and Rubene (2020) use the impulse responses technique to estimate the non-linear ERPT to Euro area inflation. They take the Jordà (2005) local projection model in which they introduce interaction terms to capture the presence of non-linearities. They find that prices respond significantly to exchange rate movements after one year, responding more when the exchange rate change is relatively large.

To finish, Becker et al. (2012) use a nonlinear threshold error-correction model to explore the pass-through of the official rate to the money market rate and of the market

[16] Micro or macro-level.
[17] Linear or non-linear relationship.
[18] Individual, country, or a geographical area.

rate to the mortgage rate in United Kingdom. Their results indicate the presence of substantial asymmetries in both steps of the process.

5 Estimation method

Several methods for impulse response estimation exist in the literature. Many authors use a vector auto regressive (VAR) methodology. The underlying assumption of this methodology is that the data are generated following a VAR model that coincides with the data generating process. Considering such assumptions when they are not met can introduce misspecification in the estimation of the impulse response function (Cooley and Dywer, 1998; Jordà, 2005). Another widely used method for impulse response function estimation is the Error Correction Model (ECM). However, the low power of co-integration tests with ECM constitutes an important limit to its use. Furthermore, Hendry (1976), Sims et al. (1990), Lin and Tsay (1996), and Chevillon and Hendry (2005) pointed the fact that estimating a VAR model in level is preferable to estimating an ECM as the former is valid when there is no information on the presence of unit roots and cointegration[19] in the case of forecasting. In fact, estimating a VAR model specified in first difference supposes the absence of cointegration among the variables because of the non-inclusion of an error correction term (Haug and Smith, 2012). The presence of a cointegration structure will then introduce misspecification.

We then specify our impulse response function in level including a trend term as recommended by Ashley and Verbrugge (2009) and adopt a local projection approach proposed by Jordà (2005) as in contrast with VAR models, it estimates direct impulse response at each horizon and can be estimated through a simple regression method

[19] We run an augmented dickey fuller and an Elliot-Rothenberg-Stock (ERS) test for our endogenous variable. The results show that it is stationary at 10 percent level.

such as OLS[20]. Moreover, the Jordà local projection method is more robust to misspecification problems as it is without any reference to DGP and even if its Wold decomposition does not exist, the impulse responses can be defined. Furthermore, they allow asymmetries and non-linearities in effects to be taken into account with flexible specifications, which is not practical in multivariate cases. We estimate our specification through the following local projection equation:

$$lav\_trans_{t+h} = \sum_{q=1}^{p} \alpha_q (lav\_trans_{t-q}) + \beta_h ltax_t + \sum_{l=0}^{m} \gamma_l X_{t-l} + \eta + \varepsilon_{t+h}, \mathrm{h} = 0, \dots, \mathrm{H} \quad (4.1)$$

where lav_trans is the logarithm of the average monthly mobile money transaction value in KSH[21]; $ltax$ is the logarithm of the excise duty rate;[22] η defines a time trend; ε_{t+h} is the error term; h refers to the number of horizons; X_t represents a matrix of control variables including the GDP per capita growth rate[23], to monthly average inflation[24], the CPIA index[25], the number of transactions[26], a dummy variable indicating high transaction season months[27], and the number of mobile money services suppliers[28]. q indicates the number of lags of the endogenous variable, which we set to 13 in line with the Akaike Information Criterion, Final Prediction Error (FPE), Schwartz Information Criterion (SIC), Bayesian Information Criterion (BIC), and Hannan-Quinn Criterion (HQC). l corresponds to the number of lags of the control

[20] Ahmed and Cassou (2016) also argued that local projection is robust with nonstationary or cointegrated data.

[21] The data comes from the Central Bank of Kenya.

[22] As we have before the excise institution a rate of 0, we compute ltax=log (1+Excise rate).

[23] The data comes from World Development Indicators.

[24] The data comes from the Central Bank of Kenya.

[25] The data comes from World Development Indicators.

[26] The data comes from the Central Bank of Kenya.

[27] We construct a dummy variable taking the value 1 for month in which high variations are observed, namely months of festive periods and school opening. The main festive dates we retained are the Aïd El-Fitr, Aïd El-Kebir, Easter, Christmas, and the New Year. Easter is celebrated in April, Christmas in December, and the New Year in January. For Aïd El-Fitr and Aïd El-Kebir, we completed them for each year since 2007. Furthermore, September is a month during which schools open and we then expect an increase of transactions. We then add a value 1 for September.

[28] Authors' construction.

variables[29]. β_h represents our coefficients of interest defined as the response of the logarithm of the average value of a transaction at time $t+h$ with respect to the logarithm of the excise rate at time t. We use Newey and West (1987) standard errors to correct for the serial correlation in the error terms due to succession of lags endogenous variable (Jordà, 2005).

6 Estimation results

Figure 16 below shows the result. We observe that the effect of the tax incidence is not immediate but occurs months later. The pass-through is negative and significant from the 6th to the 9th month after the tax change. Its value increases until it reaches -0.5 from the 9th month after the excise institution. It remains stable until the 17th month, when it starts to fall. An explanation of this result can come from two sides. It could be explained by the fact that people do not immediately respond to the transaction cost change or are not able immediately to adjust their behaviors. They then start adapting their transfer value 6 months after the shock. Another explanation could be an under shifting of the excise by mobile money operators at the first periods of the excise institution. They then bear an important share of the charge until a level at which they prefer shifting it to the consumer, leading to them to adjust the amount of their transfers. In summary, the elasticity of demand in the short term is low, so that the average value of the transaction is not significant in the early periods.

However, in the medium and long term, the elasticity increases, modifying behaviors. Furthermore, by proposing charge-amount pairs, the operators set the level of charges so as to capture the totality of the surplus of the users making the lowest

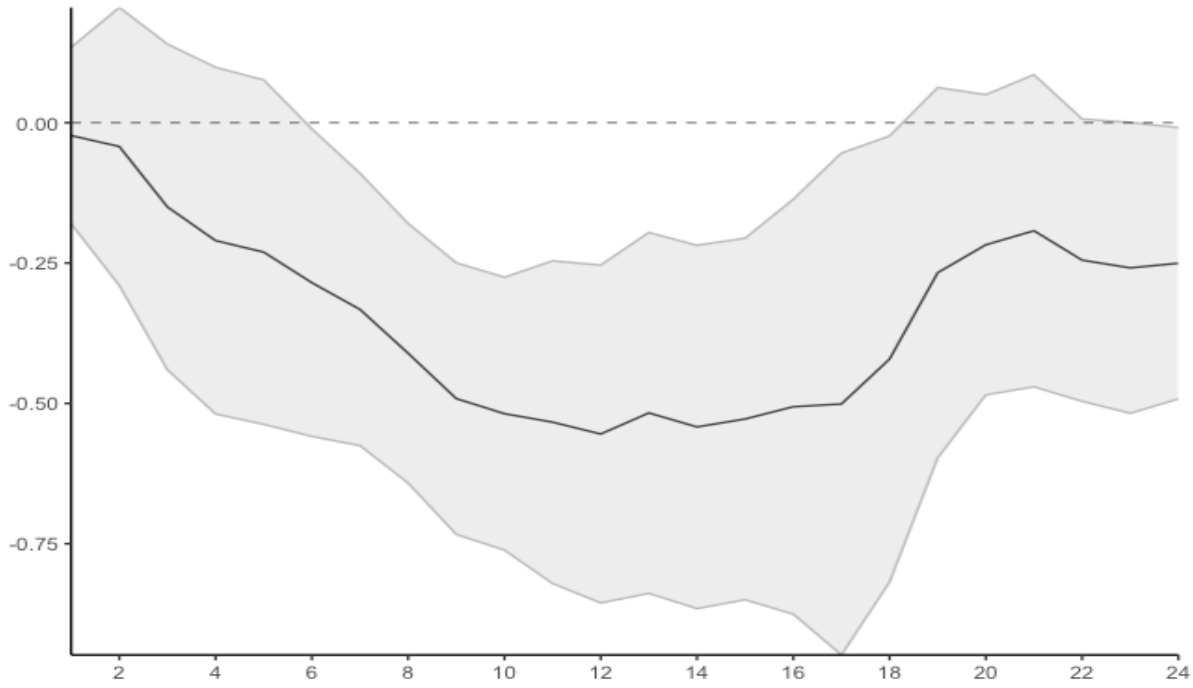
[29] We set its length to 3 considering that they have an effect a quarter after.

amounts and to guarantee a certain surplus to the users making large amounts. However, the introduction of the tax will not necessarily lead to an increase in charges for all amounts. The increase will concern the large amounts more than the small amounts because, as indicated above, the totality of the surplus of users with small amounts is recovered by the operators in the absence of a tax. Ndung'u (2019) underlines the fact that Safaricom's withdrawal fees on amounts ranging from KSh[30] 1 to KSh 100 have remained constant at 0.40% from 2012 to 2018. During the same period, withdrawal fees on amounts ranging from KSh 45,001 to KSh 70,000 increased from 10.67% in 2012 to 11.73% in 2017 and 12% in 2018.

Consumers then respond negatively in their transactions value during the 14 months after which the excise is incorporated into their behaviors. This being said, it should be noted that this incorporation of the tax into their behaviors is due to the benefits of mobile money in Kenya. This innovation, in addition to having enabled people excluded from the traditional banking system to obtain accounts, gives its users the possibility of benefiting from micro-financing and making transfers at lower costs. In this context, the opportunity cost generated by switching from mobile money to cash becomes very high for users.

[30] The Kenyan Shilling (KSh) is the currency of Kenya.

Figure 16. Linear impulse responses result



Note: The bold line depicts the estimates of β_h. The shaded area is the 95 percent confidence intervals.

Source: Authors' calculations.

We also account for non-linearities in the impulse responses by considering the Hodrick-Prescott (HP) filter (see Auerbach and Gorodnichenko, 2013)[31]. We first start by deriving the impulse responses depending on the inflation level.

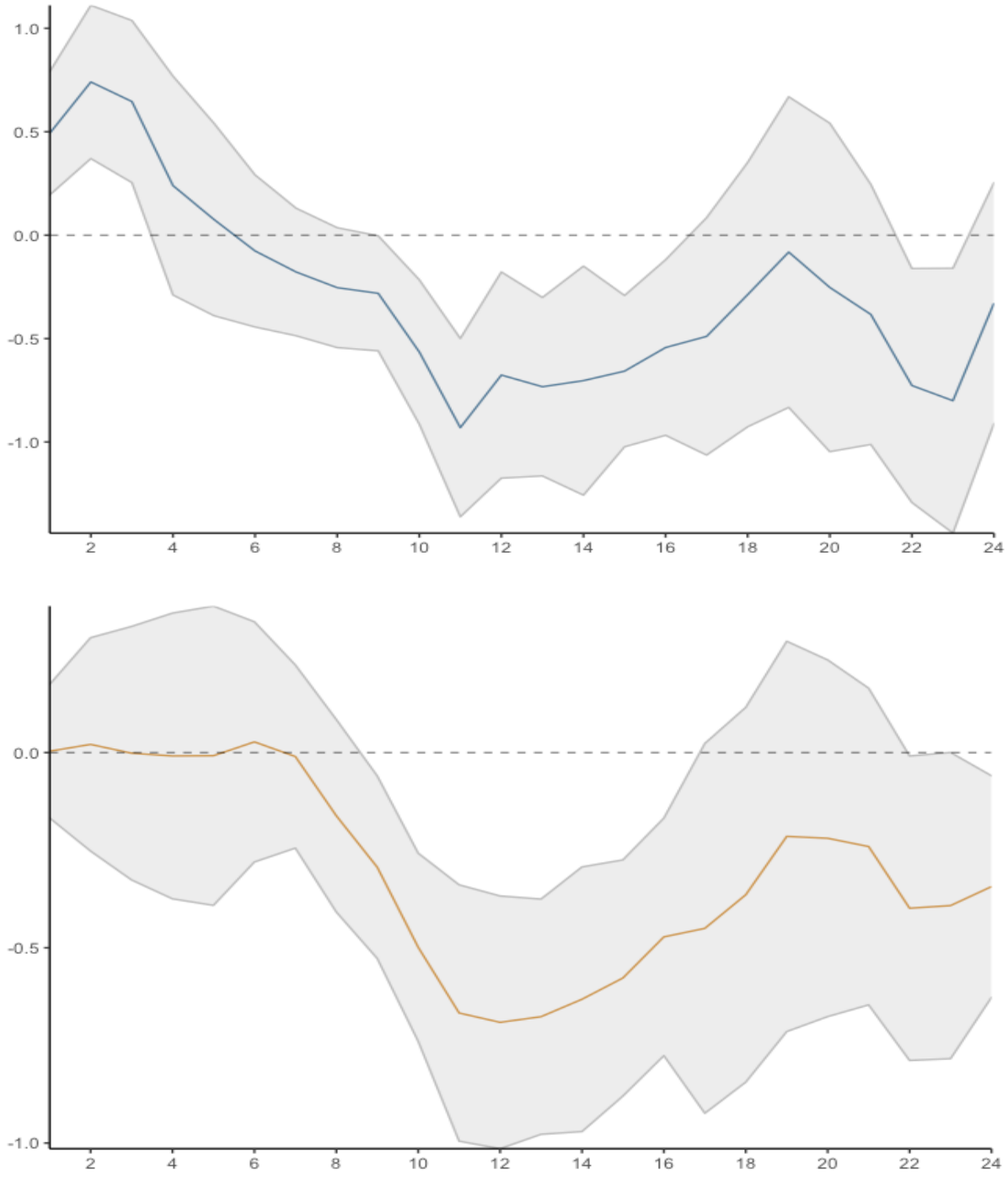
Figure 17 shows the results. We can note that during periods of high inflation (top graph), the pass-through is positive from the 1st to the 3rd month and this effect is significant, meaning that the average transaction value increases with the shock. However, it becomes negative and significant 8 months after the shock and increases up to 0.9 in the 11th month, after which it starts decreasing through the 16th month.

