

# **The Puzzle of Mobile Money Markets: An Example of Goldilocks Conditions**

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# Abstract

This paper investigates the supply-side and demand-side factors that explain the success of mobile money markets. Namely, we argue that there exists a set of Goldilocks conditions that best supports mobile money services. A population must have exposure to financial services to understand mobile money and have a high enough level of income to have a use for these services. However, the population must also not have access to highly developed banking architecture, such that their banking needs are already satisfied. By comparing El Salvador and Kenya, countries in different stages of development, we find empirical support for our hypothesis. Our evidence suggests that low income regions and households with some exposure to financial services are more likely to use mobile money than fully banked people who enjoy a higher income.

***JEL Classification:*** E40, E42, G21, G23, O12, O16, O17

**Keywords:** Mobile money, development, savings, technology, financial inclusion

# 1. Introduction

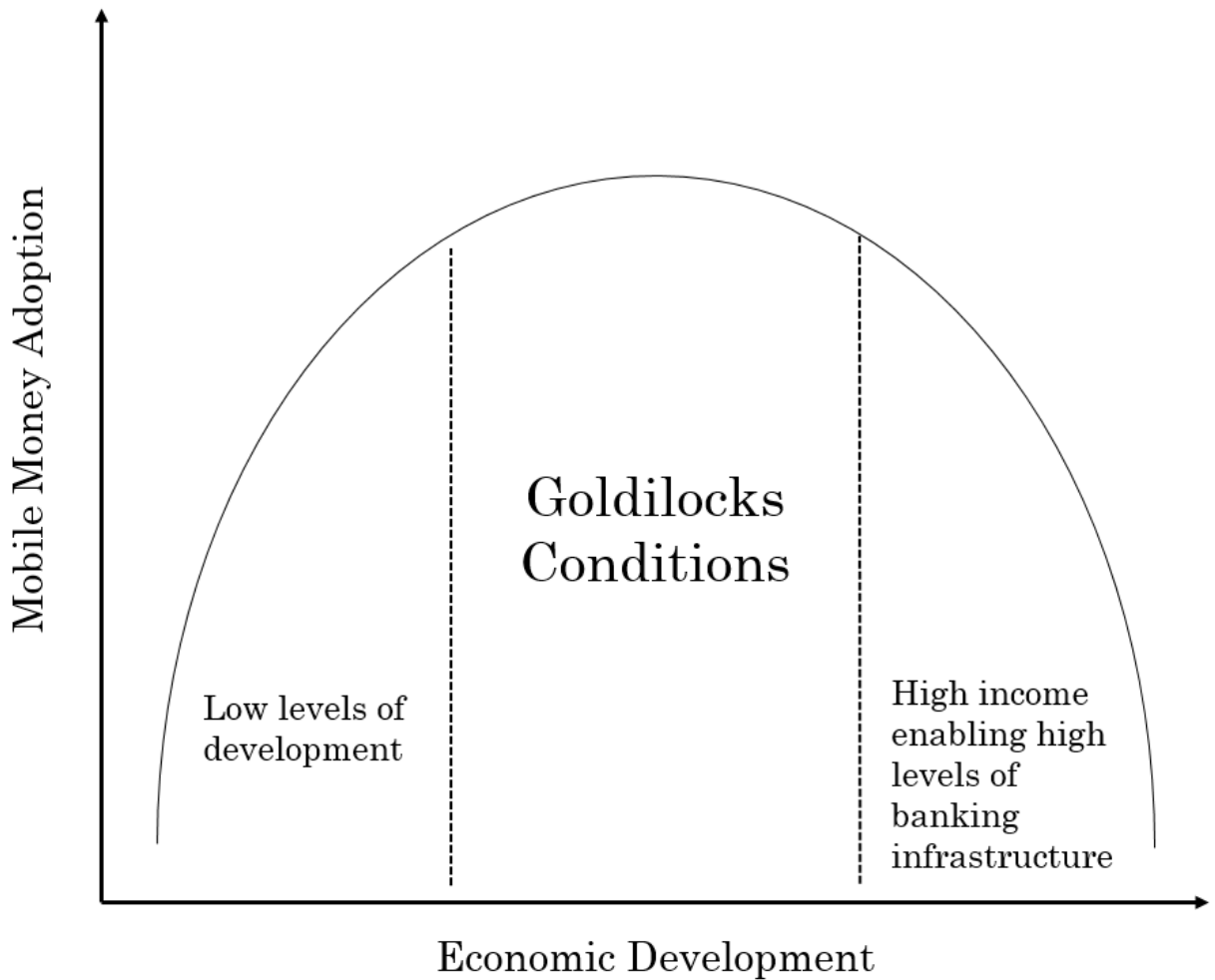
Mobile money affords developing countries access to banking services. We define mobile money as a basic, regulated payment service operated on a mobile device. By contrast, mobile banking offers more sophisticated banking functions such as checking and savings accounts.<sup>1</sup> The success of mobile money varies greatly across regions and countries. It is this puzzle of mobile money's success that we hope to discern in this paper. We examine the factors that determine the relative success of mobile money services in Kenya and El Salvador. These countries may exhibit Goldilocks conditions: high enough levels of literacy and urbanization to introduce basic financial literacy and drive a demand for financial services, but low enough levels of financial inclusion such that a market exists.

