

MOBILE MONEY ADOPTION AND FINANCIAL INCLUSION OBJECTIVES: A MACROECONOMIC APPROACH THROUGH A CLUSTER ANALYSIS

***Documents de travail GREDEG
GREDEG Working Papers Series***

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GREDEG WP No. 2015-49

<http://www.gredeg.cnrs.fr/working-papers.html>

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Mobile Money Adoption and Financial Inclusion Objectives: A Macroeconomic Approach through a Cluster Analysis

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GREDEG Working Paper No. 2015–49

Abstract

This paper investigates the adoption patterns of Mobile Money in emerging and developing countries. Starting from macroeconomic comparative and case studies realised by practitioners experts, this paper proposes a wider macroeconomic approach based on cluster analysis as an alternative strategy for assessing similarity in adoption levels. By anchoring observations from previous studies in innovation adoption and diffusion theories, this article evaluates dissimilarity between groups of countries sharing the same adoption levels. Since the results matches with hypotheses from the innovation adoption and diffusion literature, this analysis nuances the potential of Mobile Money as an inclusive financial tool fighting banking exclusion.

JEL Classification: E03, G00, O35, O33

Keywords: Mobile Money, innovation adoption and diffusion, Financial Inclusion, similarity/dissimilarity.

1 Introduction

The development of Mobile Money services in emerging and developing countries - Kenya, Tanzania, Uganda, Burundi, Rwanda - is claimed to have strong implications for Financial Inclusion of non-banked people. As a result, in the last few years,

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there has been a growing and large amount of research on these countries (Lyman et al., 2006; Camner and Sjöblom, 2009; Heyer and Mas, 2009; Mas, 2009; Mas and Morawczynski, 2009; Alexandre et al., 2010; Camner et al., 2010; Mas and Radcliffe, 2010; Mbogo, 2010; Ndiwalana et al., 2010; Jack and Suri, 2011; Mbiti and Weil, 2011; Bosire, 2012; Di Castri, 2013; Di Castri and Gidvani, 2014).

These works support the necessity to develop new tools, such as Mobile Money, in order to fight financial exclusion in emerging and developing countries. They therefore seek to understand factors which make Mobile Money successful in order to explain or predict adoption of these services. Since they assess Mobile Money attributes on success (MNO strategy, services offered, service providers' reputation), they also focus their analyses on macroeconomic characteristics of each country observed, which is primordial to understand country specificities and then adoption comportments.

Most studies are conducted by practionners such as GSMA, CGAP, Bill and Melinda Gates Foundation, UNCTAD or MNO experts (Lyman et al., 2006; Camner and Sjöblom, 2009; Alexandre et al., 2010; Camner et al., 2010; Pénicaud, 2012; Di Castri, 2013; Pénicaud and Katakam, 2013; Di Castri and Gidvani, 2014). They are mainly based on country case study or on the comparison between two selected countries (principally Kenya and Tanzania). The main limitations of these works are the absence of countries where Mobile Money is still poorly adopted and the recurrence of the countries targeted. Moreover country case studies don't enable to establish generalized trends and don't not permit to take an objective look on the financial inclusive potential of the Mobile Money. Finally, by their nature of exploratory or pratitioner-oriented studies, most of those lack of links to theoretical fields (Lyman et al., 2006; Medhi et al., 2009; Alexandre et al., 2010; Jack and Suri, 2011; Pénicaud, 2012; Di Castri, 2013).

The object of this work is to propose a wider analyse, based on a larger sample of countries. More specifically, this paper proposes a method of assessing similarity/dissimilarity in adoption levels of Mobile Money. A cluster analysis is applied to distinguish macroeconomic characteristics of countries sharing the same adop-

tion levels. Cluster gathers together those countries sharing common adoption level and common lifetime of their Mobile Money service. This technique is used to figure out adoption similarity between countries, acknowledged as the outcome of a specific distance function, and to identify characteristic dissimilarities between clusters. A similarity/dissimilarity analysis applied on a wider sample should enable to observe characteristics of countries in which Mobile Money is successful and in which it is not. It is then possible to assess the adequacy between adoption levels, country characteristics and Mobile Money objectives in order to conclude on the financial inclusive potential of Mobile Money services. Then, this paper proposes to position facts observed in the exploratory and practitioner-oriented studies about Mobile Money in the theoretical frameworks of the innovation adoption and diffusion (Rogers, 1983; Ajzen, 1985, 1991; Davis et al., 1989; Davis, 1989, 1993). This study represents - to the best of our knowledge - the first attempt to apply cluster analysis technique to assess adoption of Mobile Money for a wide sample of countries.

The paper proceeds as follows: Section 2 presents a synthetic review of the previous research and the innovation adoption and diffusion framework; Section 3 describes the empirical strategy of the work as well as a description of the sample; Section 4 presents the main outcomes of the analysis; and Section 5 concludes.