[31] We retain Lambda=129600 and gamma=10 as recommended by Ravn and Uhlig (2002) for monthly data.

In high inflation periods, an increase of 1 percent in the excise rate decreases the average transaction value up to 0.9% in the 11th month.

In low inflation periods (bottom graph), an increase in the transaction cost reflects the effect of the excise duty ceteris paribus. The average transaction value decreases from the 9th month after the shock until it reaches a rate of -0.7% in the 12th month. During periods of high inflation, regardless of the tax, the average nominal amount of the transaction increases relative to its post-tax level. The effect of the excise tax is therefore to increase the average transaction amount because transactions are made for very specific purposes, making them intangible in the short term. However, over months, consumers include the tax in their decision. This leads them to reduce their future transactions for clearing purposes. The result is a higher response than in periods of low inflation.

Figure 17. Nonlinear impulse responses: Inflation level



Note: The bold line depicts the estimates of β_h. The shaded area is the 95 percent confidence intervals. The top graph presents the impulse responses in high inflation periods. The bottom graph presents the impulse responses in low inflation periods.

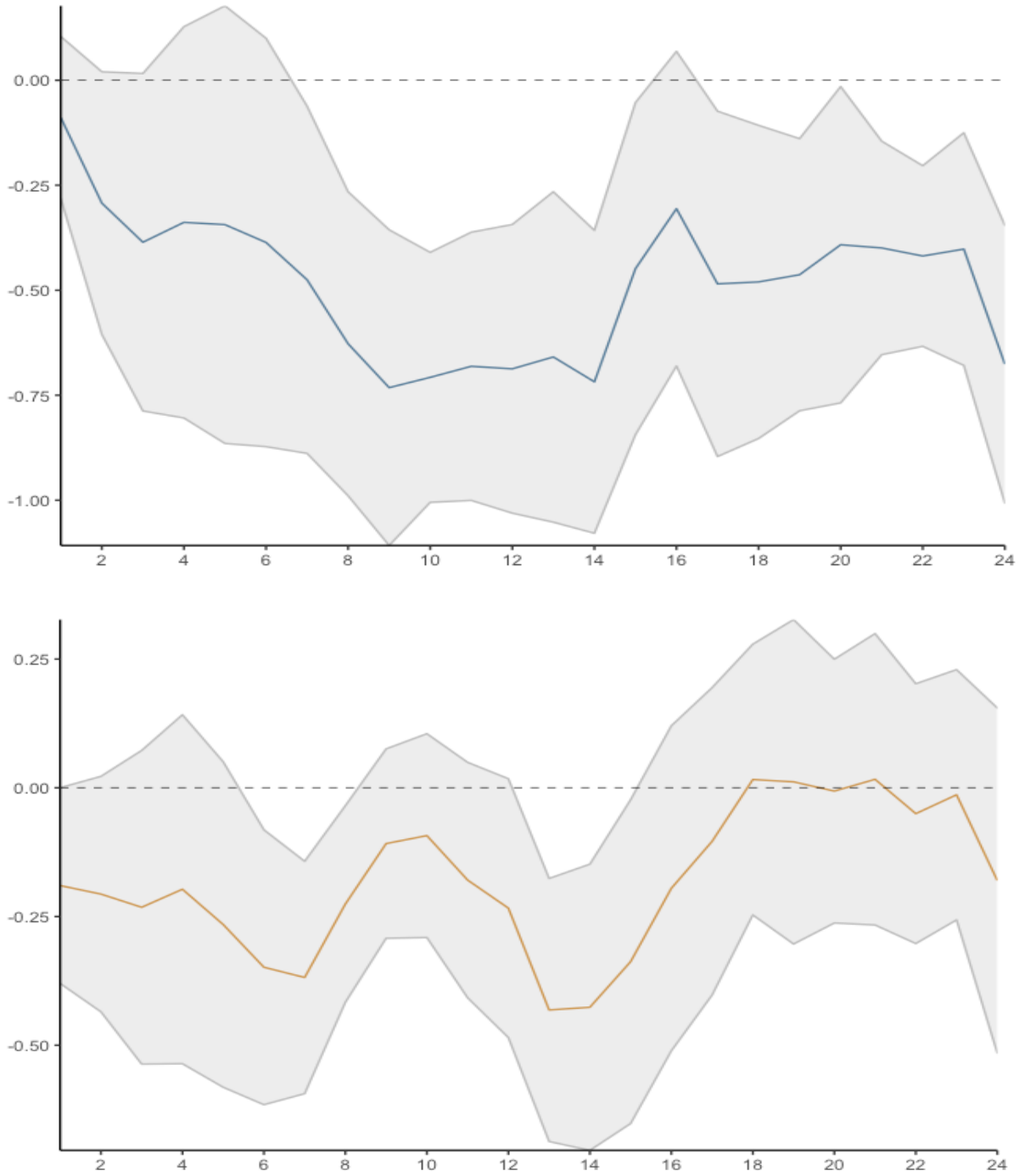
Source: Authors' calculations.

Figure 18 presents the nonlinear result concerning the growth rate level. We then delineate periods of economic expansion and recession. During economic expansion periods, an increase of 1 percent in the excise rate decreases the average transaction value from the 7th month until it reaches a maximum decrease of 0.73 percent 9 months after the shock. In economic recession periods, the effect of the shock on the average transaction value is negative but is significant only from the 5th to the 7th month after the shock and from the 13th to the 15th months; and it reaches a decrease of 0.4 percent 13 months after the shock. This could be explained by the fact that in bad economic times, people who are less sensitive to the transaction cost change make most transactions.

In figure 19, we explore whether the impulse response varies between high and low seasons.[32] In high seasons, the shock has negative and significant effect from the 6th to the 16th month after that reaches a value of -0.7 percent in the 14th month after the shock. In low seasons, the pass-through is significant from the 6th month and varies around -0.5 percent with a maximum value of -0.65 in the 11th month after the shock.

[32] We construct a dummy variable taking the value 1 for month in which high variations are observed, namely months of festive periods and school opening. The main festive dates we retained are the Aïd El-Fitr, Aïd El-Kebir, Easter, Christmas, and the New Year. Easter is celebrated in April, Christmas in December, and the new year in January. For Aïd El-Fitr and Aïd El-Kebir, we completed them for each year since 2007. Furthermore, September is a month during which schools open and we then expect an increase of transactions. We then add a value 1 for September.

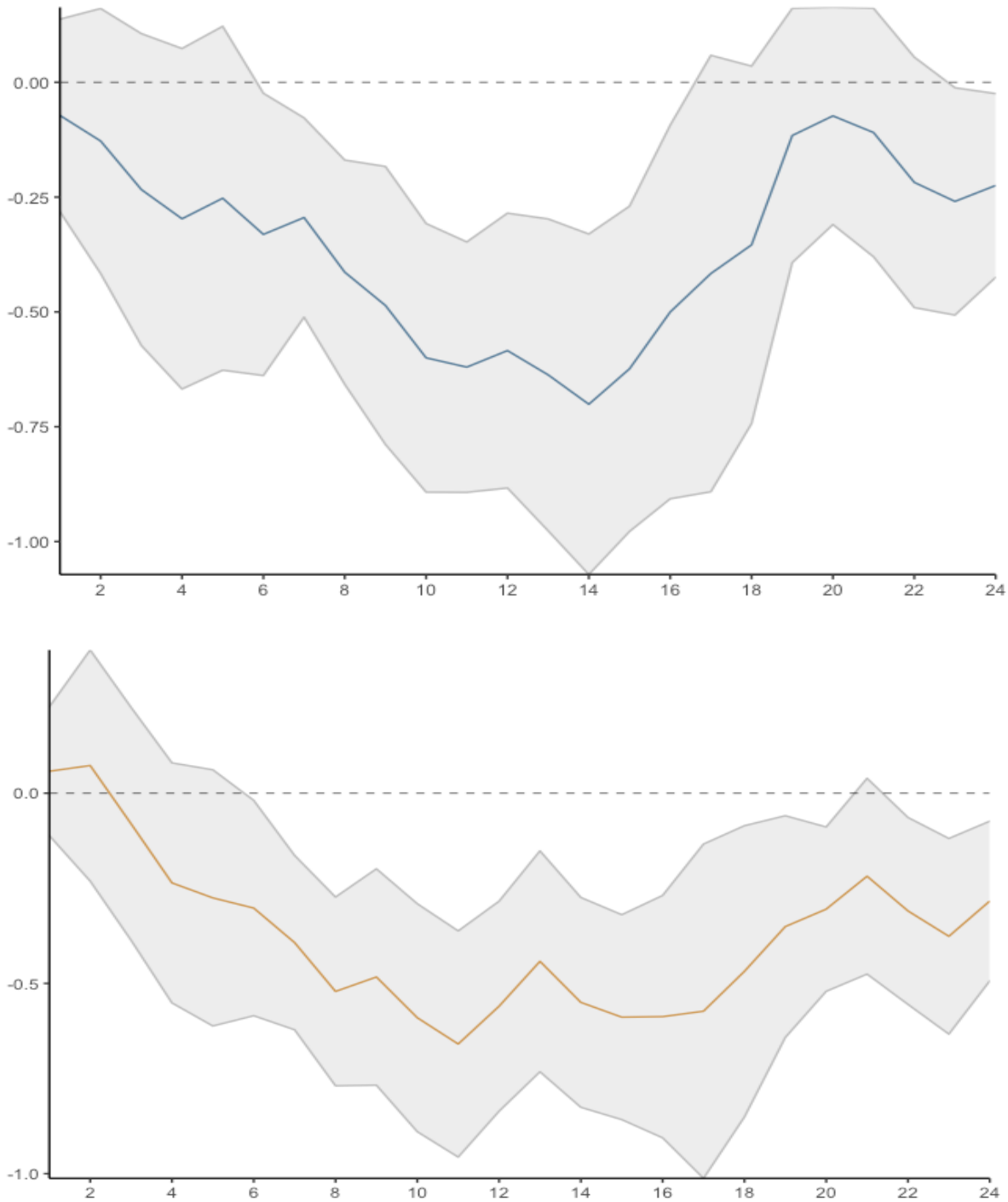
Figure 18. Nonlinear impulses responses: GDP per capita growth rate



Note: The bold line depicts the estimates of β_h. The shaded area is the 95 percent confidence intervals. The top graph presents the impulse responses in economic expansion periods. The bottom graph presents the impulse responses in economic recession periods.

Source: Authors' calculations.

Figure 19. Nonlinear impulse responses: seasons



Note: The bold line depicts the estimates of β_h. The shaded area is the 95 percent confidence intervals. The top graph presents the impulse responses in high season. The bottom graph presents the impulse responses in low season.

Source: Authors' calculations.

From the above, we make the interesting observation that consumers have an increased use of the service during crises, inflation and recession. An explanation for this could come from the work of Jack and Suri (2014). Indeed, based on household survey data in Kenya, they conclude that households with mobile money accounts have a better risk sharing following a shock through remittances. The mechanism is such that by providing a safe but non-remunerated savings vehicle for its users, mobile money encourages households to build up precautionary savings balances. In addition, households with an M-PESA could be considered more creditworthy in the eyes of creditors and thus be in a better position to borrow money in an emergency.

7 Conclusion

This paper investigates how mobile money transaction taxation has affected the mobile banking sector. To do so, we were interested the level of use. Considering Jordà local projection, we find that the excise duty's effect on the average transaction value is negative and does not occur immediately.

The findings of this work complement those of Lashitew et al. (2019) and underline the determining role played by taxes in consumer decisions regarding innovations such as mobile money adoption and use. Knowing the economic and social stakes of mobile money in Kenya, any introduction or review of excise tax should be preceded with an exploration of alternatives to mobile money taxation that can effectively support public revenues. Then, insofar as the government does not have real alternatives, an analysis of optimal taxation must be carried out to determine the rate generating the least distortion and economic inefficiency. These recommendations apply to Kenya as well as to developing African countries where such a tax is in place or proposed.

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E-MONEY, FINANCIAL INCLUSION AND MOBILE MONEY TAX IN SUB-SAHARAN AFRICAN MOBILE NETWORKS

Abstract

E-money and financial inclusion are both development challenges for developing countries, the former contributing to improving tax mobilisation and the latter to achieving certain sustainable development objectives. However, one of the main providers of financial inclusion and e-money services is mobile network operators using mobile money. The latter are subject to numerous taxes that can affect their operations. The paper studies the incidence of the new mobile money excise duty in mobile networks sector on the adoption of e-money and the advancement of financial inclusion through digital services in sub-Saharan countries more broadly. It appears that the introduction of the tax leads to an increase in user fees, which has a positive impact on demand for cash and it is only in the presence of latter that mobile money reduces the demand for cash for studied countries. In addition, study assumes that tax administrations in these countries would raise more revenue without this excise because the tax is not conducive to the full adoption of e-money.

Keywords: Cash, Financial Inclusion, Mobile money, Excise duty, Tax incidence

JEL Code : O33, C22, H22

1 Introduction

In view of the spectacular development of Mobile Money (MM) in Africa over the past decade, some countries, with a view to increasing revenue mobilization, have begun to tax MM operations. It is in this context that subscribers of Ivorian[33] Mobile Network Operators (MNOs) received messages on February 25, 2019, notifying them of changes in the MM services fee schedule. Operators specified in these messages that this new schedule was due to the increase of activity-related costs following the introduction of a tax on mobile financial transactions. Indeed, the 2019 new tax annex institutes a new 7.2 percent turnover tax for undertakings issuing e-money.