Kenya has seen significantly higher rates of mobile money adoption relative to other countries in East Africa, arguably in large part because illiteracy and low urbanization rates in other nations depress demand for mobile money services (Hinz, 2014; IFC, 2010). We observe the opposite dynamic in Latin America: mobile money services are less popular among consumers in wealthier nations that already have strong financial networks, and are more popular in countries such as El Salvador that do not enjoy such high levels of development. Put simply, the factors that restrict the adoption of mobile money services differ in wealthier countries with respect to poorer ones.

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<sup>1</sup> See Appendix (i) for greater detail.

*Figure 1. A theoretical mobile money adoption U-curve*



This paper investigates the Goldilocks hypothesis for developing nations. For highly developed countries, different variables such as the availability of cash are driving the adoption of mobile money services, like Swish in Sweden (Verbeget, 2016). Similarly, the transition to a digital cash economy can perhaps help explain the popularity of the mobile money transfer service Venmo in the U.S. (Lohr, 2016).

Across the developing world, mobile money services have grown tremendously.<sup>2</sup> Mobile money in Africa accounts for 64% of active users worldwide, and grew by 31% in 2015. As of 2015, there were 141 mobile money services and 226 million users across the continent (GSMA, 2016). Latin America has less mature mobile money platforms, but new registered mobile money accounts grew 50% in absolute terms from December 2013 to December 2014 – the fastest growth in the world during that timeframe (Sanín, 2015). There are 37 mobile money services and roughly 14.9 million registered accounts in Latin America. At least five of these mobile money services have over a million users (Almazán and Frydrych, 2015).

This proliferation of mobile technology has important implications for a region's economic outlook. Case studies in East Africa show that mobile technology can increase financial inclusion and welfare by enabling consumption smoothing.<sup>3</sup> Whether or not mobile technology specifically drives economic growth remains relatively unexamined (Aker and Mbiti, 2010), but improved access to financial services has been shown to have a positive effect on growth (Greenwood et al., 2013). Clearly, factors such as technological progress, capital formation and labor productivity growth will continue to be the main mechanisms for growth (Dao, 2014). Nevertheless, investigating the relationship between developmental variables and the success (or lack thereof) of mobile money is applicable and relevant research. It

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<sup>2</sup> See Appendix (ii) for greater detail.

<sup>3</sup> For example, see: Mbiti and Weil (2011); Bertschek and Niebel (2016); and Blumenstock, Eagle and Fafchamps (2016).

should provide relevant insights for further studies in these regions on topics related to economic development and socioeconomic inequality.

## 2. Literature Review

Prior research has found that levels of development are highly predictive of financial inclusion in richer countries. This relationship does not hold for less developed countries. GDP per capita explains 73% of financial inclusion in relatively wealthy nations, but only 15% in poorer nations (Allen et al., 2016).<sup>4</sup> Historically, the literature has explained the disparity in financial inclusion among developing nations by investigating credit or savings markets. Recent literature, however, has suggested that payment infrastructure (i.e. mobile money) is an additional factor that enables financial inclusion (Mas and Radcliffe, 2010).