2 Literature review

2.1 Mobile Money services, a Financial Inclusion solution to fight banking exclusion

Mobile Money is designed to offer access to financial services for unbanked people, especially in emerging and developing countries knowing a lack of banking infrastructures and accessibility (Mobile Money for Unbanked people (MMU)). The main goal of this service is Financial Inclusion for financial excluded. Mobile Money is based on simple financial services for the customers. It offers electronic accounts in which customers can deposit cash up to a certain ceiling and from which they can withdrawal cash and manage their electronic money. Access to these accounts and

services associated are facilitated, generally a national identification card only is required to subscribe, and opening, crediting and managing an account is totally free (only the transfers of money are taxed). Mobile Money services give the possibility to subscribers to send or receive money to/from subscribers of the same service or banked customers (domestic transfers and/or international remittances) and/or to pay some bills. Finally, users can count on a growing network of agents composed by employees of the service providers and retail commercial partners to deposit and withdrawal their cash.

To understand Financial Inclusion goals of Mobile Money services implementation, it is crucial to define Financial Inclusion, and subsequently financial exclusion. Indeed this definition is not the same from the Financial Inclusion literature point of view (Toxopeus and Lensink, 2007; Beck et al., 2008; Ramji, 2009; Sarma, 2008, 2012; Sarma and Pais, 2011; Demirguc-Kunt and Klapper, 2012; Allen et al., 2013, 2014; Amidzic et al., 2014) and from the Mobile Money literature (Morawczynski and Pickens, 2009; Camner and Sjöblom, 2009; Jack and Suri, 2011; Mbiti and Weil, 2011).

In Financial Inclusion literature (Toxopeus and Lensink, 2007; Beck et al., 2008; Ramji, 2009; Sarma, 2008, 2012; Sarma and Pais, 2011; Demirguc-Kunt and Klapper, 2012; Allen et al., 2013, 2014), this concept is associated to banking inclusion. According to the several studies, Financial Inclusion is approximated by various banking aspects: having a banking account (Toxopeus and Lensink, 2007; Ramji, 2009), the frequency of use of banking services, like the fact of effectively using a banking account and the frequency of common operations done via a banking account (Allen et al., 2013), or more complete definitions including banking factors of accessibility to banking services (having a bank account), availability of banking infrastructures (number of Automated Teller Machines (ATM) and bank branches per sq km or per people) and the effective use of banking services (level of deposits and credits) (Beck et al., 2008; Sarma, 2008, 2012; Sarma and Pais, 2011; Demirguc-Kunt and Klapper, 2012; Amidzic et al., 2014). To measure Financial Inclusion, Sarma and Pais (2011) proposed an Index of Financial Inclusion (IFI) whose calculation is composed by these three banking factors (accessibility, availability, and

usage) and provides an index between 0 and 1. IFI is calculated on the aggregation of these three factors to build a complete measure of Financial Inclusion in a country in order to rank countries (see Sarma and Pais (2011) for details on calculation). This definition of Financial Inclusion, or more precisely banking inclusion, takes into account the territorial coverage of banking infrastructures, the ease of access, and the effective use of banking services. Banking inclusion/exclusion results from different factors: proximity with banking equipments and infrastructures (Beck et al., 2008; Sarma, 2008, 2012; Sarma and Pais, 2011; Demirguc-Kunt and Klapper, 2012; Allen et al., 2013), banking services price (fixed and transaction costs) (Beck et al., 2008; Allen et al., 2013), confidence into financial institutions (Beck et al. 2008; Demirguc-Kunt and Klapper, 2012; Allen et al., 2013), knowledge about financial services (Findscope, 2009; Camner and Sjöblom, 2009).

In Mobile Money literature, Financial Inclusion concept is disconnected from banking aspects (Camner and Sjöblom, 2009; Camner et al., 2009; Heyer and Mas, 2009; Mas, 2009; Morawczynski and Pickens, 2009; Mas and Radcliffe, 2010; McKay and Pickens, 2010; Jack and Suri, 2011; Merritt, 2011; Bosire, 2012; Di Castri, 2013). Mobile Money is designed to provide a financial connection between consumers (Lawack, 2013), and this solution is named “branchless banking” (Lyman et al., 2006; Mas, 2009) which refers to financial services offered by private or financial actors which are not banks (Dermish et al., 2011). Recent studies take into account development of Mobile Money systems and integrate this new possibility into their definition of Financial Inclusion (Allen et al., 2013).

Mobile Money is promoted as an engine fighting against financial exclusion, because it offers an answer to, at least, two of major issues: financial services price (Morawczynski and Pickens, 2009; Mbiti and Weil, 2011; Donovan, 2012; Arestoff and Venet, 2013) and proximity with financial infrastructures (Morawczynski and Pickens, 2009; Camner and Sjöblom, 2009; Jack and Suri, 2011; Mbiti and Weil, 2011). Indeed, in a survey realised on 18 branchless banking providers in 10 different countries, McKay and Pickens (2010) estimate that the price of branchless banking solutions is 19%, on average, lower than price charged by banks. In addition, Mobile Money providers deploy a growing network of agents in order to offset

the lack of banking infrastructures and to make financial services reachable. These agents are both service providers' employees and retail stores (cash-in / cash-out points) offering to users possibility to deposit and withdrawal cash. In 2012, a survey realised by the Groupe Speciale Mobile Association (GSMA) on the state of Mobile Money Industry estimates that in 28 countries, Mobile Money agents were more numerous than bank branches. This is true for Tanzania where 17541 Mobile Money agents are deployed in the countries compared with only 504 bank branches (Di Castri and Gidvani, 2014).