Côte d'Ivoire is not the only country that tax MM. According to GSMA (2019), MM taxation is growing fast in sub-Saharan Africa. In Kenya and Tanzania, governments put an excise duty directly on MM transactions. Uganda, on the other hand, tax both all MM transactions in addition to operators' turnover[34]. However, these taxes in the e-money sector in these countries have all led to an increase in MM tariffs.

These notable events lead to important issues as the mobilization of tax revenues and financial inclusion are real economic challenges for these countries. Then, why are MNOs shifting the tax burden to consumers? Would answers be found in previous governments interventions in this area? What is Government's interest to tax undertakings issuing e-money? Is this interest important than financial inclusion? Does not the tax slow down mobile financial inclusion in developing countries?

In doing so, while government's measures concern undertakings issuing e-money, this paper will take an interest in MNOs for specific reasons. First, this institutional

[33] The mobile operators that communicated their new tariffs by that date were Orange and Moov Côte d'Ivoire.

[34] The payers of the transactions tax are the consumers and those of turnover tax are MNOs.

sector is generally described as a value-added sector. Indeed, mobile network industry in developing countries has undergone these last years a great wave of liberalization because of government regulations. In past, this market was served by a public monopolist because of large fixed costs. Except that, the incumbent monopolist inefficiency and technological change required government interventions. These interventions consisted in setting up incentive and liberalization reforms. The opening to competition has led to a transition from a monopolistic to an oligopolistic structure. However, following economic intiution, this theoretically imperfect competition should facilitate explicit or implicit collusion between operators, which should generally lead to high prices and thus a higher capital return than that needed to encourage operators in the sector to invest. Thus, States mainly use taxation to capture the maximum of this value-added. Nevertheless, unlike sectors such as mining, which generate an exogenous value-added, the mobile communications sector generates an endogenous value-added that decreases with government's connections and pro-competitive policies (Faccio and Zingales, 2017). This reduces the taxable base in term of value-added.

The second reason is the major involvement of the industry in the process of the financial inclusion process in developing countries. The MNOs provide microfinance and transfers services to the population and especially to people excluded to formal financial system. For example, M-Pesa, a microfinance and money transfer system launched by the Vodafone group in Kenya and Tanzania.

Therefore, of these two reasons it should be noted that governments have to make a very interesting arbitrage in the mobile network sector. On the one hand, government wanting to mobilize more public ressources, will restrict competition and increase tax revenues based on sector value-added. On the other hand, consumers want more

financial services at lower costs. This could involve a higher degree of competition and a decrease of tax revenues specific to value-added.

From an economic theory point of view, the discussion on the subject remains unfinished to this day. Therefore, in addition to theoretical work, empirical evidence is also needed to sustain public policy dialogue on the issue in Sub-Saharan African countries.

Thus, this article is of both academic and political interest. From an academic point of view, the paper constitutes an empirical resource on the evaluation of the impact of tax measures in the mobile network sector. At the political level, it provides empirical evidence constituting a decision aid enabling governments to better understand the impact of tax interventions and to achieve efficient public policies.

From the MM market, we study how in Sub-Saharan African countries government uses regulation and tax in the mobile network industry knowing the real economic stake of financial inclusion. According to theories of the demand of cash, we realize an empirical analysis to bring some answers to this issue. Indeed, the inclusive financial services provided by MNOs are leading to a growing adoption of e-money at the expense of cash. That said, the analysis provided below is based on two assumptions, which are set out as follows.

First, study supposes we have an oligopolistic mobile network market that is the main provider of digital financial services in these countries. This observation can be explained by the government's desire to ensure the best possible protection of consumer funds. Indeed, with a reduced number of suppliers the costs of control are lower. The regulation of MM in many sub-Saharan African countries provides guidance on consumer protection rules. However, another explanation for this choice, which is in favor of firms, may be the existence of political connections. Based on work of

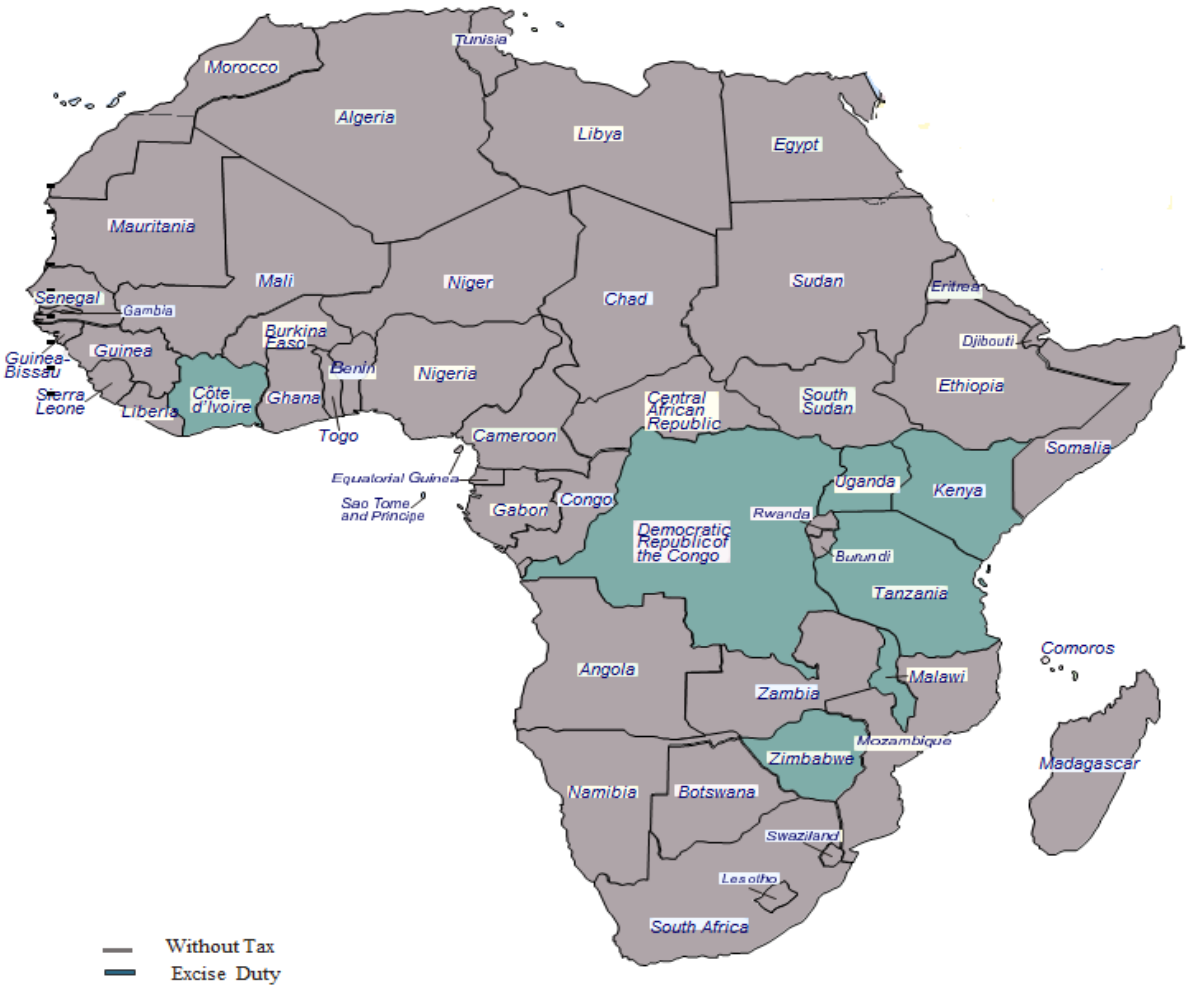
Peltzman (1976) which underlines that regulation is the outcome of the pressure of multiple constituencies, Faccio and Zingales (2017) find that government's rules appear to be tilted more in favor of MNOs when these firms are more politically connected.

Second hypothesis is that taxes on MM considerably reduce the capacity of the industry to invest in the activity because states generally tax consumption than production. Of the thirty-seven countries in sub-Saharan Africa with MM, seven have recently started to tax MM services. In doing so, three of these seven countries have chosen to introduce excise duties on MM operator's revenues, while four have chosen excise duties on transaction. Ghana is also considering introducing a tax aimed at operators rather than subscribers. Nevertheless, excise duties remain imperfect substitutes for the states to tax MM activities that escape direct taxation in these countries.

Thus, the aim of these excise duties is not to reduce negative externalities by making consumers bear a social cost according to the Pigouvian logic. Through these excise duties, governments aim instead to raise revenue to help finance public expenditure while changing consumer behaviour as little as possible. This is illustrated by tax rates that are very lower compared to excise duties on goods such as tobacco, fuel or alcohol in those countries. However, mobile sector-specific taxes have indeed become as prevalent as in the extractive industries leading to a high tax burden for operators. For Matheson and Petit (2020), taxes on the mobile network sector have become over the past decade a source of considerable uncertainty and compliance costs. From Rota-Graziosi and Sawadogo (2020), it appears that the tax burden of a MNO is relatively higher than that of a gold mining firm in some African countries. The instrument of comparison used by the latter is an Average Effective Tax Rate (AETR) designed to take

into account both general and sector-specific taxes. In such a context, the new tax on MM may run counter to the objective assigned to it by governments.

Figure 20. African Countries with Tax on Mobile Money Activities



Source: Traditional and country-specific tax code, Author's Calculations,

The rest of the paper is as follows. Section 2 reviews the taxes applied to operators in sub-Saharan countries, focusing on those that are mobile-specific. It also compares tax rates between the countries. Section 3 then provides characteristics of MM services users. This is done by identifying common trends across the sub-Saharan African countries covered by the Research ICT Africa Survey (RIAS) in 2012. Section 4 makes a detail description of the dataset used for empirical analysis, exposes the econometric

strategy and presents the results. Section 5 discusses policy implications. Section 7 concludes the study.

2 Telecom Taxation Regime

Telecom tax regimes in developing countries have changed significantly over the last years. However, major tax provisions are similar across sub-Saharan countries, with differences only in the rate level. The tax burden includes both consumers and MNOs. In doing so, some taxes are borne by networks through a fall in their profits, while others may be passed through to consumers through higher prices, or there may be a combination of the two. It depended to country, market conditions and MNOs strategies.

Table 13 summarizes certain tax provisions specific to MNOs while including provisions relating to MM. The countries covered are from the sub-Saharan Africa with the largest flows in MM activity. As for provisions, they include corporate income tax (CIT), value-added tax (VAT), call and MM excise. However, substantial regulatory charges specific to the sector such as spectrum and interconnection fees have not been introduced.

CIT is a tax provision of countries 'general taxation system. MNOs are subjugated to it and the indirect tax based on their turnovers. CIT rates vary from 20 percent in Madagascar to 40 percent in Zambia. All countries except Kenya and Zambia practice uniform rates[35]. Kenya differentiates the rate according to the tax residence that leads residents to pay 30 percent while non-residents have a rate of 37.5 percent. Zambia has opted for a progressive tax based on the level of turnover. Therefore, a Zambian

[35] However, the elements used to determine the taxable base differ from one country to another.

firm with a profit up to 250 million kwacha[36] gives 35 percent of its profit and a firm with a profit exceeding 250 million kwacha gives 40 percent.

As far as VAT is concerned, it is an indirect tax recovered on final consumption of goods and services. This tax is collected and remitted to governments by collectors, including MNOs. Nevertheless, the table 13 shows the VAT rates incurred by operators that are not deductible. VAT rates vary from 15 percent in Zimbabwe to 20 percent in Madagascar.

In addition to the above-mentioned taxes, governments apply ad valorem excises to mobiles services provided to subscribers. In my analysis, I present the excise duties levied on calls and MM. In term of calls, tax charges on cell phone airtime. The rate differs from one country to another with a value of 3 percent in Côte d'Ivoire and 17.5 percent in Zambia. Some countries such as DRC, Malawi and Rwanda have all chosen to tax this service at a rate of 10 percent.

Then comes the excise tax on MM. This tax was introduced in countries very recently and it is the legitimacy of this tax that the paper is dealing with. Some countries, namely Côte d'Ivoire and DRC[37] have decided to apply the tax on the profit generated by the activity. In doing so, the tax burden is generally transferred to consumers through an increase in tariffs. Ndung'u (2019) shows that the M-Pesa tariffs for most trasfers and withdraws ranges have increased since the introdcution of the excise tax on financial services in 2013 and update in 2018. Kenya, Malawi, Tanzania and Zimbabwe have chosen to tax transactions directly at rates of 12 percent, 1 percent, 10 percent and 2 percent respectively.

[36] Kwacha is the official currency of Zambia.

[37] DRC withdrew the tax in 2018.

Table 13. Taxes on mobile services in eleven countries

	CIT	**Non deductible VAT**	**Excise Duties**		
			Call	MM	
	CIT is based on computed taxable telecoms operator's profits	*VAT charge on telecom products and/or services*	*Ad valorem charge on cell phone airtime*	*Ad valorem charge on MM operator's revenues*	*Ad valorem charge on MM transactions*
DRC	35%	16%	10%	3%	-
Côte d'Ivoire	30%	18%	3%	7.2%	-
Kenya	Residents: 30% Non Residents: 37.5%	16%	10%	-	12%
Madagascar	20%	20%	10%	-	-
Malawi	30%	16.5%	10%	-	1%
Namibia	32%	15%	-	-	-
Rwanda	30%	18%	10%	-	-
Tanzania	30%	18%	17%	-	10%
Uganda	30%	18%	12%	10%	0.5%
Zambia	Profit up to k 250 million: 35% Profit exceeding K 250 million: 40%	16%	17.5%	-	-
Zimbabwe	27.75%	15%	10%	-	2%

Source: Traditional and country-specific tax code, Author's Calculations

Note in the case of Kenya that this tax was first introduced in 2013 at a rate of 10 percent. It then increased to 12 percent in 2018. Finally, we have Uganda, which taxes both business profits and transactions. In 2013, the Ugandan government only introduced a 10 percent tax on operators' revenues. In doing so, if I expected a decrease in demand, the latter has not been disrupted and contributed to increase government revenues. It is under these conditions that the State introduced in July 2018, in addition to the operators' revenues tax, a 1 percent tax on the value of deposits, withdrawals, payments and transfers. However, this new tax has had a negative impact on the demand, as the measure does not meet the criteria of neutrality and fairness. In October 2018, Government reduced the tax to 0.5 percent and restricted it to withdrawals.