As such, the literature on mobile money (mostly focused on East Africa) has turned to address this third factor. Empirical papers based on household surveys in Kenya have primarily examined how consumption smoothing, micro-financing conditions, and female empowerment have improved (Buku and Meredith, 2013). Within this context, we wish to understand what variables explain successful mobile money markets.

These variables can be disaggregated into demand-side and supply-side factors.

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<sup>4</sup> Here, financial inclusion refers to the percentage of adults with a formal account. Wealthier countries have a GDP per capita above \$15,000 while poorer countries have a GDP per capita below \$2,436. Poorer countries represented the bottom 50% of the country-level income distribution in the sample.

## 2.1 Demand-Side Factors

Mobile money adoption is in part a function of demand-side variables, mainly developmental variables, remittances, and proximity to urban centers. Development variables such as urbanization rates, education, and income influence success of mobile money (Heyer and Mas, 2011). Basic literacy is a prerequisite for successful mobile money platforms (Donovan, 2012). A case study in India shows the importance of literacy in mobile money design (Medhi et al., 2011). Osei-Assibey (2015) investigates demand-side drivers for Susu collectors (informal financial intermediaries) in Ghana. Using field survey data from market traders and Susu collectors in several local markets, the paper finds that perceived risk, education level, relative advantage, and age significantly impact adoption rates.<sup>5</sup> These same factors are likely important in mobile money markets as well.

Furthermore, remittances (both domestic and international) reveal important demand-side information. The impact of remittances on financial inclusion has been well-studied for both Central America (Anzoategui et al., 2014) and Sub-Saharan Africa (Aggarwal et al., 2011). Both papers present evidence of a positive link between remittances and financial development because demand for savings and credit is a function of household income. Given the high dependency on remittances in developing nations (especially in Central America), remittances likely drive a higher adoption rate of mobile money – high amounts of remittances suggest a

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<sup>5</sup> The author defines relative advantage from Rogers (1995) as the degree to which a new product is considered better over its predecessor.



demand for a money transfer service.<sup>6</sup> Existing remittance services can have high transaction costs, which negatively impact remittance flows (Freund and Spatafora, 2008). This opens the door for a market alternative to satisfy the demand for remittance services (Morawczynski and Pickens 2009).

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<sup>6</sup> Remittances as percent of GDP exceeds 15% in Honduras (18.2%) and El Salvador (16.6%), and other countries in Central America like Guatemala (10.3%), Nicaragua (9.4%), and Belize (4.8%) are also highly dependent. East African nations are significantly less dependent – remittances constitute much smaller percentages of GDP. For example; Uganda (4.0%), Kenya (2.5%), and Rwanda (2.0%). All data are from World Bank for 2015.

## 2.2 Supply-Side Factors

Similarly, mobile money is a function of supply-side variables such as mobile phone penetration and existing banking infrastructure.<sup>7</sup> Banking architecture can render mobile money redundant, but a lack of banking architecture can provide a market opportunity for mobile money service providers. Morawczynski and Pickens (2009) conclude from their survey of Kibera, Kenya, that a lack of formal banking promoted the use of M-PESA, the most successful mobile money platform in the world.<sup>8</sup> There are no banks within Kibera, yet there are more than 40 M-PESA agents. Even when some banking infrastructure exists, a service such as M-PESA can be complementary (Mbiti and Weil 2011). By contrast, when financial inclusion rates are already high, mobile money is unlikely to succeed. Despite partnering with a bank in South Africa that already offered extensive financial services to clients, M-PESA failed in that more highly-developed country (Mbele, 2016).<sup>9</sup> Mobile money platforms have grown more slowly in wealthier countries in Latin America for similar reasons.

The regulatory framework must support mobile money for it to succeed (Pénicaud, 2012). Consumers must see mobile money as a legitimate banking platform. Otherwise, users have little trust – an important consideration that explains different levels of financial inclusion (Allen et al., 2016). Here, Kenya is a

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<sup>7</sup> The literature is divided on whether a public or private-sector approach drives financial inclusion (Chibba, 2009), but we take an agnostic view.