2.2 Determinants of Mobile Money services adoption

Adoption, and more precisely assimilation, of an innovation is largely studied in economic literature. Several theories have been wrote in order to understand and predict adoption of an innovation: the Technology Acceptance Model - TAM - (Davis et al., 1989; Davis, 1989, 1993), the Theory of Planned Behaviour - TPB - (Ajzen, 1985, 1991), the Innovation Diffusion Theory (Rogers, 1983). These models analyse the innovation's characteristics and benefits they provide to users, in order to predict the potential adoption of such innovation. Based on these models, it is possible to detect factors which can affect the decision of implementation of Mobile Money in a specific country by evaluating the real interest of the service and predicting the potential adoption.

Rogers (1983) proposes the Innovation Diffusion Theory in which he distinguishes 5 perceived interests that a innovation has to offer to users to be adopted and assimilated: the relative advantage, the complexity, the compatibility, the trialability, and the observability.

Mobile Money offers a relative advantage to customers by providing cheaper financial services than existing banking system. McKay and Pickens (2010) reveals in a survey that price of using Mobile Money is 19% cheaper on average than using the banking system. On the other hand, Mobile Money financial services are accessible from users' mobile phone, and do not require to access a banking infrastructure (ATMs or bank branches), often poorly distributed in countries suffering of Finan-

cial Exclusion, to realise transactions, deposits, or withdraws. The developpement of mobile financial services in emerging and developping countries, where populations are largely equipped with a mobile phone, could provide a relative advantage for inhabitants, in terms of access to financial services, compared to the traditional banking system. By now, individuals can access to Mobile Money services wherever the mobile network is available.

It offers low complex financial services to inhabitants of these countries. Indeed, Mobile Money services are principally SMS-based services and do not required any learning to be used in countries where mobile phone technology is still widely diffused. However, the adoption and the use of Mobile Money services could required some pre-existing knowledge on financial services in general.

An inclusive banking system, in terms of accessibility, availability and usage, can be difficult to compete. If people have access to the banking system, if they are banking included, there is no need for an other financial system to replace it (Heyer and Mas, 2009; Bosire, 2012). Mobile Money, as a service offering easy and low cost access to financial services, fighting against banking exclusion, would be pointless and not used. Then, Mobile Money services must stage a lack of banking infrastructures and access and they should answer to a need for financial services. The fact is that migrations of inhabitants from rural to urban areas, to find a job in order to feed their family remained in rural areas, revealed their need for distant money transfers. In the situation where it exists a need for distant money transfers and that an efficient banking system doesn't exist, Mobile Money could be an helpful solution.

On the other hand, innovation must be compatible with past experiences to be adopted. In the case of Mobile Money, this compatibility with past experiences can be related to the need of financial knowledge and experience (Financial Literacy) to ensure adoption of these services. Financial Literacy is correlated to literacy, level of education, numeracy skills and access to information (Findscope, 2009). This need of Financial Literacy can also be linked to the perceived trialability of the innovation. Indeed, potential adopters must perceive that they have an opportunity to experiment with the innovation prior to use it. Financial Literacy, and more pre-

cisely financial experience, appears to be primordial to Mobile Money adoption, as a trial of this new service. An inclusive banking system can be synonym of financial experience. If people can integrate relatively easily the banking system, they can benefit from a financial experience which increases their probability to adopt a new financial service. Financial experience is a real advantage for Mobile Money service providers who know they will meet their demand by offering new financial services (Camner and Sjöblom, 2009).

Finally, Ajzen (1985, 1991) mentions the perceived behavioural control which has to be taken into account in determinants of attitude towards usage intention. In fact, potential users can face internal and external factors which act as a major constraint on behaviour, called the volitional control factors. A lack of individual abilities and skills for the innovation use can disturb the relation between the intentional behaviour and the effective behaviour. In addition, the potential users' perceived self efficacy (Taylor and Tod, 1995; Khraim et al., 2011), which is the perception and the self confidence of potential users of their ability to use the innovation, can also be a constraint to adoption and usage. The volitional control factors and the self efficacy perception depend on the level of education of individuals. Mobile Money services' targeted population must be literate, because most of Mobile Money services are SMS-based services (M-PESA) or work via an electronic platform (MTN Mobile Money), and people have to know reading and writing to use these systems (Camner and Sjöblom, 2009; Merritt, 2011; Buku and Meredith, 2013). It corresponds to effective abilities and skills needed to adopt and use the innovation. Individuals also need to have a high level of education to be confident in their self efficacy necessary to adoption.

The observability of an innovation is relative to the adoption of this innovation (Rogers, 1983). It coincides with the positive network effects of the adoption of a new means of payment, as described in "search-theoretic" approach to monetary economics and in the literature on financial and monetary innovation adoption. In fact, the adoption of a new money or a new means of payment depends on the number of customers using it, thus making it attractive through the multiplication of possible exchanges. The utility of a certain means of payment (or money) in-

creases with the number of its users (Kiyotaki and Wright, 1993; Katz and Shapiro, 1994; Berentsen, 1998; Shapiro and Varian, 2000; Chou et al., 2004; Rysman, 2004; Orléan, 2008). Our studied variable of interest being adoption, this variable will be considered only as a variable of result.

3 Mobile Money Adoption Model: Method and Data

To adress the issue of accordance between determining factors in Mobile Money adoption and Financial Inclusion objective, this study is conducted on 24 countries having at least one non-bank-led Mobile Money in 2011 to understand adoption factors of the Mobile Money alternative, both to identify determinants factors of adoption and to evaluate the adequacy of these factors with MMU supported goals.