3 Mobile Money Users

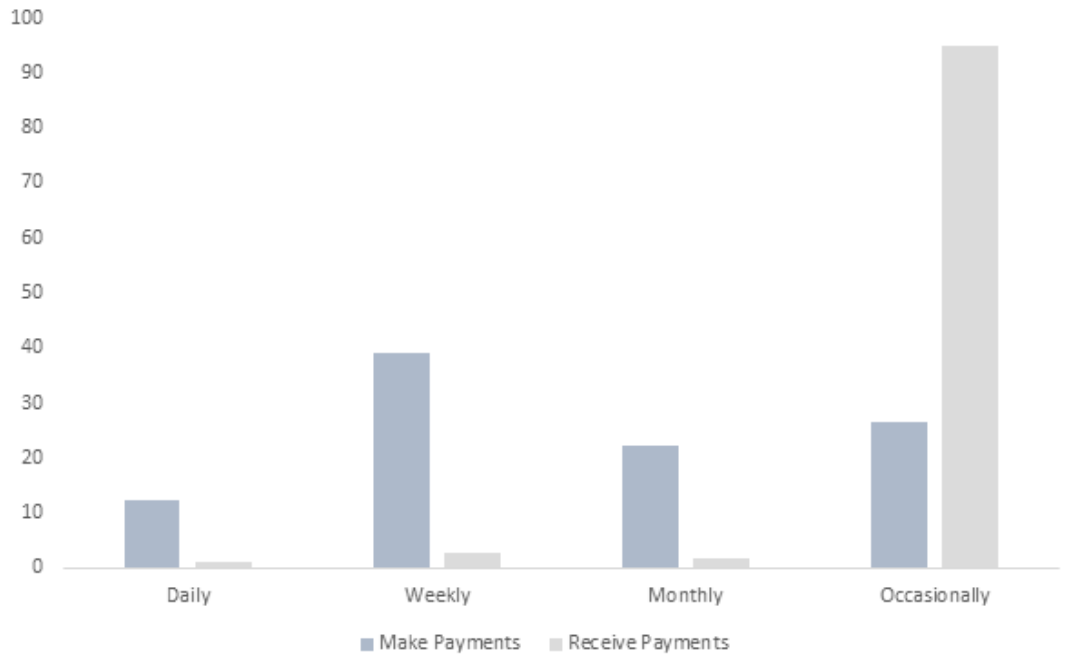
This part's idea is to design the profile of MM users. This will allow us in the rest of the paper to judge the impact of tax following the user category and discuss its legitimacy. In order to do so, I use RIAS Household and Business micro-data in 2011-2012. Using frequency of use and transaction amounts, we will see which of the households or informal businesses use MM the most. The data cover 12 countries in sub-Saharan, including countries such as Kenya, Uganda and Tanzania.

Thus, initially the focus will be on the general frequency of service use in the countries surveyed. In the questionnaire submitted to the individuals, there is a question asking them how often they use MM. Figure 21 and 22 show the respective frequencies of Businesses and Households.

We note that business have generally a weekly use of MM services while nearly 48 percent of households have a monthly use. This makes business the most regular users of the services, although it should be noted that a part makes occasional use. Indeed, the cash still the most used mean of sending and receiving money of businesses. This reflects their low voluntary rate of bank penetration and their relatively low use of digital technology.

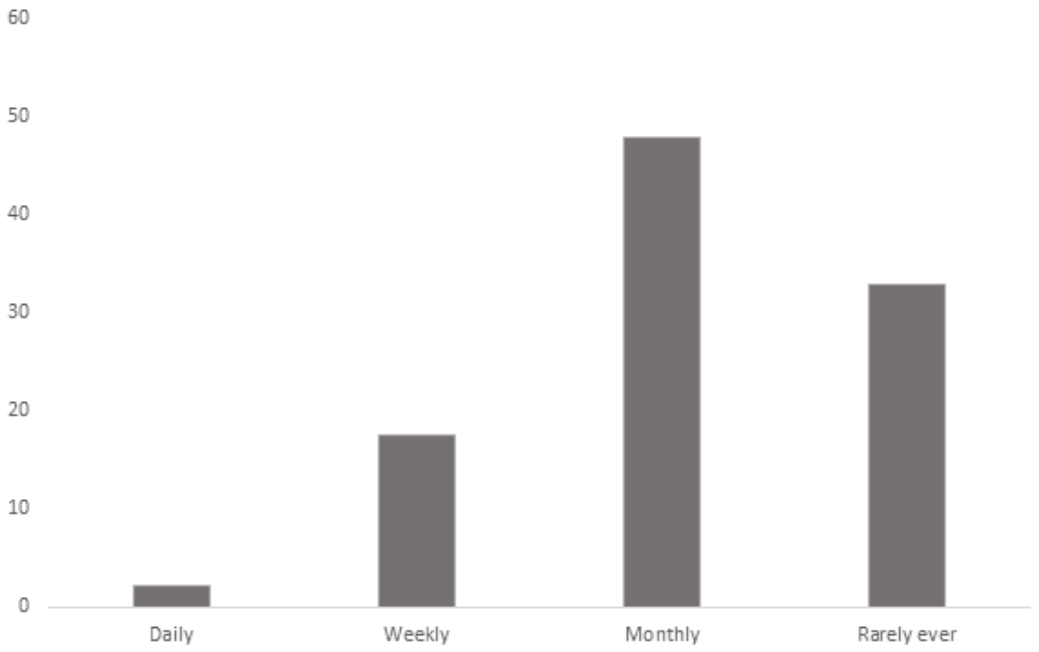
In doing so, businesses behind this regular use of MM are mainly groceries and retail shops. As for households, which as a reminder have a rather monthly use, I note that women remain the most active compared to men. They make more frequent use of MM services than men do. The reasons given by women to justify this level of use are the saved time and the service's low cost. It should be noted that women include populations traditionally excluded from the formal financial system, including displaced persons and the rural poors. Women's use generally consists of receiving money and airtime top up.

Figure 21. Business usage frequency of Mobile Money



Source: RIAS Household and Business micro-data , Author's Calculations

Figure 22. How often household send or receive Mobile Money

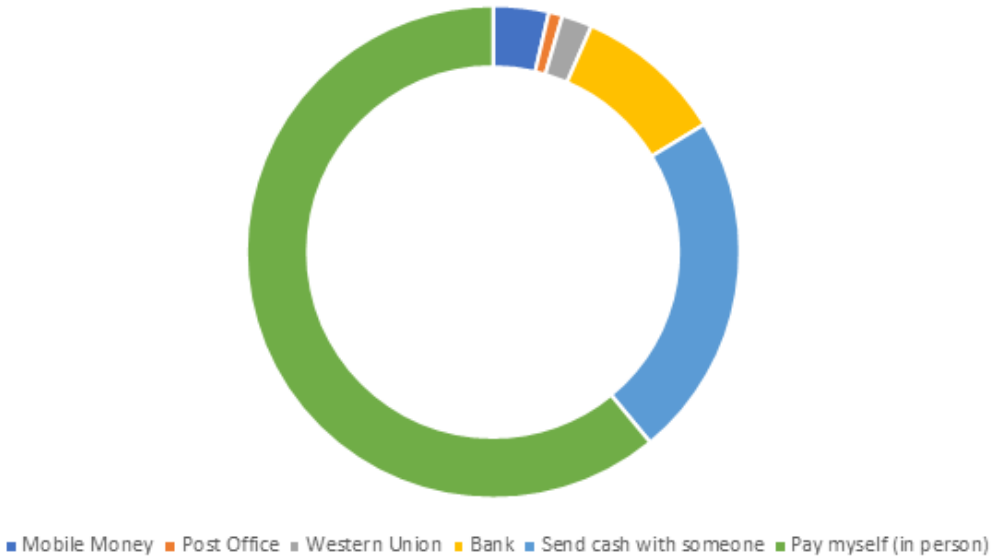


Source: RIAS Household and Business micro-data , Author's Calculations

Thus, while it is clear from the above that the frequent users of MM are businesses, it cannot be said that the MNO profits are due to the use of these businesses. In fact, a business with a regular use with very low amounts cannot be qualified as the main user of the service compared to a household who has a monthly use with relatively very high amounts. Therefore, in addition to the volume aspect, I am interested in the value aspect in my analysis to identify precisely the main users of the service.

In the process, businesses essentially use MM to pay some of their suppliers who ask for it and to review the payments of their customers who offer it to them for large amounts. In the area covered by the survey, the amounts sent to settle a business payment could be five times the received amounts for commercial purposes.

Figure 23. Most used means of sending and receiving money



Source: RIAS Household and Business micro-data , Author's Calculations

As far as the households are concerned, the majority affirms that the amounts received and sent are approximately same. However, these amounts are almost ten times lower than those of the businesses are. This is intuitive in the sense that first businesses have more resources and then business's operations are about settling deals. The business's operations with the associated amounts are essentially carried out by retail shop while those of the households come from the women.

This section shows that there are two main categories of users of MM services, namely individuals and informal businesses. Of these two categories, the main users are informal businesses, headed by shops. The latter have a regular use with large transactions. In the following section, the question will be to assess the impact of excise duty on the global usage of these two categories basing on the demand for cash.

4 Empirical Evidence

4.1 Data

Empirical estimates were performed on the basis of an unbalanced panel of 10 african countries with monthly periods from 2000 to 2019. To measure the cash demand, we use the monetary aggregate labeled as M1. This aggregate includes paper money and coin currency in circulation and demand deposits. It was recovered in Monetary and Financial Statistics (MFS) of the International Monetary Fund. Then, we compute two ratios basing on the monetary aggregate. The first one is the cash demand per capita obtained by dividing the monetary aggregate by the total population. The second ratio, named GDP held in cash, it the share of cash in the national wealth.

Table 14. Sample Countries

Democratic Republic of Congo	Rwanda
Côte d'Ivoire	Tanzania
Kenya	Uganda
Madagascar	Zambia
Namibia	Zimbabwe

Concerning the MM tax, we use a dummy variable that takes the value 1 from the month the tax was applied in the country and 0 otherwise. Then, the use of MM services is captured by the value of MM transactions collected on Financial Access Survey (FAS).

The other variables GDP per capita, number of ATM (Attanasio et al., 2002), agricultural value added as proxy for imformality level and the short-term nominal interest rate that rate paid by commercial or similar banks for demand, time, or savings deposits (Tobin, 1956).

Table 15. Summary Statistics

Variable	Mean	Median	Std. Dev.	Min	Max
log(cash demand per capita)	2,424	3.99483	1.970609	0	24.68153
log(GDP held in cash)	2,424	0.228091	0 .8431748	0	18.00898
Tax	2,772	0 .2164502	0 .4118989	0	1
log(MM per capita)	2,209	0 .7871296	1.290591	0	4.231333
log(MM in GDP)	2,209	0 .0053876	0.0116441	0	0 .0533466
Tax * log(MM per capita)	2,209	0 .3225698	1.040569	0	4.231333
Tax * log(MM in GDP)	2,209	0.0033097	0.011002	0	0.0533466
GDP per capita	2,519	1221.347	1343.132	276.0559	6274.753
ATM	1,812	8.63278	14.69333	0 .0402514	72.44603
Informal	2,604	21.87766	8.165745	2.860718	38.81841
Short-term R	2,148	12.55442	21.56222	2.433333	203.375
Internet	2,519	8.298291	10.19132	0.0059021	51
Unemployment	2,651	5.800363	5.544267	0.599	23.352
MM agents	2,364	136.5539	256.3248	0	1540.9

4.2 Model Specification

In this part, we conduct an empirical analysis that highlights the causual effect of MM tax on cash demand. Assuming that a large adoption of e-money leads to a decrease in cash demand, our main objective is to analyze the impact of MM on cash demand in the presence of tax on MM transactions. To do this, the study seeks to present separately the direct impact of the tax on the demand for cash and then the contributions according to whether countries have implemented a tax or not.