<sup>8</sup> See Appendix (ii) for more details.

<sup>9</sup> In South Africa, 77% of adults have accounts at formal banks; in Kenya, this proportion falls to 22.6%. Data are as of 2015 from FinScope.

positive regulatory example. The country's banking and financial regulators were involved in the development and deployment of M-PESA (Hughes and Lonie, 2007). Today, the Central Bank of Kenya extends deposit insurance to mobile money users (IFC, 2010). By contrast, research suggests that stringent 'Know Your Customer' (KYC) regulations stunted M-PESA's growth in Tanzania before a regulatory overhaul (Ibid.).<sup>10</sup>

The success of mobile money is also dependent on cellular penetration and coverage. Although these factors have improved dramatically in recent years, some countries still lack the cellular infrastructure necessary for mobile money to see widespread adoption. Similarly, telecommunication reach can have a big impact on mobile money success, depending on the type of distribution of mobile money (Hannig and Jansen, 2010).<sup>11</sup> Successful mobile money platforms driven by telecommunication firms have occurred in countries where a single provider monopolizes telecommunications (Mas, 2012).

Flores-Roux and Mariscal (2010) argue, though, that the success of mobile financial services in a given country is an inexplicable enigma. They analyze specific enabling conditions that the literature has identified as necessary for mobile financial services to succeed and conclude that many developing countries satisfy these conditions yet lack developed mobile financial services markets.<sup>12</sup> Their investigation

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<sup>10</sup> KYC regulations in financial services require banks to conduct extensive due diligence on potential clients, chiefly to prevent money-laundering. In Tanzania, M-PESA customers with a maximum account balance of \$61,500 must present their ID, Taxpayer Identification Number (TIN), and business license to the agent (Di Castri and Gidvani, 2014).

<sup>11</sup> See Appendix (i) for discussion on different business models.

<sup>12</sup> Enabling conditions include infrastructure, regulation, cost of alternatives, financial inclusion, and volume and scale (international and domestic remittances).

analyzes successful case studies, like Kenya, to show why the underlying enabling conditions are important, but stops short of quantifying their impacts while controlling for other variables.

### 3. Empirical Framework – Methodology

We employ a series of multivariate regressions to identify what factors drive the proposed Goldilocks curve of mobile money success. In particular, we seek to analyze how factors such as income, banking architecture, and remittances impact the demand for mobile money platforms while isolating for developmental factors (such as urbanization and internet access) in order to quantify this impact.

We use El Salvador and Kenya as case studies. Sufficient data exist to control for relevant variables and tease out the marginal effects of different factors on the success of mobile money. We run a combined Kenya and El Salvador regression model at a regional level, in addition to individual analysis that focuses on each country.<sup>13</sup>

The baseline OLS regression we employ for the sub-regional data is presented below:

$$(1) \ln(\text{Mobile Money Agents per Capita})_i = \beta_0 + \beta_1 \ln(\text{Population Density})_i + \beta_2 (\text{Education Attendance})_i + \beta_3 (\text{Internet Access})_i + \beta_4 \ln(\text{Annual Income})_i + \beta_5 [\ln(\text{Annual Income})]_i^2 + \beta_6 \ln(\text{Population Abroad per Capita})_i + \beta_7 \ln(\text{Minutes to Capital})_i + \varepsilon_i$$

We include or omit other variables to account for country-specific conditions. For example, remittances are an important aspect of the Salvadoran economy, but not the Kenyan one. Similarly, income squared is not as relevant in El Salvador as

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<sup>13</sup> The regional level for Kenya is defined by data disaggregated at the county level, whereas for El Salvador the regional level is defined by data disaggregated at the municipality level. There are 47 counties in Kenya and 263 municipalities in El Salvador. Kenya has roughly one million inhabitants per county, whereas El Salvador has roughly 25,000 inhabitants per county. We therefore expect much greater regional variance in Kenya.

the country has a significantly higher GDP per capita than Kenya, suggesting it is already somewhere on the right side of the curve.<sup>14</sup>