3.1 A Cluster Analysis

Cluster analysis produces groupings of data into natural groupings, in order to organise them, according to their similarity. The goal is to create several distinct groups in which objects of study are similar. It means that groups will be constituted by maximising the distance interclass and minimising the distance intraclass. The purpose of this adoption factors analysis is to regroup countries according to their level of adoption and the number of years passed since the first MMU was implemented, to merge countries with homogeneous adoption characteristics. Then it will be possible to determine in which class there is the highest rate of adoption and to describe characteristics from these groups. To perform this study, the Ward's minimum-variance method is used. It has been chosen preferably from other hierarchical cluster algorithms because of its better predictive potential tested and attested in numerous studies based, for instance, on the Euclidean distance or the Rand Index (Ferreira and Hitchcock, 2009; Becker et al., 2011). At the beginning, the number of clusters is unknown and this analysis starts by attributing each individual to a distinct cluster. Clusters are progressively merged according to a

minimised variance between two clusters merged. Ward's method for cluster stops when it remains only one cluster. To determine the optimal number of clusters, different methods can be used. In this analysis, two of them have been tested: the Duda and Hart Index and the realisation of a dendrogram. The Duda and Hart Index is defined as:

$$DH = \frac{J_1^2(m)}{J_2^2(m)}$$

where $J_1^2(m)$ is the within-cluster sum of squared errors of the mth cluster, $J_2^2(m)$ the within-cluster sum of squared distances when the mth cluster is optimally divided into two. The value of the Duda and Hart Index is high and the value of the Pseduo T-squared is low when the number of groups is optimum.

This index result is completed and checked by a visual confirmation via the dendrogram produced.

3.2 Data Collection

In this clustering analysis, countries are regrouped according their rate of Mobile Money adoption and the number of years spent since the first MMU was implemented. A central database on Mobile Money adoption is currently emerging, provided by IMF through the Financial Access Survey (FAS). This database provides the number of Mobile Money accounts in countries implemented. However, if this database is still incomplete - not all countries having a Mobile Money are recorded - it has been completed by a search on different sources of information. These sources are various: reports¹, interviews², case studies³, corporate annual reports⁴, and conference presentations⁵.

¹UNCTAD, Afghanistan (2011), Burundi, Rwanda, Tanzania and Uganda (2012); GSMA (2014), Côte d'Ivoire; GSMA (2012), Thailand.

²mPAY Managing director (2011), Thailand.

³UNDP, Burkina Faso, Xacbank Mongolia (2011); NAWC, Morocco (2011); CGAP (2012), Senegal

⁴MTN Sustainability report (2011), Benin, Liberia and Zambia; France Telecom Overview of business (2011), Mali

⁵Mobile Money APAC 2012 conference, Mongolia; IFC (2012), Paraguay.

The number of years spent since the first MMU was implemented is obtained in the GSMA Mobile Money Tracker Database which provides the year and the month of implementation. Then, the number of years spent until the end of 2011 is calculated.

Macroeconomic variables about countries' characteristics have been found in the World Bank database, including World Development Indicators, Education Statistics, Jobs and Findex.

3.3 Variables choice

To understand the determinants of Mobile Money adoption, the variables chosen refer to the innovation adoption literature cited previously. Obviously, banking factors, in terms of accessibility, availability and usage of the banking system, are taken into account, expressing the real need, the past experience, the ability and the self-confidence of the potential users (Ajzen, 1985, 1991; Rogers, 1983; Taylor and Todd, 1995; Khraim et al., 2011). Availability of the banking infrastructures, the usage of banking services and the complete Index of Financial Inclusion are calculated based on the IFI calculation proposed by Sarma and Pais (2011). The rate of adults having a bank account is used to express the accessibility to the banking system. Again, the expected influence of banking factors remains to be determined, as mentioned previously.

Education level of the population is also included to evaluate its real abilities and the self-confidency to use Mobile Money innovation (Ajzen, 1985, 1991). The level of education is expressed by the average number of years of schooling of the population. If the information was not available for 2011, data for 2009 or 2010 have being used. The rates of a country urbanisation growth and of its labour force participation evaluate the compatibility of Mobile Money with existing needs (Rogers, 1983). The rate of urbanisation growth, combined to the rate of labour force participation, express these movements of population from rural to urban areas and the existing need for Mobile Money services (Medhi et al., 2009; Camner and Sjoblom, 2009; Bosire, 2012; Buku and Meredith, 2013). Finally, mobile penetration, expressed by the mobile cellular subscriptions per 100 people, and the mobile network, expressed