The economic literature proposes different alternatives to model the demand for cash. Keynes, in his general theory, indicated that the preference for liquidity in the economy stems from three motives: the transaction motive, the precautionary motive

and the speculation motive. Therefore, by looking at the economic inputs that define these motives, we end up with a demand for cash as a function of income or gross domestic product, the interest rate and inflation (Steven, 2003). Keynes's vision has of course been criticized and improved over time by the monetarist movement, led by Friedman, and also by the brilliant works of Baumol (1952) and Tobin (1956). For our part, we model the demand for cash in our developing countries as a function of the level of economic activity, the level of informality and the interest rate. We obtain the following specification:

$$CD_{it} = \alpha_0 + \alpha_1 GDP_{it} + \alpha_2 ATM_{it} + \alpha_3 Informal_{it} + \alpha_4 R_{it} + \epsilon_{it} \tag{5.1}$$

where CD_{it} is the level of cash in circulation in country i in month t, GDP is gross domestic product per capita, ATM is the number of ATMs per 100,000 adults, $Informal$ is the value added of the agricultural sector, and R is the nominal short-term interest rate, the rate paid by commercial or similar banks for demand, time, or savings deposits. Two complementary models are derived from equation (5.1) to study the impact of the tax and the impact of MM as a digital financial service respectively:

$$CD_{it} = \alpha_0 + \alpha_1 Tax_{it} + \alpha_2 GDP_{it} + \alpha_3 ATM_{it} + \alpha_4 Informal_{it} + \alpha_5 R_{it} + \epsilon_{it} \tag{5.2}$$

$$CD_{it} = \alpha_0 + \alpha_1 Tax_{it} + \alpha_2 MM_{it} + \alpha_3 (Tax_{it} * MM_{it}) + \alpha_4 GDP_{it} + \alpha_5 ATM_{it} + \alpha_6 Informal_{it} + \alpha_7 R_{it} + \epsilon_{it} \tag{5.3}$$

where Tax corresponds to the presence of the tax and MM the value of the MM transactions.

Thus, following Le et al (2020), we estimate our models using the robust standard errors proposed by Driscoll and Kraay (1998) in order to correct for cross-sectional dependence (SCC) and temporal dependence due to the very large temporal size of the database. To do so, we used the xtscc program produced by Hoechle (2007) which produces the standard Driscoll and Kraay (1998) errors for linear panel models since they are not only consistent with heteroskedasticity but also robust to very general forms of cross-sectional and temporal dependence. In addition, the program used has the particularity of working well with both balanced and unbalanced panels. The method is therefore suitable for our panel with missing values. In doing so, to account for the specificities of the countries studied, Discoll and Kraay's (1998) standard errors for coefficients are estimated by fixed effects (within).

4.3 Results

Results obtained from the estimation of cash demand equations (5.1), (5.2) and (5.3) using Hoecle (2007)'s procedure are reported in table 16. The estimation of the basic model indicates that GDP per capita has a significant negative impact on the demand for cash. Indeed, a very large proportion of the population in these countries derives its income from the agricultural sector, which has a relatively small contribution to the construction of GDP compared to the private and public sectors. Thus, an increase in GDP per capita, benefiting to a large extent the employees of public and private companies who have a better knowledge of finance than those working in the agricultural sector, will lead to greater access to credit cards, debit cards and all other cashless payment instruments. Second, there is the negative impact of the short-term nominal interest rate (Baumol, 1952; Tirol, 1956) and the positive impact of the

informal sector (Amromin and Chakravorti, 2009; Chen et al., 2017) on the demand for cash.

The second phase of our empirical analysis consisted in introducing into the basic model the variable tax, which is a dummy variable taking the value 1 when there is a tax on MM transactions and 0 when there is no tax. We note that the tax on MM leads to an increase in the demand for cash. With the increase in MM user fees induced by the tax, individuals as well as legal entities will prefer to use cash. It should be noted that cash remains the most widely used monetary instrument in these economies, even in the presence of MM. Under these conditions, the tax will discourage the adoption of e-money through MM and will lead individuals to return to cash, which does not incur costs. The introduction of the tax leads to a 21.1 percent increase in the per capita demand for cash and an 11.9 percent increase in the GDP held in the countries studied.

Table 16. Currency demand estimations

	log(cash demand per capita)			log(GDP held in cash)		
Tax		0.211***	1.749**		0.119***	1.201***
		(0.0735)	(0.706)		(0.0316)	(0.375)
log(MM per capita)			0.170***			0.0782***
			(0.0573)			(0.0279)
Tax * log(MM per capita)			-0.526**			-0.342***
			(0.221)			(0.113)
GDP per capita	-0.00355***	-0.00372***	-0.00421***	-0.00168***	-0.00178***	-0.00199***
	(0.000592)	(0.000615)	(0.000695)	(0.000262)	(0.000281)	(0.000329)
ATM	0.00755	0.00963	0.00954	0.0190***	0.0201***	0.0200***
	(0.0104)	(0.0107)	(0.0123)	(0.00469)	(0.00491)	(0.00603)
Informal	0.0809***	0.0761***	0.0979***	0.0520***	0.0493***	0.0605***
	(0.0100)	(0.0103)	(0.0136)	(0.00616)	(0.00612)	(0.00728)
Short-term R	-0.0419**	-0.0418**	-0.0428**	-0.0253	-0.0253	-0.0263
	(0.0179)	(0.0179)	(0.0190)	(0.0160)	(0.0160)	(0.0171)
constant	7.994***	8.275***	8.767***	1.674***	1.832***	1.975***
	(0.782)	(0.829)	(1.084)	(0.371)	(0.408)	(0.555)
Observations	1408	1408	1245	1408	1408	1245
Countries	10	10	10	10	10	10
R-squared (within)	0.2511	0.2529	0.2946	0.1400	0.1416	0.1611

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

We then turn our attention to MM. First, we can see that MM has a significant positive impact on the demand for cash. This is because MM is mainly used to transfer cash from one individual to another (P2P) in these countries. The bill payment and microfinance aspects are still underdeveloped. An increase in the value of MM transactions leads to a 0.17 percent increase in the demand for cash per capita and a 0.08 percent increase in the demand for cash in GDP. However, in the presence of tax, MM has a negative impact on the demand for cash. With the presence of tax, individuals will primarily turn to the use of cash with hand-to-hand remittances, as the transfer of cash becomes costly with MM. In such conditions, the use of MM will be more concerned with payments and microfinance, activities that necessarily require the use of e-money. In this context, an increase in the number of transactions recorded in the MM-account will result in an increase in e-money and a decrease in the demand for cash for transactions.

4.4 Sensitivity

At this stage of our analysis, our results are subjected to a sensitivity exercise. The exercise consists of adding variables to the model to see if the coefficients of our variables of interest are influenced. The test set is done by adding the percentage of the population using the internet, total unemployment as a percentage of the labor force and the number of registered MM agencies per 100,000 adults. None of the added variables is significant. The coefficients of our variables of interest are not affected by these additions, as they retain their significance and their signs. We can interpret such results as a proof of the good specification of our model, which would not suffer from the omission of determining variables.

Table 17. Sensitivity of variables of interest

	log(cash demand per capita)			log(GDP held in cash)		
Tax	1.504**	2.019***	1.419*	1.003***	1.321***	1.066***
	(0.687)	(0.639)	(0.771)	(0.375)	(0.347)	(0.403)
log(MM per capita)	0.233***	0.136**	0.252***	0.129***	0.0630**	0.116***
	(0.0825)	(0.0547)	(0.0808)	(0.0378)	(0.0246)	(0.0427)
Tax * log(MM per capita)	-0.457**	-0.558***	-0.396	-0.287***	-0.356***	-0.287**
	(0.210)	(0.200)	(0.247)	(0.110)	(0.105)	(0.125)
GDP per capita	-0.00401***	-0.00396***	-0.00403***	-0.00183***	-0.00188***	-0.00190***
	(0.000727)	(0.000692)	(0.000772)	(0.000339)	(0.000333)	(0.000366)
ATM	0.0149	0.00897	0.00381	0.0243***	0.0197***	0.0172**
	(0.0119)	(0.0121)	(0.0155)	(0.00539)	(0.00600)	(0.00757)
Informal	0.0925***	0.0865***	0.0914***	0.0561***	0.0554***	0.0581***
	(0.0132)	(0.0176)	(0.0148)	(0.00665)	(0.00942)	(0.00785)
Short-term R	-0.0433**	-0.0445**	-0.0435**	-0.0266	-0.0270	-0.0266
	(0.0190)	(0.0194)	(0.0192)	(0.0171)	(0.0173)	(0.0172)
Internet	-0.0173			-0.0140**		
	(0.0138)			(0.00653)		
Unemployment		0.139			0.0620	
		(0.0978)			(0.0529)	
MM agents			-0.000681			-0.000315
			(0.000419)			(0.000221)
constant	8.659***	7.860***	8.849***	1.888***	1.571***	1.984***
	(1.076)	(1.147)	(1.111)	(0.540)	(0.565)	(0.565)
Observations	1245	1245	1211	1245	1245	1211
Countries	10	10	10	10	10	10
R-squared (within)	0.2970	0.3029	0.3022	0.1654	0.1655	0.1656

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.5 Robustness

In order to test the robustness of the results obtained, we change the variables of interest by close proxies. Indeed, in the reference equations, we use the value of MM transactions per capita. For robustness, we use instead the value of MM transactions relative to GDP. This leads us to have also a new cross variable between the tax variable and the value of MM transactions relative to GDP.

The significances and signs of the coefficients of the tax, the MM and the cross variable are not influenced by these manipulations.

However, the magnitude of the coefficients is not. Indeed, the positive impact of the tax on the demand for cash is reduced by the manipulations. The impact of the MM in the presence of the tax increases drastically from 0.33 to 28 percent for cash demand

per capita and from 0.34 to 20 percent for cash demand in GDP. This can be explained by the fact that the ratio of MM transactions to GDP is very low relative to the variables measuring cash demand.

Table 18. Robustness tests

	log(cash demand per capita)				log(GDP held in cash)			
Tax	0.779***	0.791***	0.905***	0.856***	0.540***	0.558***	0.595***	0.589***
	(0.231)	(0.239)	(0.230)	(0.255)	(0.130)	(0.139)	(0.131)	(0.147)
log(MM in GDP)	18.22**	20.64**	17.02**	25.12**	12.38***	16.01***	11.85***	18.54***
	(7.531)	(9.139)	(7.111)	(10.57)	(3.370)	(4.004)	(3.133)	(5.830)
Tax * log(MM in GDP)	-28.71***	-29.56***	-28.77***	-30.50***	-20.28***	-21.54***	-20.30***	-22.30***
	(10.57)	(11.34)	(9.865)	(11.69)	(4.957)	(5.478)	(4.735)	(5.850)
GDP per capita	-0.00416***	-0.00407***	-0.00392***	-0.00406***	-0.00200***	-0.00187***	-0.00190***	-0.00189***
	(0.000687)	(0.000728)	(0.000681)	(0.000777)	(0.000326)	(0.000342)	(0.000330)	(0.000365)
ATM	0.0154	0.0182	0.0136	0.0141	0.0228***	0.0269***	0.0220***	0.0210***
	(0.0120)	(0.0123)	(0.0118)	(0.0137)	(0.00570)	(0.00530)	(0.00575)	(0.00646)
Informal	0.0921***	0.0897***	0.0801***	0.0877***	0.0581***	0.0545***	0.0528***	0.0548***
	(0.0119)	(0.0109)	(0.0165)	(0.0128)	(0.00680)	(0.00585)	(0.00910)	(0.00728)
Short-term R	-0.0424**	-0.0426**	-0.0445**	-0.0428**	-0.0264	-0.0265	-0.0273	-0.0267
	(0.0190)	(0.0190)	(0.0194)	(0.0192)	(0.0171)	(0.0171)	(0.0174)	(0.0172)
Internet		-0.00651				-0.00974*		
		(0.0113)				(0.00530)		
Unemployment			0.154				0.0681	
			(0.0980)				(0.0530)	
MM agents				-0.000462				-0.000335
				(0.000397)				(0.000221)
constant	8.863***	8.812***	7.898***	8.979***	2.054***	1.978***	1.629***	2.050***
	(1.029)	(1.040)	(1.103)	(1.068)	(0.536)	(0.531)	(0.550)	(0.544)
Observations	1245	1245	1245	1211	1245	1245	1245	1211
Countries	10	10	10	10	10	10	10	10
R-squared(within)	0.2904	0.2909	0.3011	0.2964	0.1614	0.1639	0.1669	0.1661

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5 Discussions

In this pat we discuss the legitimacy of the tax basing of empirical results. The reflection is related to the implications in terms of financial inclusion and adoption of e-money.

In an effort to obtain and retain a large customer base, MNOs are adopting a variety of business strategies to differentiate themselves from one another. Although these strategies are of several types, only those related to tariff are analyzed in this study. In fact, the pricing strategy is the only one that is directly implemented through taxes. Thus, concerning the MM activity, MNOs practice non-linear pricing by proposing a set of amount-price pairs that each amount of a transaction corresponds a price

(Ndung'u, 2019). In this conditions, at the optimum, low-preference consumers derive no surplus from the exchange, in contrast to high-preference consumers who enjoy an information rent. Moreover, the greater the preference for large amounts in a group, the greater its surplus (Carlton and Perloff, 2015).

In doing so, when the State decides to introduce an excise duty , consumer prices are expected to increase. However, prices will not be allowed to vary by this amount for low-preference consumers, their initial level taking up the entire surplus. Under these conditions, MNOs will bear the tax in its entirety so that the tariff applied to this category remains unchanged. With respect to high-preference consumers, MNOs networks bear part of the cost of the tax in order to be able to ensure that the principles of non-linear pricing are respected. This being the case, high-preference consumers therefore bear the other part of the tax and they change their consumption behavior following the introduction of the tax. To generalize, the greater the preference for large amounts in a category, the greater the cost of the tax that the group will bear.

In Section 2, it was noted that informal businesses preferred particular large relative amounts. By way of deduction, these businesses would bear the majority of the tax. The reaction of the latter would simply be to reduce their level of use of this service in order to use cash, which is still the means most used by these businesses in the current presence of MM. Our empirical analysis corroborates this fact to the extent that the demand for cash increases following the implementation of the tax. From a tax point of view, this reaction by businesses is undesirable. In fact, within these informal businesses, there are medium-sized firms that escape the general taxation system by using cash. E-money would enable the tax authorities not only to identify them but also to subjugate them to tax by means of electronic payments. With a view, therefore, to optimizing tax mobilization, it would be preferable not to tax transactions or the

turnovers linked to these services in order to encourage a total switch from cash to e-money by everyone and subsequently to catch the fraudsters who have hitherto managed to evade the tax authorities. In addition, MM is a particular service that generate positives externalities with its social gain that is higher than its private gain. Therefore, the excise is not objectively appropriate since the service does not generate negative externalities.