We further test out the Goldilocks hypothesis on Kenyan household data. We employ the following probit regression:

$$(2) \textit{Probability}(\textit{Ever Used Mobile Money})_i = \beta_0 + \beta_1(\textit{Source of Water})_i + \beta_1(\textit{Internet Access})_i + \beta_2(\textit{Highest Education})_i + \beta_3(\textit{Mobile Phone Ownership})_i + \beta_4(\textit{Urban Binary})_i + \beta_5(\textit{No Banking Products})_i + \beta_6(\textit{Income per Capita})_i + \beta_7(\textit{Income per Capita})^2_i + \beta_8(\textit{Time to Bank})_i + \varepsilon_i$$

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<sup>14</sup> El Salvador has a GDP per capita of 3,826 USD whereas Kenya's is 1,245 USD (World Bank, 2013).

## 3.1 Dependent Variable

We use the number of mobile money agents per capita in each county (Kenya) and municipality (El Salvador) to serve as an effective proxy for the adoption of mobile money in the regional regression analysis. We were unable to gather proprietary data on individual mobile money adoption. However, our approach is a novel and appropriate proxy for a number of reasons. Unlike other types of financial institutions (such as a bank branch), agents tend to have a small, fixed size (Davidson and Leishman, 2010). Because agents are not typically scalable, the number of agents per capita serves as an accurate measure of adoption. Moreover, the agents operate independently and emerge in a bottom-up fashion. Pockets of localized information are more likely to reflect the local use of mobile money. Safaricom, M-PESA's parent company, only approves and regulates agents.<sup>15</sup> A similar logic applies to Tigo Money's agent distribution network (Simon, 2012).

For El Salvador, we use the number of Tigo Money agents in each municipality as of December 2016, drawn from the firm's website. As of September 2015, Tigo was the largest of the country's five network operators, with an estimated mobile subscriber base of 2.86 million and market share of 31.7% (TeleGeography, 2016). The International Finance Corporation, a World Bank group, has called Tigo Money the "current mobile money solution" in El Salvador (Simon, 2012). There is currently one other mobile money service provider in the country (m-Banco, now branded as

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<sup>15</sup> More details on M-PESA agent requirements and applications can be found here: <https://www.safaricom.co.ke/personal/m-pesa/get-started-with-m-pesa/m-pesa-agents>

MoMo), but it has not been as widely adopted. It only operated in 35 municipalities as of August 2016 (Romero, 2016). The locations of Tigo Money agents thus serve as an effective proxy for the success of mobile money in El Salvador. Because several municipalities have zero agents, we add one agent to all municipalities in order to consider all observations when the natural log is taken in the regressions.

For Kenya, FinAccess provides geo-spatial mapping data that present the location of mobile money agents at the county level for all mobile money providers since 2007. Although the literature has focused on M-PESA, other mobile money services do exist in Kenya, such as Airtel Money and Orange Money. These data have the aggregated list across all services. Four observations (out of 65,971) were omitted because no county data are provided. These data differ from the aggregated amount of mobile money agents reported by the Central Bank of Kenya, but the rate of increase is roughly similar.<sup>16</sup> We suspect, as Pénicaud (2012) suggests, that the higher estimates of mobile money agents presented by the Central Bank of Kenya are inflated by the high number of inactive agents.

For the Kenya probit model, we use a binary as our dependent variable that is equal to 1 if the respondent has ever used mobile money.

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<sup>16</sup> Central Bank of Kenya – Mobile Payments, as of 2016. See more here: <https://www.centralbank.go.ke/national-payments-system/mobile-payments/>



## 3.2 Independent Variables

As previously discussed, there are a number of demand-side and supply-side variables that we expect to be correlated with the growth of mobile money. To establish a link from Goldilocks conditions to the success of mobile money, we will square terms such as income to investigate the impact of increasingly high income on mobile money adoption.

The data for El Salvador are collected at the municipality level (262 data points) in 2007 and at the department level (14 data points) for all the years from 2007 to 2015. The sources for El Salvador include the Central Reserve Bank of El Salvador and the National Institute of Statistics and Censuses.

For Kenya, we use two different sources of data for the two sets of regressions. We use census data that exist at the county level in 2009 (44 data points) for the regression at the regional level. The census data come from the National Bureau of Statistics. We additionally use geospatial mapping data, recorded by FinAccess in 2016, to gather banking agent data for the regression at the regional level.