TABLE 1
Features of Mobile Money Adoption

<i>Features</i>	<i>Variables</i>	<i>Description</i>	<i>Data Source</i>
<i>Relative advantage</i> (Rogers, 1983; Morawczynski and Pickens, 2009; Camner and Sjoblom, 2009; Mbiti and Weil, 2011; Jack and Suri, 2011)	Availability of the Banking Infrastructures	Aggregation of the number of ATMs per 1000 km2 and the number of bank branches per 1000 km2	WDI World Bank
	Mobile Network	Population covered by mobile cellular network (%)	ITU
<i>Complexity</i> (Rogers, 1983; Camner et al., 2010; Heyer and Mas, 2009; Bosire, 2012)	Mobile Penetration	Mobile cellular subscriptions (per 100 people)	WDI
<i>Compatibility with past experiences and Trialability</i> (Rogers, 1983; Findscope, 2009)	Accessibility to the Banking System	Aggregation of % of the adult population having a bank account	Findex World Bank
<i>Compatibility with Existing Needs</i> (Rogers, 1983; Heyer and Mas, 2009; Camner and Sjoblom, 2009; Bosire, 2012)	Index of Financial Inclusion	Aggregation of Availability Usage and Accessibility Index	
	Urban Growth	Urban population growth (annual %)	WDI
	Labour force	Labor force participation rate, total (% of total adult population)	WDI
<i>Volitional control: Ability and Self-confidence</i> (Ajzen, 1985, 1991; Taylor and Tod, 1995; Khraim et al., 2011; Camner and Sjoblom, 2009; Merritt, 2011; Buku and Meredith, 2013)	Level of education	Average number of years of schooling of the population	Education Statistics World Bank

by the % of the population covered by the mobile network, are also observed to evaluate the complexity of the Mobile Money innovation and the effective presence of equipment required to use it.

3.4 Sample description

The sample observed (figure (2)) is composed of 24 developing and emerging countries, having at least one non-bank-led Mobile Money system in 2011. Exploring descriptive statistics, some tendencies can still be observed. Some countries with a relative high Index of Financial Inclusion seem to present also relative high rate of adult adoption of Mobile Money. For instance, Thailand, Philippines and Kenya, respectively ranked 1, 4 and 6 in term of IFI in the sample report relative high rate of adult adoption of Mobile Money (respectively 12.40%, 13.68% and 79.39% of the adult population). However, these observations need to be tempered. These three countries also have a Mobile Money service in life since a longer time than the others in 2011, respectively 6.6, 10.4 and 4.3 years.

TABLE 2
Countries of the Sample and their Mobile Money Adoption Rate
and Index of Financial Inclusion

<i>Country</i>	<i>Date of the first launch of MMU</i>	<i>Rate of Adotpion of MMU in 2011 (adults)</i>	<i>IFI</i>	<i>Rank IFI</i>
Afghanistan	2008	0,794	0,02437973	23
Benin	2010	2,8977	0,07902451	17
Burkina Faso	2009	0,6926	0,07587785	18
Burundi	2010	0,5429	0,05482996	21
Colombia	2012	5,31025	0,19599486	7
Côte d'Ivoire	2008	17,6784	0,113455041	12
Indonesia	2007	4,7551	0,18216564	9
Kenya	2007	79,3894	0,24142126	6
Liberia	2011	2,0292	0,1103701	13
Madagascar	2010	7,3003	0,01765872	24
Malaysia	2007	2,52812	0,58345327	2
Mali	2010	4,01493	0,04735483	22
Mongolia	2010	5,9646	0,30289354	5
Morocco	2010	0,3462	0,35165323	3
Nigeria	2003	3,6184	0,19144928	8
Paraguay	2010	3,4134	0,13804902	11
Philippines	2004	13,6772	0,30517101	4
Rwanda	2010	4,9742	0,17635357	10
Senegal	2008	10,6378	0,06713996	19
Sierra Leone	2009	1,9094	0,06292025	20
Tanzania	2008	35,9904	0,09425764	15
Thailand	2004	12,4031	0,75442921	1
Uganda	2009	11,6486	0,1017	14
Zambia	2009	5,8899	0,09331877	16

Source: GSMA Mobile Money Deployment Tracker

The sample is also composed with countries presentig a relative low Index of Financial Inclusion and a relative low rate of adult adoption of Mobile Money. Afghanistan and Sierra Leone are low banking included countries (their IFI are respectively 0.024 and 0.063) and record relative low rate of adoption (respectively 0.794% and 1.909% of the adult population). Again, these observations need to be tempered. For instance, Morocco and Burundi suffer from relative low rates of adoption and low IFI but residents of these countries have not access to Mobile Money services for a long time.

According to the descriptive statistics, it is not possible to determine countries' profiles and to draw conclusions. Countries need to be grouped according their rate of adult adoption of Mobile Money and the service life of their MMU. Merging countries presenting these same characteristics will allow comparisons and the understanding

of their differences.

4 Results

In order to precise these first observations, a clustering analysis is run to regroup countries with similar Mobile Money rates of adoption and service life. A dendrogram is used to distinguish the groups formed by the clustering analysis (figure (1)), where the heights of the links of the dendrogram inform about the level of proximity between groups formed. The number of groups selected was derived by the observation of the dendrogram and the observation of the Duda and Hart Index (table (3)).