As far as individuals are concerned, the issue at stake is their full financial inclusion by encouraging them to use MM services. Our empirical results indicate that although in the presence of the tax, MM leads to a reduction in the demand for cash, the positive direct impact of the tax on the demand for cash is relatively much higher. Thus, although the cost of the tax borne by individuals is relatively low, individuals will reduce their level of use. The process of inclusion of these individuals in developing countries will be undermined. The tax therefore appears cumbersome under these conditions as well.

6 Conclusion

This paper investigates the impact of MM taxation on the adoption of e-money and financial inclusion in sub-Saharan countries. Based on survey data, two categories of users of the MM service are identified, namely households and businesses. However, businesses are the main users in terms of frequency of use and value of transaction amounts. Then, basing on an empirical analysis, it appears that tax has a positive impact on demand for cash and it is only in the presence of latter that MM reduces the demand for cash. In doing so, we note that there is a good chance that the tax will largely be borne by informal businesses.

The findings underline the embarrassing nature of this new tax. To begin with, as far as tax mobilization is concerned, the tax does not make it possible to track down fraudsters who evade the tax authorities by using cash. Indeed, with the tax, the opportunity cost of using e-money becomes high. Then the tax, by increasing the fees for the use of MM, slows down the process of financial inclusion. Governments would benefit from removing this new tax for fiscal revenues supported by more attractive alternatives.

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GENERAL CONCLUSION

The link between financial inclusion and development is based on the assumption that poor and marginalized people, excluded from the formal financial system, need financial services to provide themselves with income and livelihoods, especially in countries with limited infrastructure and resources. Access to these services enables individuals to set up projects and eventually improve their living conditions, and businesses to invest, innovate and employ.

Digital financial technology or "Fintech" projects and the rapid spread of smartphones have led to an expansion of access to financial services at lower cost and risk. Mobile money is one of the increasingly popular Fintech projects as a safe, efficient and convenient way to achieve the goal of full financial inclusion. Digital financial inclusion with mobile money has been adopted by the Central Bank of West African States (BCEAO), MFIs, World Bank and philanthropic foundations such as the Gates Foundation. The analysis in this dissertation focuses on issues related to the economics of digital financial inclusion and the impact of the tax environment on its evolution.

Following a macroeconomic approach, Chapter 2 revisits the relationship between financial inclusion and economic growth by presenting separately the contribution of traditional financial inclusion and digital financial inclusion with mobile money. The analysis suggests that stimulating consumption through human and technological capital accumulation is the main channel through which financial inclusion influences

a country's economic growth. Once financially included, individuals invest in their education, health, and research and development, all of which lead to increased productivity. Second, regarding the contributions of the two types of financial inclusion, the chapter reveals that the contribution to growth of digital financial inclusion via mobile money is greater than that of formal inclusion with commercial banks in developing countries. This finding underscores the need for governments to put in place policies to encourage telecommunications companies to invest in and promote this digital activity.

Chapter 3 takes a microeconomic approach. It considers Mobile Money as a determining factor in business creation in Africa. Indeed, the idea is to recognize the ability of mobile money to provide financial resources to individuals in order to become architects of their development, to provide themselves with their livelihood through entrepreneurship. The chapter finds that mobile money contributes to the expansion of entrepreneurship in African countries. Thus, by increasing entrepreneurship, mobile money indirectly contributes to the reduction of unemployment, which has remained at a relatively high level despite the high growth the continent has experienced over the past twenty years. Moreover, the impact of mobile money on entrepreneurship is direct. It does not involve improving the entrepreneurial environment through the key societal (taxation, government support) and individual (gender) determinants of entrepreneurs' environmental orientation.

Chapter 4 examines the impact of taxation on the use of digital financial services. For this purpose, the analysis focuses on Kenya with the M-Pesa service, a perfect model of successful mobile money in developing countries, which was subject to a 10% excise tax from 2013. The excise will subsequently increase in 2018 to a 12% rate. Thus, it is noted at first that the direct consequence of the introduction of the transaction tax has

been an increase in the rates of use of the digital service (withdrawal fees, transfer fees). Second, the analysis finds that the impact of the excise tax on the average transaction value is negative and does not occur immediately. This negative relationship underscores the determining role played by taxes in consumers' decisions regarding digital financial services such as mobile money. Given the economic stakes of financial inclusion, the introduction or revision of a tax on these services should be subject to a prior review of country-specific user behavior.

Chapter 5 follows on from chapter 4, the idea being to assess both the direct impact of the tax on digital financial transactions and the impact of the use of Mobile Money on the demand for cash in African countries. The basic assumption is that an increase in the demand for cash is at the expense of electronic money. It appears that the tax has led to an increase in the demand for cash. With the increase in user fees induced by the tax, individuals and legal entities will prefer to turn to cash. The tax thus discourages the adoption of electronic money. However, in the presence of the tax, the use of mobile money has a negative impact on the demand for cash. Indeed, with a tax, individuals will mainly turn to the use of cash with hand-to-hand transfers, as cash transfer becomes expensive with mobile money. Under such conditions, the use of mobile money will be more for payments and microfinance, activities that necessarily require the use of electronic money.

The overall findings of my thesis could lead to two major policy implications. First, governments in developing countries need to encourage the rapid adoption and use of digital financial services as they offer the potential to increase financial inclusion and facilitate the achievement of the Sustainable Development Goals (SDGs). This requires firstly, the adoption of policies that facilitate access to low-cost, high-quality technologies and basic innovations (cell phones, internet, and network coverage) for

the entire population, especially women, the poor and the elderly. Secondly, national training programs should be implemented to increase the financial literacy rate of the population, enabling them to make efficient use of both traditional and digital financial services. Finally, a regulatory framework for digital financial services should be put in place to protect users (scams, misuse of personal information) and encourage providers to invest and promote this digital activity. Regulation (concentration, competition and pricing) must be guided by economic principles and not by political lobbying.

The issue of regulation relates to the second recommendation, which is to establish a simplified, homogeneous and stable tax framework for Mobile Network Operators in order to both maximize tax mobilization and achieve full digital financial inclusion. Indeed, rather than using the argument of sectoral added value to tax all the activities carried out by Mobile Network Operators, it is advisable to first assess the nature of the service provided, the economic and social stakes of the latter and the level of the tax rate. If until now, setting an optimal rate is done by trial and error, a high initial rate can have negative consequences that cannot be corrected later even with a drastic reduction of the rate below its optimal level.

Therefore, the tax framework for the main providers of digital services, i.e. Mobile Network Operators, should be simple to ensure the legibility and transparency of the tax system and to facilitate its application. The framework will have to be homogeneous in order to avoid discretionary decisions and de facto discourage rigorous tax optimization behavior by companies. Finally, it will have to be stable because if operators are not convinced of the sustainability of the government's new financial strategy, they will focus their efforts on lobbying for protection rather than on restructuring their activities.

TO GO FURTHER!

ICT and Economic Growth in Developed and Developing Countries: A Panel Data Approach

Abstract

The ICT revolution has led to the emergence of tools, services, and techniques to create, store, process and transmit information and data easily, quickly, and reliably. These different skills have led to the recognition that ICT has a strong potential to improve economic productivity gains. The objective of this study is to analyze the magnitude of the long-term growth boost that countries can expect from ICT investments based on data from 134 developed and developing countries. A dynamic fixed effects panel model is used to account for the relationship. The results highlight a positive and significant relationship between ICT and growth, with a positive return on ICT investment.

Keywords: ICT, Economic Growth, Investment Return, Panel Data Approach

JEL Code: E22, J24, O11, O47

1 Introduction

Economic intuition recognizes numerous benefits to the economic growth of a country. Indeed, the growth contributes to reduce unemployment (Aghion and Howitt, 1994; Soylu et al., 2018), income inequalities when this growth is inclusive (Kuznets, 1955), risks linked to wars, and to improve political stability (Feng, 1997). It is therefore justified that growth appears as one of the main objectives in the political agenda of countries and international organizations. In order, to achieve this growth objective, the policy makers must identify the major determinants of growth.

It is in this context that a positive relationship between ICT and economic growth has been established. In other words, investment in ICT leads to an increase in productivity, which in turn leads to an improvement in the level of economic growth. Moreover, in times of crisis, as it was recreated with the global health crisis of covid, the tools provided by ICTs have made it possible to support economic activity thanks to alternatives in terms of employment (telecommuting, meeting via ZOOM and Microsoft teams), education (e-learning, virtual classrooms) and the functioning of public administration (remote declaration, digital identification). However, even before this crisis, Jorgenson et al (2007) pointed out that the use of ICT equipment by the industrial sector led to a strong growth in US labor productivity in the 1990s. This result has also been found in studies of the United Kingdom. Marrano et al (2009) show that the development of the "Knowledge Economy", supported by a massive investment in ICT, has increased the value of some key macroeconomic variables in the UK (labor productivity, gross value added of the market sector, capital deepening).

However, the impact of ICT on growth in developing countries is still unclear. Indeed, while some studies highlight the fact that the impact of ICT in developing and emerging

countries is higher than that observed for developed countries (Dimelis and Papaioannou, 2010), others simply indicate that the impact of ICT is not significant in developing countries (Dewan and Kraemer, 2000; Yousefi, 2011).

Niebel (2018), on the other hand, finds no statistically significant differences in the elasticity of ICT output between developed, emerging and developing countries. For this author, the argument that emerging and developing countries would 'leapfrogging' through ICT would be questioned. The analysis was conducted on a global sample of 59 over a period from 1995 to 2010.

That said, while there is a rich literature on the impact of ICT on growth, there are few studies that consider the role of ICT in a macroeconomic growth model. The empirical work done so far is mainly based on growth accounting models, cross-sections, and time series.

This paper, following the panel data approach adopted for telecommunications by Datta and Agarwal (2004), uses a macroeconomic growth framework to study the long-run relationship between ICT and economic growth in 134 developed and developing countries including 49 developed and 85 developing countries. In addition to estimating a fixed effects model, the estimates also incorporate dynamic panel estimation. The paper is organized as follows: Section 2 discusses the panel data approach and describes the growth model used. Section 3 presents the main results while additionally highlighting the results obtained in terms of return on ICT investments. Section 4 presents the robustness tests and Section 5 concludes.

2 Data, variables and method

To assess the effect of ICT on economic growth, we use data from 134 developed and developing countries from 2006 to 2016 based on the availability of the data. It includes 49 developed countries and 85 developing (36 upper-middle income, 31 Lower-middle income, 18 Low-income countries).

Table 19. Summary statistics and sources

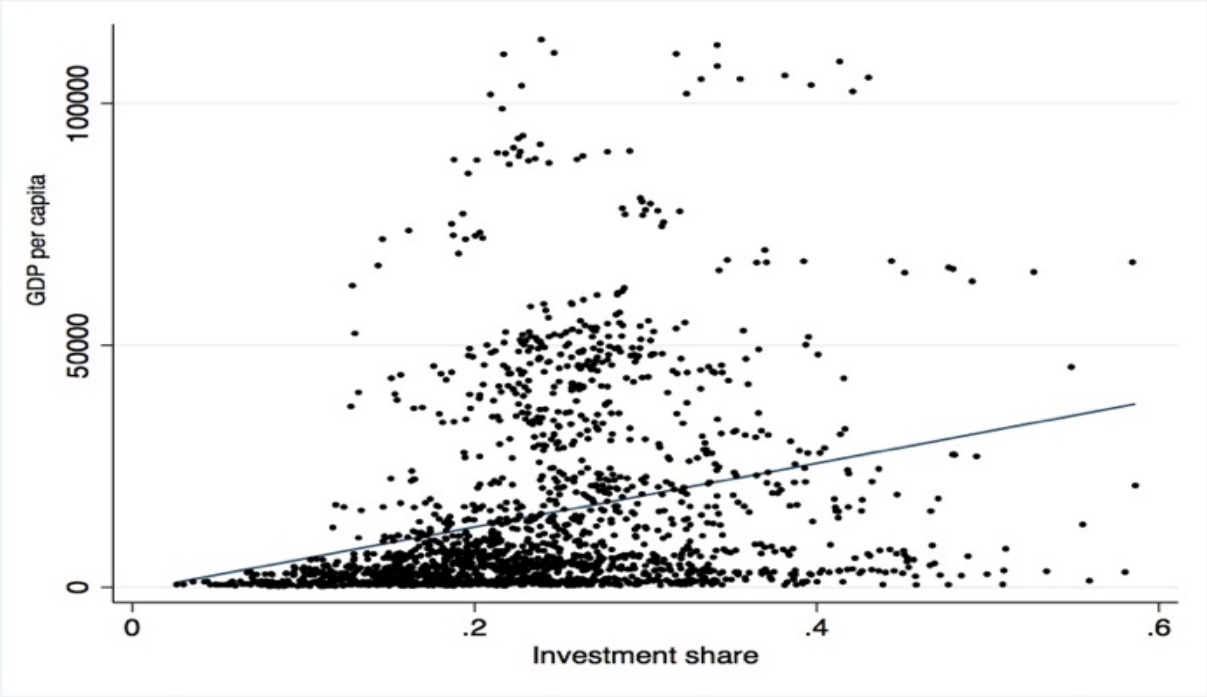
Variables	Observations	Mean	Standard Deviation	Minimum	Maximum	Source
GDP per capita growth (Growth)	1283	0.0188218	0.0388016	-0.2982714	0.2404868	World Development Indicators (WDI)
GDP per capita (GDP)	1283	16007.12	20546.86	219.9614	112077.6	WDI
Population growth	1283	1.450343	1.667486	-2.258464	17.51221	WDI
Share of government consumption expenditure in GDP	1283	0.1728506	0.0603256	0.0214199	0.3437592	Penn World Table version 10.0 - 2021 (PWT)
Share of total investment in GDP	1283	0.2359664	0.079354	0.042134	0.584587	PWT
Trade openness (OPEN)	1283	-0.061395	0.1648349	-0.6859814	0.7575524	PWT
The use of Information and Communication Technologies (ICT)	1283	3.69774	1.002045	1.99	6.07	The Global Information Technology Report (GITR)