We also use the FinAccess Household Surveys from 2013 and 2016 (14,095 total observations) for the probit regression. These surveys present a great deal of useful information at the household level about income, development, and financial inclusion. We decided to not include the 2009 FinAccess Household Survey for methodological reasons. The methodologies of the 2013 and 2016 household surveys are much more similar to each other than they are to the 2009 survey. It was therefore

much more straightforward to ensure methodological consistency and avoid framing effects by excluding the 2009 survey.<sup>17</sup>

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<sup>17</sup> For example, the 2009 survey's best measure of income would be an aggregate of what the survey respondent claims to spend on a variety of goods and services in a given month. That aggregate expenditure amount was far higher than reported incomes in 2013 and 2016. We therefore suspect that respondents either overstated their expenses in 2009 or understated their incomes in 2013 and 2016. To ensure consistency, we only include 2013 and 2016 observations in our regression analysis.

## 4. Data Summary

### 4.1 Kenya and El Salvador Regional Data

*Table 1.1 Breakdown of Regional Data for Kenya and El Salvador*

Dependent Variable	Kenya <sup>1</sup>			El Salvador <sup>2</sup>		
	Year	Scope	Description	Year	Scope	Description
<i>Mobile Money Agents per Capita</i>	2007 - 2016	County	Total mobile money agents per capita	2016	Municipality	Total Tigo money agents per capita
<b>Supply-side Variables</b>						
<i>Population Density</i>	2009	County	Persons per sq. km	2007	Municipality	Persons per sq. km
<i>Education Attendance</i>	2008	County	Percent of population that has attended or is attending school	2007	Municipality	Percent of population aged 7-14 years that is currently attending school
<i>Mobile Phone Ownership</i>	2008	County	Percent of population that owns a mobile phone	2008-2015	Department	Percent of population that owns a mobile phone
<i>Bank Agents / Employees per Capita</i>	2007 - 2016	County	Total bank agents per capita	2012	Department	Number of people employed by the financial services industry in per capita
<b>Demand-side Variables</b>						
<i>Income per Capita</i>	2013, 2016	County	Annual Income Estimated from FinAccess Survey (2010 Dollars)	2008-2015	Department	Income per capita
<i>Income per Capita Squared</i>	2013, 2016	County	Annual Income Estimated from FinAccess Survey (2010 Dollars)	2008-2015	Department	Monthly income on per capita and per household basis squared
<i>Population Living Abroad per Capita</i>	2009	County	Number of emigrants (KNBS via International Organization for Migration)	2008-2015	Department	Number of residents living abroad
<i>Minutes to Capital</i>	2017	N/A	Minutes from County Capital to National Capital	2017	N/A	Minutes from Municipality to National Capital
<i>Minutes to Nearest Big City</i>	2017	N/A	Minutes from County Capital to Nearest Big City	2017	N/A	Minutes from Municipality to Nearest Big City

<sup>1</sup> All Kenya data are at the county level. Source is the Kenya National Bureau of Statistics (KNBS) unless otherwise indicated.

<sup>2</sup> Data are at municipality level unless otherwise indicated. Source is the Direccion General de Estadisticas y Censos unless otherwise indicated.

We use the number of bank agents per capita in Kenya as the financial inclusion variable to analyze the effect of banking architecture. A bank agent lies

somewhere between a bank branch and a mobile money agent. In many cases, especially rural Kenya, bank agents manage the local savings co-op (Kithuka, 2012). Formal banking infrastructure in Kenya is so low that data for bank branches (and even ATM's) are inadequate for analysis. In the case of El Salvador, bank branch data from the census are misleading. The ratio between financial services employees to financial services offices varies widely by department. This suggests bank branches in more urban areas are highly scaled. Consequently, we use bank employees per capita to better gauge the level of financial inclusion. This variable is recorded at the department level and allocated according to relative population at the municipality level.