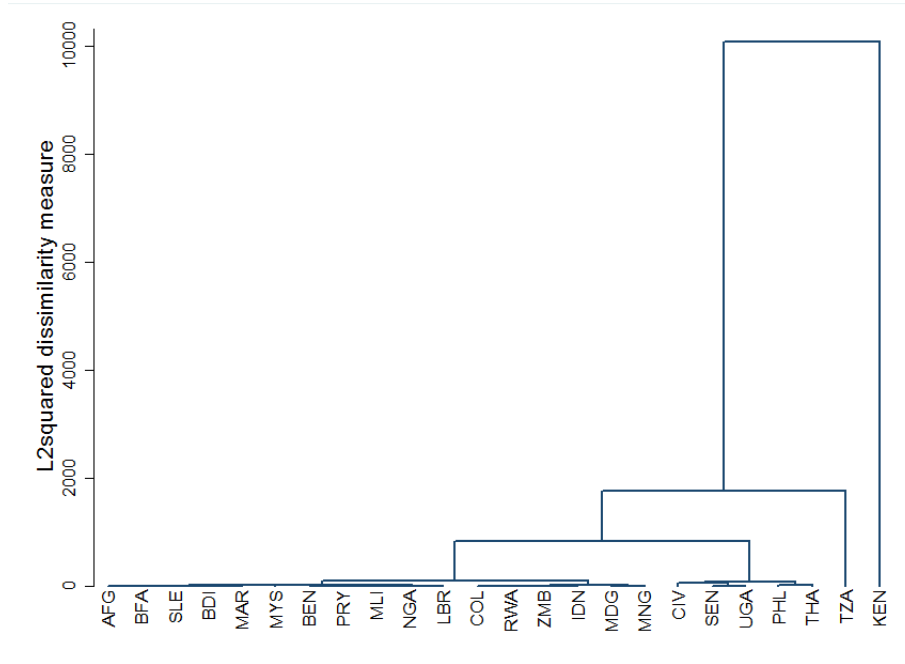


Figure 1: Dendrogram for Cluster Analysis

Five clusters are constructed (table (4)), two of them being composed by only one country, Kenya and Tanzania, which present higher rates of adoption not comparable with the rates of the other countries observed.

This study is focused on three different groups of similar countries in terms of Mobile Money adoption and service life (table(5)). Kenya and Tanzania, each country composing a distinct group, are excluded from this study. The success of Kenya and

TABLE 3
Duda and Hart Index

<i>Number of clusters</i>	Duda Hart	
	<i>Je(2)/Je(1)</i>	<i>Pseudo T-squared</i>
1	0.2258	75.41
2	0.3982	31.74
3	0.2882	49.39
4	0.4325	19.68
5	0.4760	3.30
6	0.0175	56.06
7	0.4696	10.16
8	0.0000	.
9	0.2943	9.59
10	0.4113	7.16
11	0.3963	4.57
12	0.3695	5.12
13	0.3712	5.08
14	0.0000	.
15	0.1237	7.08

Tanzania is often studied (Mas, 2009; Heyer and Mas, 2009; Camner and Sjöblom, 2009; Jack and Suri, 2011). Numerous arguments have been presented in case studies to explain Mobile Money success in these two countries. These factors of success emerge from different sources: MMU and service providers' characteristics on the one hand and countries' specificities on the other. MMU and service providers' characteristics consist principally in the ease of use of the Mobile Money service (Mas and Morawczynski, 2009), in a large enrolment of retail businesses as agents (Camner and Sjöblom, 2009; Mas and Morawczynski, 2009), in a high control of agents distribution (Mas and Morawczynski, 2009), and in the trust in MMU provider (Camner and Sjöblom, 2009; Heyer and Mas, 2009), the traditional factors of innovation adoption (Davis et al., 1989; Davis, 1989, 1993; Rogers, 1983). Countries characteristics are mainly: a relatively available banking system (Camner and Sjöblom, 2009), a large population awareness of financial services (Camner and Sjöblom, 2009), an increasing urbanisation (Heyer and Mas, 2009) and a high mobile penetration along with a large mobile network coverage (Mas and Morawczynski, 2009). These two countries seem to present favourable specific conditions enabling adoption and will

TABLE 4
Ward clusters

5 clusters

Cluster 1	LBR-PRY-BFA-BDI-MAR-AFG-BEN-NGA-SLE-MYS-MLI
Cluster 2	IDN-ZMB-MDG-RWA-COL-MNG
Cluster 3	UGA-SEN-THA-CIV-PHL
Cluster 4	TZA
Cluster 5	KEN

not be studied anew in this clustering analysis.

Cluster 1 can be defined as the group of countries which have been implemented for a short time (approximately a year and a half) and where MMU is not well spread (2.07% of adult population). Cluster 2 can be defined as the group of countries which have also been implemented for a short time (just below 2 years, on average duration quasi similar to Cluster 1) and where MMU is more widely spread than in Cluster 1 (5.69% of adults). Cluster 3 is composed of countries which has been implemented for a longer time than the other clusters (5 years), and where MMU is more widely spread than in the other clusters (more than 13% of adult population). All the results are confirmed by the run of a t-test revealing significant differences.

A comparison of countries characteristics between different clusters is studied to identify which factors could explain the differences in MMU adoption rates (table (6) and figure (2)).