In line with the literature on economic growth (Stern, 1991; Barro, 1991; Dewan and Hussein, 2001; Datta and Agarwal, 2004; Lee et al., 2012), the GDP per capita rate of growth is used as the dependent variable and a set of control variables have been selected. Concerning the control variables, we use the lagged GDP per capita that is per capita gross domestic product, which allows measuring the average wealth of individuals in a country. To support the convergence theory, a negative effect of GDP_{t-1} is expected. Indeed, the convergence theory argues that a higher level of previous GDP leads to lower subsequent current GDP growth. In addition, the total population growth rate is used, which is the estimated change in the number of all residents at

mid-year, regardless of their legal status or citizenship. We expect a negative effect of population growth on economic growth. This is because GDP per capita is measured by dividing GDP by total population. Therefore, the higher the population, the lower the GDP per capita would be. Moreover, government total consumption measured as the ratio of public procurement to GDP. The total investment is the share of fixe investment in GDP. A positive effect of investment on GDP growth is expected based on literature (Gwartney et al., 2006; Zou, 2006; Anwer, and Sampath, 1999; Blomström et al. 1996; Bleaney, 1996). Besides, there is the economics openness measure with trade openness. The trade openness is calculated by summing imports and exports. We also expect positive relationship between trade openness and growth (Bahmani-Oskooee, and Niroomand, 1999; Yanikkaya, 2003). Data on GDP per capita and GDP per capita growth are from World Development Indicators (WDI), while the share of government expenditure in GDP, total investment in GDP and trade openness are from Pen World Table 10.0 (PWT). Regarding the ICT uses, the data are collected from Global Information Technology Report from 2006 to 2016 edition. We present in table 19 the summary statistics

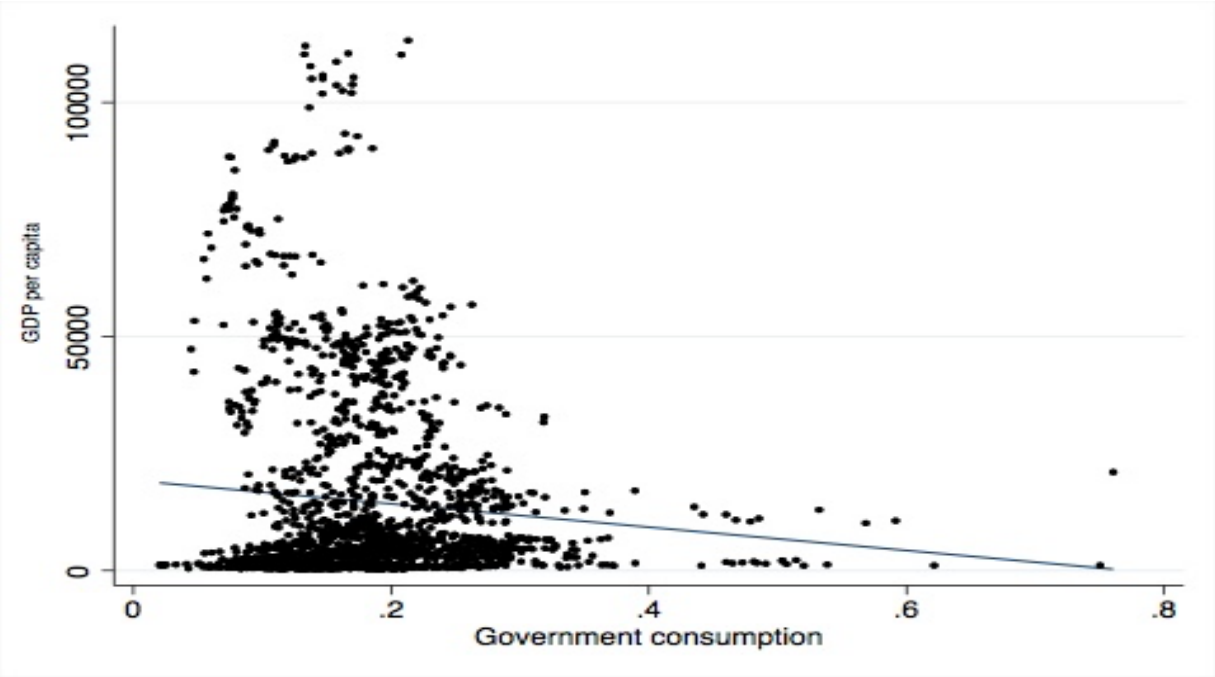
Following Datta and Agarwal (2006), we assess the nature of the relationship between the explained variable (GDP per capita growth) and selected variables (Investment, consumption, and ICT). Figure 24 shows positive relation between investment and GDP growth. However, a negative relationship is found with government consumption. As for the relationship between ICT use and GDP growth, it is positive. However, these numbers just give us an intuition of possible empirical results. They should not be considered as strong results because a correlation is not a causality.

Figure 24. Correlation between Investment and GDP



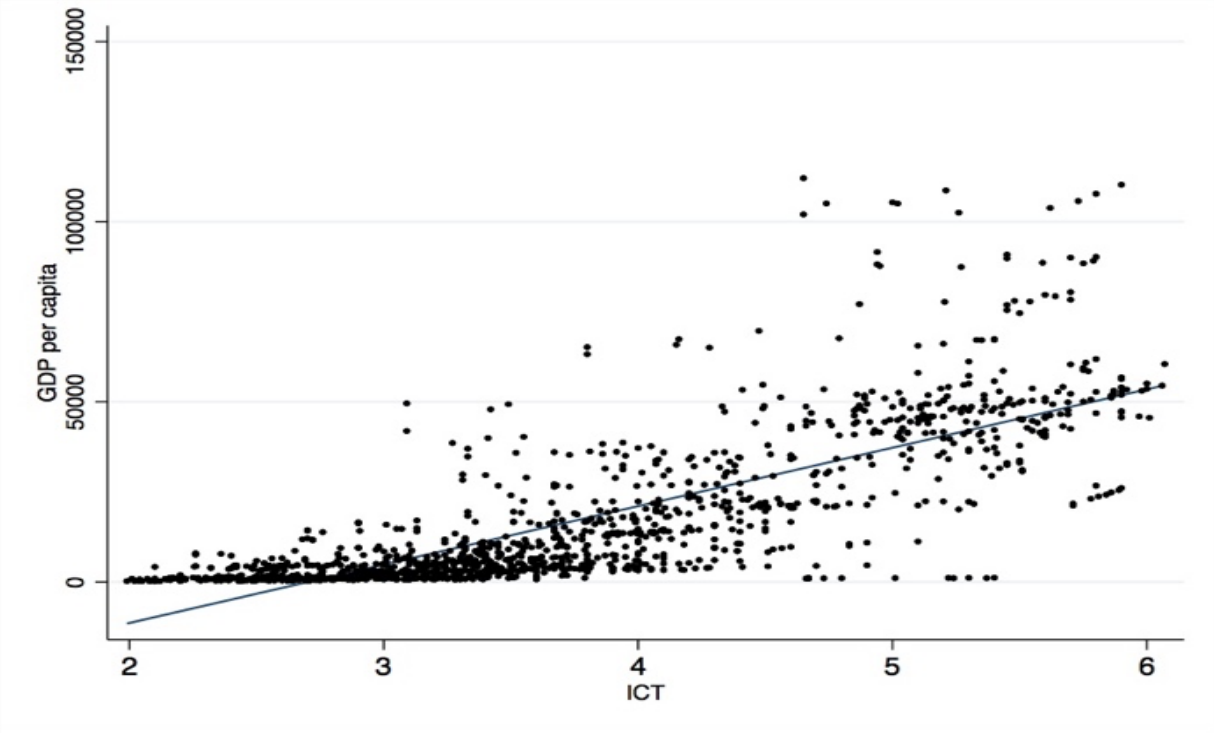
Source: Authors' Calculations

Figure 25. Correlation between Consumption and GDP



Source: Authors' Calculations

Figure 26. Correlation between ICT uses and GDP



Source: Author's Calculations

To analyze the effect of ICTs usages on economic growth, we specified the panel model. We consider country and time fixed effects in the estimations. The model to estimate is presented by the equation (6.1). In the right size, ICT_{it} indicates ICT use for country i in year t. α_i, γ_t, refers to country and time fixed effects and ε_{it}, and the error-term. The set of control variables is represented by X_{it},. Moreover, φ is the constant term of the model. Finally, δ represents the coefficient of ICT usage and β the coefficient of control variable.

$$Growth_{it} = \varphi + \delta ICT_{it} + \beta_1 growth_{i(t-1)} + \beta_2 \log(GDP)_{i(t-1)} + \beta_3 POP_{it} + \beta_4 INV_{it} + \beta_5 CONS_{it} + \beta_6 OPEN_{it} + \alpha_i + \gamma_t + \varepsilon_{it} \quad (6.1)$$

3 Empirical results

3.1 Baseline results

Table 20 presents the baseline results obtained for the estimation of the effect of ICT on economic growth. The basic model presented in column 1 suggests that ICT has a significant positive impact at the 1% level on economic growth. The signs of the control variables are consistent with the literature. The coefficient on lagged growth is positive and significant. The negative and significant coefficient on the previous level of GDP per capita confirms the convergence hypothesis which states that countries with initially high GDP per capita tend to grow relatively more slowly. Low population growth is associated with high economic growth. The relationship between government consumption and growth is negative, while the relationship between investment and growth is positive. These relationships are easily understood, since public consumption is thought to reduce savings, which are used to finance economic growth, and investment remains a channel for transmitting the impact of savings on growth.

The estimates are then controlled in the three remaining columns (2, 3 and 4) by the degree of openness. It turns out that the association between openness and growth is not significant, although it is positive.

Overall, it appears that ICT has a positive and significant impact (mostly at the 1% level) on growth. In doing so, to justify that the results are not simply subject to reverse causality, the relationship is tested using lagged values of ICT. The tests support the fact that the positive relationship is not simply due to reverse causality. Indeed, the

coefficients of the lagged values (first and second lags) of the ICT variable are positive, significant with smaller magnitudes than the level value.

Table 20. Effect of ICT on growth

	(1)	(2)	(3)	(4)
	Dependent variable: Growth			
Growth(t-1)	0.135***	0.135***	0.137***	0.096**
	(0.045)	(0.045)	(0.043)	(0.047)
Log GDP(t-1)	-0.144***	-0.144***	-0.112***	-0.107***
	(0.018)	(0.018)	(0.015)	(0.017)
Population	-0.004	-0.004	-0.006**	-0.007*
	(0.003)	(0.003)	(0.003)	(0.004)
Government consumption	-0.429***	-0.425***	-0.368***	-0.362***
	(0.073)	(0.079)	(0.094)	(0.092)
Total investment	0.168***	0.174***	0.182***	0.174***
	(0.031)	(0.040)	(0.042)	(0.047)
ICT	**0.030*** **	**0.030*** **		
	(0.005)	**(0.005)**		
OPEN		0.008	0.018	0.029
		(0.026)	(0.028)	(0.026)
ICT(t-1)			**0.014*** **	
			(0.005)	
ICT(t-2)				**0.022*** **
				(0.004)
Fixed effects	Yes	Yes	Yes	Yes
Observations	1283	1283	1272	1142
Countries	134	134	134	134
R-Squared	0.260	0.260	0.231	0.175

Notes: Robust standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01

3.2 Return to ICT

At this stage of the analysis, we are now interested in the marginal return in terms of growth obtained using ICT. To do so, we introduce the squared values of ICT in the model (ICT_SQ). The model can therefore be rewrite as follow:

$$Growth_{it} = \varphi + \delta ICT_{it} + \rho ICT\_SQ_{it} + \beta_1 growth_{i(t-1)} + \beta_2 \log(GDP)_{i(t-1)} + \beta_3 POP_{it} + \beta_4 INV_{it} + \beta_5 CONS_{it} + \beta_6 OPEN_{it} + \alpha_i + \gamma_t + \varepsilon_{it} \quad (6.2)$$

After estimation, the coefficient of ICT_SQ is significant at 1% level and negative (Table 21). This underlines to the presence of diminishing returns, i.e., the marginal return from the additional use of ICT products decreases, all else being equal. In other words, the observed positive effect of ICT on GDP growth is greatest for countries whose initial level of ICT use is still very low.

This finding is consistent with a conclusion of Datta and Agarwal (2004) that the effect of telecommunications investment on economic growth in 22 OECD countries was subject to diminishing returns. Thus, in this case study, it turns out that countries at an early stage of development are likely to benefit most from investment in ICT equipment.