We select population abroad rather than monthly remittances as a variable for El Salvador. Preliminary regression results employing monthly remittances as a variable were neither statistically nor economically intuitive. We suspect census respondents are probably under-reporting monthly remittances because of fiscal implications. Although the data for population abroad vastly underestimate the total Salvadoran diaspora, they still illustrate relative provincial differences. We only have data on population abroad at the department level. We therefore assume a population-weighted distribution among the municipalities within a given department (for example, if a municipality is home to 10% of a department's population, we assign it 10% of the department's total population abroad). For Kenya, we analyze population abroad at the county level, as no monthly remittances data are available in the census.

The Kenyan census does not include income per county. Estimates for GDP per capita at the Kenyan county level are available for 2013 (World Bank, 2015). However, these estimates use electrification to predict GDP per capita. More problematically, they assume rural areas are like-for-like across the different counties despite accounting for urbanization rates. As such, we use average income at the county level from the FinAccess 2013 Household Survey. We omit three observations (out of 6,449) that were extreme outliers and we thus suspect were incorrectly inputted. Furthermore, income data on three counties are not included in the survey (Garissa, Mandera and Wajir). We adjust these county averages to 2010 levels, using CPI data from the Central Bank of Kenya.<sup>18</sup> El Salvador income data are provided at the departmental level. These values are also adjusted to 2010 levels, employing CPI data from the Central Reserve Bank of El Salvador.<sup>19</sup> Due to data limitations, we assume that each municipality in the department has the same annual income as the overall department (i.e. zero intradepartmental variance). Income figures for Kenya and El Salvador are then converted into 2009 dollars using a PPP conversion factor provided by the World Bank in order to ensure comparability.<sup>20</sup>

For supply-side data in El Salvador, population data are not available at the municipal level after 2007, but we do have population data at the department level

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<sup>18</sup> More details on the Central Bank of Kenya's CPI figures can be found here: <https://www.centralbank.go.ke/statistics/inflation-rates/>

<sup>19</sup> More details on the Central Reserve Bank of El Salvador's CPI figures can be found here: <http://www.bcr.gob.sv/eng/>

<sup>20</sup> More details on the World Bank's PPP conversion factor can be found here: <http://data.worldbank.org/indicator/PA.NUS.PPP>

after that year. Consequently, we explicitly assume that the change in population from 2007 to 2015 has an equal distribution throughout each department. Put simply, we assume each municipality to have maintained its share of the total population of the department. Although this is not ideal from a methodological perspective, it ensures a greater number of observations for the El Salvador regression.

We also recorded certain developmental variables for the regional regressions. For example, we analyze population density, education attendance, and internet access. In El Salvador, we lack education attendance data at the municipality level after 2007. We assume that each municipality within a department grew its education attendance levels at the same rate as the overall department. Data limitations also force us to assume that each municipality in El Salvador has the same internet access as the overall department. These data (in addition to mobile phone access data) exist at the county level for Kenya, so no assumptions were necessary.

Lastly, we measure the time (in minutes) from the capital of a county (in Kenya) or a municipality (in El Salvador) to the respective country's capital by employing Google Maps API data. These data account for the type of road that would need to be taken (e.g. a village road or a highway). We observe high variability despite similar distances in several cases. We believe this information is relevant for mobile money services because a greater distance should, all else equal, suggest a greater demand for remittances. We also measure the time (in minutes) from the center of a county (in Kenya) or a municipality (in El Salvador) to the nearest city by again

employing Google Maps data. We define the term ‘nearest city’ as follows. For Kenya, it is the nearest city of 100,000 people or more (or the county’s biggest city). For El Salvador, it is the nearest city of 50,000 people or more (or the department’s biggest city). We add one minute to all observations where the time is zero in order to avoid omitting observations in our analysis. In some cases, the nearest big city (or capital) is the county capital or the center of the municipality.