MMU and providers' characteristics could not be taken into account in this study because of the impossibility to ascertain the rate of adopters for each service provider. A comparison between qualities of services has not been realised. This analysis focuses on countries' specificities. A first difference is observed in terms of banking infrastructure availability between Cluster 3 and the two others. In fact, this Cluster has an higher availability indicator than the two others (0.203 compared with 0.058

TABLE 5
MMU Adoption : Mean Vectors of the Cluster Analysis

	<i>MMU Adoption Rate (% of adult population)</i>	<i>Service life of MMU (year)</i>
Cluster 1	2.07	1.64
Cluster 2	5.69	1.92
Cluster 3	13.21	5
Cluster 4	35.99	3.2
Cluster 5	79.39	4.3

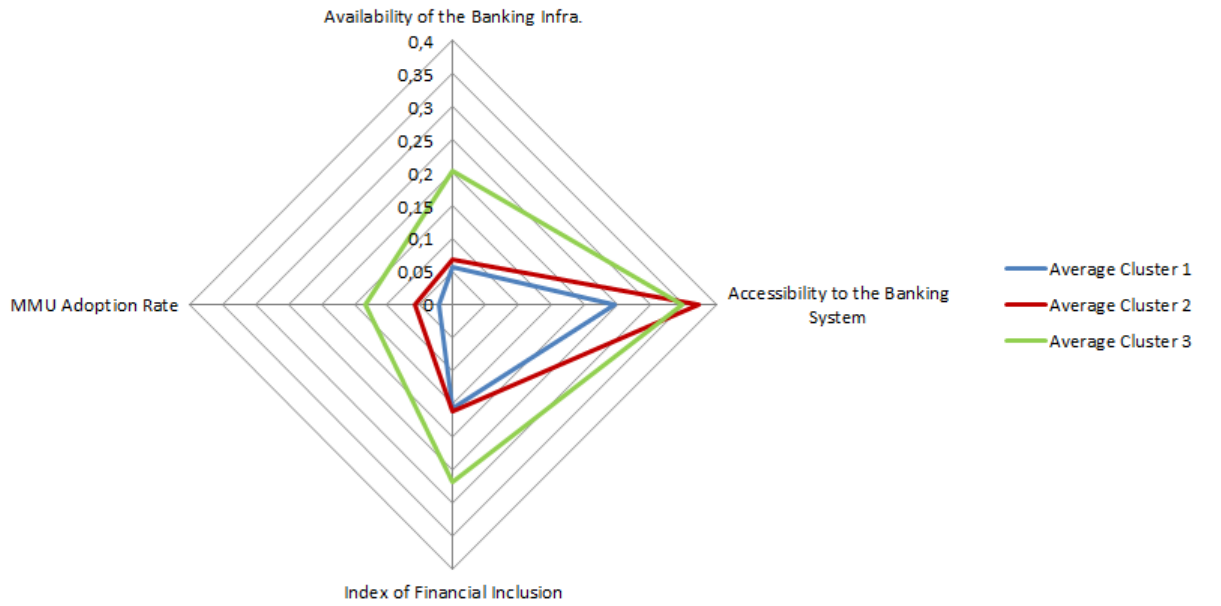


Figure 2: Graphic Analysis of Adoption Rate and Financial Inclusion

in Cluster 1 and 0.069 in Cluster 2). This observation is not compatible with objectives of Mobile Money which is to include banking excluded but it confirms results found in some case studies analysis. Agents in charge of the opening and crediting of users' electronic accounts with the amount the users have given them in cash need to be in the vicinity of bank branches or ATM to manage their liquidity (i.e. deposit users' cash on their own account and withdraw funds in order to provide

enough cash to customers) (Mas and Morawczynski, 2009; Camner and Sjöblom, 2009; Camner et al., 2010; Mas and Radcliffe, 2010; Merritt, 2011; Bosire, 2012). Cluster 3 is the cluster with the higher Mobile Money service time, expressing the need for MMU providers to benefit from the banking infrastructures availability to run their activity. The mobile network coverage is also wider in Cluster 3 than in two others 96% of the population covered by the mobile network on average in Cluster 3 compared with 74% in Cluster 1 and 75% in Cluster 2. This difference could also explain why these countries have been implemented earlier than the other countries. In fact, to deploy their financial services and to ensure adoption, MMU providers need to connect a significant part of the global population via the mobile network. It could also explain the higher rate of adoption in Cluster 3, despite the longer service time of MMU. A greater mobile network coverage in countries from Cluster 3 provides a relative advantage to residents in using Mobile Money services compared to the use of the banking services (Rogers, 1983; Mas and Morawczynski, 2009). Cluster 3 presents also a higher mobile penetration than the two other clusters. Residents from Cluster 3 countries are more familiar with mobile phone technology which reduces the complexity of using financial mobile services (Rogers, 1983; Camner et al., 2010; Heyer and Mas, 2009; Bosire, 2012).

TABLE 6
Country characteristics : Mean of Vectors of the Cluster Analysis

<i>Clusters</i>	<i>GDP per capita</i>	<i>Availability of Banking Infra.</i>	<i>Bank Accounts (% of Adult Pop.)</i>	<i>Index of Financial Inclusion</i>	<i>Mobile Penetration</i>	<i>Mobile Network</i>	<i>Labour Force</i>	<i>Urban Growth</i>	<i>Years of Schooling</i>
Cluster 1	1415.72	0.058	21.73	0.156	73.14	74.09	64.69	3.90	5
Cluster 2	1446.45	0.069	31.23	0.161	74.54	75.50	74.33	3.47	7.48
Cluster 3	1336.41	0.203	29.35	0.268	84.51	96.20	71.54	3.37	5.90