Table 21. Returns to ICT

	(1)	(2)
	Dependent variable: Growth	
Growth(t-1)	0.143***	0.144***
	(0.044)	(0.044)
Log_GDP(t-1)	-0.157***	-0.157***
	(0.021)	(0.021)
Population	-0.005**	-0.005**
	(0.002)	(0.002)
Government consumption	-0.436***	-0.431***
	(0.075)	(0.081)
Total investment	0.177***	0.183***
	(0.030)	(0.037)
OPEN		0.008
		(0.025)
ICT	**0.087*** **	**0.087*** **
	(0.017)	**(0.017)**
ICT_SQ	**-0.007*** **	**-0.007*** **
	(0.002)	**(0.002)**
Fixed effects	Yes	Yes
Observations	1283	1283
Countries	134	134
R-Squared	0.270	0.270

Notes: Robust standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01

4 Additional Analysis

4.1 Heterogeneity

To test the robustness of the results, we perform estimations to check for sensitivity to sample selection bias. We examine whether the results depend on the level of development of the country. Based on the World Bank categorizations 2020, we classify the countries into two groups: developed and developing countries. Tables 22 and 23 present the results for each group.

Thus, in columns 1 and 2 of tables 22 and 23, the coefficients of ICT obtained for developed and developing countries, in addition to not being capitally different from each other, are not fundamentally different from the main results (table 20). These findings reveal a lack of specific heterogeneity across countries according to their level of development. Therefore, the average effect of ICT in the main model is reliable.

However, when we look at the marginal returns to ICT use (columns 5 and 6 of tables 22 and 23), we find that the relationship is more pronounced for developing countries than for developed countries. However, this observation is not harmless in the sense that developing countries have a relatively low level of ICT use compared to developed countries. Thus, knowing that there are diminishing returns, the least developed country of the developing countries will benefit, with proportional investments in ICT, more in terms of economic growth than the least developed country of the developed countries.

Table 22. Effect of ICT on growth: case of developed countries

	(1)	(2)	(3)	(4)	(5)	(6)
			Dependent variable: Growth			
Growth(t-1)	0.189***	0.188***	0.202***	0.185***	0.191***	0.190***
	(0.049)	(0.048)	(0.047)	(0.060)	(0.048)	(0.047)
Log_GDP(t-1)	-0.233***	-0.232***	-0.219***	-0.232***	-0.232***	-0.231***
	(0.038)	(0.036)	(0.032)	(0.038)	(0.038)	(0.036)
Population	-0.004	-0.004	-0.005**	-0.005	-0.004	-0.004*
	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)	(0.002)
Government consumption	-0.619***	-0.652***	-0.592***	-0.686***	-0.621***	-0.651***
	(0.134)	(0.189)	(0.192)	(0.224)	(0.133)	(0.190)
Total investment	0.134***	0.114	0.123	0.045	0.136***	0.117
	(0.049)	(0.082)	(0.090)	(0.113)	(0.050)	(0.083)
OPEN		-0.020	-0.010	-0.026		-0.018
		(0.064)	(0.065)	(0.079)		(0.064)
ICT	**0.028*** **	**0.028*** **			**0.045**	**0.044**
	(0.007)	**(0.007)**			**(0.040)**	**(0.039)**
ICT(t-1)			**0.020*** **			
			(0.007)			
ICT(t-2)				**0.035*** **		
				(0.007)		
ICT_SQ					**-0.002**	**-0.002**
					(0.004)	**(0.004)**
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	487	487	486	438	487	487
Countries	49	49	49	49	49	49
R-Squared	0.338	0.339	0.323	0.290	0.339	0.339

Notes: Robust standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01

Table 23. Effect of ICT on growth: case of developing countries

	(1)	(2)	(3)	(4)	(5)	(6)
			Dependent variable: Growth			
Growth(t-1)	0.124*	0.124*	0.115*	0.055	0.114*	0.114*
	(0.069)	(0.070)	(0.066)	(0.065)	(0.064)	(0.065)
Log_GDP(t-1)	-0.134***	-0.134***	-0.087***	-0.068***	-0.136***	-0.136***
	(0.024)	(0.024)	(0.018)	(0.019)	(0.025)	(0.025)
Population	-0.002	-0.002	-0.002	-0.001	-0.004	-0.004
	(0.006)	(0.006)	(0.006)	(0.007)	(0.005)	(0.005)
Government consumption	-0.389***	-0.389***	-0.335***	-0.321***	-0.388***	-0.387***
	(0.089)	(0.092)	(0.110)	(0.106)	(0.090)	(0.093)
Total investment	0.197***	0.198***	0.201***	0.223***	0.200***	0.202***
	(0.036)	(0.042)	(0.045)	(0.051)	(0.035)	(0.040)
OPEN		0.001	0.017	0.036		0.002
		(0.029)	(0.034)	(0.030)		(0.028)
ICT	**0.036*** **	**0.036*** **			**0.111*** **	**0.111*** **
	(0.008)	**(0.008)**			**(0.034)**	**(0.033)**
ICT(t-1)			**0.011** **			
			(0.006)			
ICT(t-2)				**0.013** **		
				(0.005)		
ICT_SQ					**-0.012** **	**-0.012** **
					(0.005)	**(0.005)**
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	796	796	786	704	796	796
Countries	85	85	85	85	85	85
R-Squared	0.241	0.241	0.205	0.149	0.248	0.248

Notes: Robust standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01

4.2 GMM Estimation

As a continuation of the robustness check of our main results, we run the two-step difference generalized method of moments (GMM) estimators (Blundell and Bond, 1998). The GMM addresses both the issue of reverse causality and the potential failure to meet the independence assumption between the explanatory variables (lagged value of the dependent variable) and the error. In addition, following Roodman's (2009) pedagogical introduction, we restrict and reduce the set of instruments to overcome instrument proliferation. The statistics of the Arellano-Bond autocorrelation test (of order 1 to 3), testing the existence of autocorrelation in the idiosyncratic error term and the Hansen Test of over identification confirm the validity of our results.

Table 24 reports the results of the estimation by breaking them down according to whether the sample considered is general (columns 1 and 2), made up of developed countries (columns 3 and 4) and developing countries (columns 5 and 6). The estimated coefficients of the ICT are positive, significant at the 1% level and equal to 0.078, 0.052, and 0.116 for the total sample, developed countries, and developing countries respectively.

Thus, with respect to the marginal return to ICT, we find the negative coefficient. However, the coefficient is only significant for the total sample.

Table 24. Effect of ICT on growth: GMM estimation

	Total Sample		Developed countries		Developing countries	
	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: Growth					
Growth(t-1)	-0.053	-0.032	-0.005	-0.112	-0.057	-0.028
	(0.059)	(0.066)	(0.074)	(0.099)	(0.101)	(0.075)
GDP(t-1)	-0.280***	-0.276***	-0.381***	-0.363*	-0.332***	-0.176**
	(0.060)	(0.076)	(0.090)	(0.204)	(0.089)	(0.070)
Population	-0.001	-0.006	-0.008	-0.021	0.004	-0.004
	(0.007)	(0.009)	(0.006)	(0.013)	(0.007)	(0.005)
Government consumption	-0.451**	-1.029***	-0.910***	-1.554**	-0.436*	-0.370
	(0.201)	(0.365)	(0.285)	(0.638)	(0.225)	(0.230)
Total investment	0.228***	0.344**	0.155	0.699**	0.292***	0.312***
	(0.082)	(0.155)	(0.146)	(0.276)	(0.093)	(0.087)
ICT	**0.078*** **	**0.211*** **	**0.052*** **	**0.072**	**0.116*** **	**0.205** **
	(0.012)	**(0.046)**	**(0.014)**	**(0.189)**	**(0.023)**	**(0.097)**
OPEN	0.033	0.000	-0.064	0.094	0.029	0.039
	(0.037)	(0.080)	(0.090)	(0.197)	(0.050)	(0.057)
ICT_SQ		-0.016***		-0.002		-0.022
		(0.005)		(0.021)		(0.015)
Observations	864	864	340	340	524	524
Countries	133	133	49	49	84	84
Instruments	97	98	32	33	65	66
AR1-pvalue	0.152	0.028	0.584	0.629	0.176	0.019
AR2-pvalue	0.001	0.005	0.000	0.027	0.773	0.438
AR3-pvalue	0.709	0.844	0.746	0.912	0.936	0.583
Hansen-P_value	0.176	0.319	0.013	0.017	0.178	0.169

5 Conclusion

Theoretical and empirical studies attribute much of the labor productivity growth in the US and the UK to ICT. The use of ICT products (computers, internet, telephones, software etc.) by the different sectors of activity would boost the overall labor productivity which would lead to an increase in the level of economic growth in these countries. Thus, with the recent and rapid diffusion of ICT in all countries of the world, this paper empirically studies the magnitude of the long-term growth that countries can expect from this ICT revolution.

The analysis covers a sample of 134 countries, 85 developing and 49 developed. The estimation is based on a dynamic fixed effects model. The panel data have the merit of correcting for the omitted variable bias that would be encountered when using a simple cross-sectional regression. The results show that ICT has both a statistically significant and positive effect on GDP per capita growth for our study countries.

The results are robust even to the choices of control variables (lagged growth, past GDP levels, population growth, government consumption, investment, and openness) and sample selection (developed countries, developing countries).

Furthermore, the results suggest that investment in ICT is subject to diminishing returns. In other words, countries at an early stage of development are likely to benefit most from investment in ICT equipment. Thus, from the perspective of policy implications, the empirical analysis provides strong evidence to suggest that the effective use of ICT is fundamental for stimulating economic growth.

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APPENDIX TO EXTENSION

1 Supplementary Tables

Table 25. List of developed countries

1	Australia	18	Hong Kong SAR, China	35	Poland
2	Austria	19	Hungary	36	Portugal
3	Bahrain	20	Iceland	37	Qatar
4	Barbados	21	Ireland	38	Saudi Arabia
5	Belgium	22	Israel	39	Singapore
6	Brunei Darussalam	23	Italy	40	Slovak Republic
7	Canada	24	Japan	41	Slovenia
8	Chile	25	Korea, Rep.	42	Spain
9	Croatia	26	Kuwait	43	Sweden
10	Cyprus	27	Latvia	44	Switzerland
11	Czech Republic	28	Lithuania	45	Trinidad and Tobago
12	Denmark	29	Luxembourg	46	United Arab Emirates
13	Estonia	30	Malta	47	United Kingdom
14	Finland	31	Netherlands	48	United States
15	France	32	New Zealand	49	Uruguay
16	Germany	33	Norway		
17	Greece	34	Oman		

Authors' construction based on World Bank database

Table 26. List of developing countries

1	Albania	23	Cote d'Ivoire	45	Kenya	67	Peru
2	Algeria	24	Dominican Republic	46	Kyrgyz Republic	68	Philippines
3	Angola	25	Ecuador	47	Lebanon	69	Rwanda
4	Argentina	26	Egypt, Arab Rep.	48	Lesotho	70	Senegal
5	Armenia	27	El Salvador	49	Madagascar	71	South Africa
6	Azerbaijan	28	Eswatini	50	Malawi	72	Sri Lanka
7	Bangladesh	29	Ethiopia	51	Malaysia	73	Suriname
8	Benin	30	Gabon	52	Mali	74	Tajikistan
9	Bolivia	31	Gambia, The	53	Mauritania	75	Tanzania
10	Bosnia and Herzegovina	32	Georgia	54	Mexico	76	Thailand
11	Botswana	33	Ghana	55	Moldova	77	Tunisia
12	Brazil	34	Guatemala	56	Mongolia	78	Turkey
13	Bulgaria	35	Guinea	57	Montenegro	79	Uganda
14	Burkina Faso	36	Guyana	58	Morocco	80	Ukraine
15	Burundi	37	Haiti	59	Mozambique	81	Venezuela, RB
16	Cabo Verde	38	Honduras	60	Namibia	82	Vietnam
17	Cambodia	39	India	61	Nepal	83	Yemen, Rep.
18	Cameroon	40	Indonesia	62	Nicaragua	84	Zambia
19	Chad	41	Iran, Islamic Rep.	63	Nigeria	85	Zimbabwe
20	China	42	Jamaica	64	North Macedonia		
21	Colombia	43	Jordan	65	Pakistan		
22	Costa Rica	44	Kazakhstan	66	Paraguay		

Authors' construction based on World Bank database

Table 27. Heterogeneity by income sub-group

	(1)	(2)	(3)	(4)	(5)	(6)
	Upper-middle income		**Lower-middle income**		**Low income**	
			Dependent variable: Growth			
Growth(t-1)	0.095	0.079	0.187*	0.177	-0.124	-0.124
	(0.082)	(0.078)	(0.106)	(0.104)	(0.093)	(0.093)
GDP(t-1)	-0.161***	-0.158***	-0.161**	-0.161**	-0.074***	-0.071***
	(0.037)	(0.035)	(0.077)	(0.077)	(0.023)	(0.023)
Population	-0.008	-0.010**	0.017	0.014	-0.002	-0.004
	(0.005)	(0.004)	(0.019)	(0.020)	(0.016)	(0.015)
Government consumption	-0.418***	-0.453***	-0.381**	-0.375**	-0.381	-0.379
	(0.108)	(0.118)	(0.155)	(0.154)	(0.231)	(0.225)
Total investment	0.259***	0.274***	0.134	0.140*	0.234***	0.233***
	(0.082)	(0.077)	(0.080)	(0.078)	(0.077)	(0.076)
OPEN	0.011	0.006	-0.034	-0.024	0.082	0.082
	(0.032)	(0.032)	(0.051)	(0.054)	(0.051)	(0.050)
ICT	**0.039*** **	**0.147*** **	**0.053** **	**0.139** **	**0.004**	**-0.073**
	(0.009)	**(0.048)**	**(0.024)**	**(0.063)**	**(0.014)**	**(0.132)**
ICT_SQ		**-0.016** **		**-0.014**		**0.014**
		(0.007)		**(0.011)**		**(0.026)**
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	342	342	295	295	159	159
Countries	36	36	31	31	18	18
R-Squared	0.317	0.331	0.257	0.262	0.171	0.173

Notes: Robust standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01