A part of the higher rate of adoption in Cluster 3 can be explained since countries from Cluster 3 can benefit for a Mobile Money service for a longer time than countries from the two other clusters. Clusters 1 and 2 benefit for a Mobile Money for the same time but present different rates of adoption. A comparison between these two clusters seems relevant. Cluster 2 presents several specificities compared with Cluster 1. First, countries from Cluster 2 are more widely included in the banking system, in terms of having a bank account (on average 31% of the population have a bank account in Cluster 2, compared with 21% in Cluster 1). This observation is neither in accordance with objectives of MMU. However, it is compatible with past experience of residents and their need of trialability of the new financial service. Residents with a bank account have still experienced financial services and they are relatively more familiar with them - Financial Literacy (Rogers, 1983; Findex, 2009). Moreover, this observation has already been highlighted in some studies. They actually reveal that early adopters of Mobile Money services are principally banked people (Jack and Suri, 2011). Second, population from Cluster 2 is also the more educated (more than 7 years of schooling in average compared with 5 years in Cluster 1). It corresponds with the need for residents to reach an adequate level of education to avoid the volitional control factors (Ajzen; 1985, 1991). Indeed, potential users must have the necessary abilities to adopt Mobile Money, principally literacy skills, and a sufficient perceived self-efficacy (Taylor and Todd, 1995; Khraim et al., 2011), i.e. a good perception of their ability adequacy to use innovation, capacities that can be both improved by education. Again, this observation has been revealed in others studies showing that early adopters are more educated (Van den Bulte, 2000; Chia et al, 2006; Ndiwalana et al., 2010; Tobbin and Adjei, 2012).

Validation of the hypothesis of compatibility with existing needs is more contrasted. Cluster 2 presents a higher rate of labour participation which could confirm the need for residents to send a part of their earning to their family. But this observation is not confirmed with the urban growth rate which is approximately equal between the three clusters. Moreover, Mobile Money is introduced to answer a need of Financial Inclusion. However, Cluster 3 presenting a higher rate of adoption is also the Cluster with the higher Index of Financial Inclusion.

Results seem highlighting a Mobile Money paradox. Mobile Money service is designed to fight financial exclusion by offering low-cost and easily accessible financial services. Contrary to its objectives, Mobile Money services need to meet a relatively well inclusive banking system to be set up and adopted. Indeed, Mobile Money services could not be considered independently from the existing banking system. It is a “banking beyond branches” solution (Alexandre et al., 2010). To run their financial services activity, Mobile Money service providers need to find a suitable and available banking infrastructure, especially if they want to be able manage their cash and provide good quality services ensuring adoption. In addition, the adoption of financial services, as Mobile Money, necessitates a prior knowledge and experience of such services. That is why, unlike its objective of fighting financial exclusion, Mobile Money is not the most successful in countries affected by a most lack of banking access.

Mobile Money dependence on banking system generates two kinds of issues. The dependence on banking system is the very reason why Mobile Money service providers do not always choose countries with the largest deficiency in banking access and infrastructures availability, which would be however in accordance with their objective to fight financial exclusion. In countries highly affected by banking exclusion, the difficulty of Mobile Money service providers to implement their services reinforces the country’s financial exclusion. This situation leads in fact to the double exclusion of low-banking countries: a banking exclusion and an exclusion from innovative financial solutions (such as Mobile Money). On the one hand, these countries are likely to be increasingly excluded from financial services by the fact that the solutions currently designed are not totally independent from the existing banking infrastructures. On the other hand, the dependence on the banking system, which makes it necessary to dispose of a system that is sufficiently inclusive reinforces the double exclusion problem for population from low-banked countries. However, if Mobile Money providers succeed in setting their financial services in low-banked countries, this innovation is less likely to be adopted there than in better banked countries. Mobile Money adoption is dependent on prior financial experience and current knowledge of potential users. Banked people are more likely to adopt this

innovation than unbanked people.

The Mobile Money paradox highlights the Financial Literacy issue. Education and financial education appear to be the key element in Mobile Money adoption as an instrument of Financial Inclusion. Population must be aware of financial and Mobile Money services available. To inform and educate a population, Mobile Money service providers have understood the importance of deploying an important network of agents, playing the role of educators. MMU providers and practitioners claim this necessity to deploy an extensive network of agents in order to raise awareness and educate population to Mobile Money and financial services (Davidson and Leishman, 2010; McKay, and Pickens, 2010; Flaming et al., 2011). Furthermore, local agents, licensed and delegated by MMU providers, are employees or retail shopkeepers, often already known by the local population. Their proximity to local population enables them to educate population and promote Mobile Money services in a climate of trust and confidence, a factor leading to a mass adoption of Mobile Money.

5 Concluding remarks

This work investigates the characteristics of countries sharing the same adoption levels of Mobile Money services. To this end, this paper proposes a macroeconomic approach through a cluster analysis based on a wider sample, as an alternative to the case study approaches used in the exploratory and practitioner-oriented analyses. On the basis of adoption and diffusion of innovation theories, this work assesses the main trends explaining differences in terms of adoption levels through the countries observed.

The results of the cluster analysis support the hypothesis of relative advantages, complexity, compatibility with existing needs and past experiences, and volitional control factors, from the adoption and diffusion of innovation theories. Most of relevant observations noticed in the case studies are confirmed in this large-scale work. However, this analysis doesn't support the shared conception of a financial inclusive Mobile Money. Trends observed linking adoption levels and efficiency of

the banking system don't allow concluding on the real potential of the Mobile Money.

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