## 4.2 Household Data for Kenya

*Table 1.2 Breakdown of Household Data for Kenya*

<b>Dependent Variable</b>	<b>Year</b>	<b>Description</b>
<i>Mobile Money Use (Binary)</i>	2013, 2016	Has the respondent ever used mobile money? (Y = 1)
<b>Supply-side Variables</b>		
<i>Water</i>	2013, 2016	Quality of water source on scale of 1 - 3 <sup>1</sup>
<i>Internet (Binary)</i>	2013, 2016	Does the respondent's household have internet access? (Y = 1)
<i>Highest Education</i>	2013, 2016	Highest education level of respondent or female head of household on scale of 1 - 7 <sup>2</sup>
<i>Mobile Phone Ownership (Binary)</i>	2013, 2016	Does the respondent's household have a mobile phone? (Y = 1)
<i>Urban / Rural (Binary)</i>	2013, 2016	Is the respondent's household located in an urban area? (Y = 1)
<i>Banking Product (Binary)</i>	2013, 2016	Does the respondent have banking products? (N = 1) <sup>3</sup>
<b>Demand-side Variables</b>		
<i>Income per Capita</i>	2013, 2016	Annual Income Estimated from FinAccess Survey (2010 Dollars)
<i>Income per Capita Squared</i>	2013, 2016	Annual Income Estimated from FinAccess Survey (2010 Dollars)
<i>Time to Bank</i>	2013, 2016	Time of commute to nearest bank branch on scale from 1 - 9 <sup>4</sup>

<sup>1</sup> 1 = Primary source of water is from rivers, ponds, streams, unprotected dug well, springs, or by collecting rainwater. 2 = Primary source of water is from protected springs, protected dug wells, or tubes / wells / boreholes with pumps. 3 = Primary source of water is public tap, piping into yard, or piping into their dwelling. This was originally on a scale from 1 - 9.

<sup>2</sup> 1 = None; 2 = Some primary; 3 = Primary completed; 4 = Some secondary; 5 = Secondary completed; 6 = Technical training after secondary school; 7 = University degree

<sup>3</sup> "Bank products" here only includes Postbank accounts, bank accounts for savings or investment, current accounts with a check book, bank accounts for everyday needs but no check book, bank overdraft, ATM/Debit cards, and credit cards.

<sup>4</sup> 1 = Under 10 minutes; 2 = About 10 - 30 minutes; 3 = About 30 minutes - 1 hour; 4 = About 2 hours; 5 = About 3 hours; 6 = About 4 hours; 7 = About 5 hours; 8 = About 6 hours; 9 = 7 hours or more

Generally, the 2013 and 2016 variables are similar. However, it is important to note that some questions are asked differently. We expect framing effects to explain



some of the differences between these two years. Consequently, we disregard several promising variables (such as whether respondents had ever been banked), because we are not confident that the methodology was consistent enough over time. Instead, we opt for questions (such as whether the respondent had any bank products) that were asked consistently. Additionally, income levels are significantly higher for 2016 when compared to 2013. We suspect this is because the 2013 survey asks respondents, “How much would you say you get in a month (KSh) in gross earnings?” whereas the 2016 survey asks, “Overall, including all your sources of income how much money would you say you get on average in a month (KShs)?” Perhaps asking respondents to include “all [their] sources of income” leads people to consider other forms of income that they wouldn’t otherwise count as part of their “gross earnings.” As mentioned earlier, we omit three outlier observations in the 2013 income data because they likely reflect input errors. There are 14,095 total observations when the 2013 and 2015 surveys are aggregated.

For the supply-side variables, we consider several binary and scale variables. As a proxy for development, we use the answers given by survey respondents that describe their primary water source. More technologically advanced sources yield higher values on our scale.<sup>21</sup> For education, we took the highest value of education for the most educated person in the household. To measure a level of financial

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<sup>21</sup> As discussed in footnote 1 under Table 1.2: 1 = primary source of water is from rivers, ponds, streams, unprotected dug well, springs, or by collecting rainwater; 2 = primary source of water is from protected springs, protected dug wells, or tubes / wells / boreholes with pumps; and 3 = primary source of water is public tap, piping into yard, or piping into their dwelling.

inclusion, we recorded whether respondents had any bank products.<sup>22</sup> If they did not, they received a score of 1.

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<sup>22</sup> As discussed in footnote 3 under Table 1.2, bank products here only includes Postbank accounts, bank accounts for savings or investment, current accounts with a check book, bank accounts for everyday needs but no check book, bank overdraft, ATM/Debit cards, and credit cards.

## 5. Empirical Specification and Results

*Table 2.1 Regional Regression Results (Kenya Mobile Money Agents as of 2013; El Salvador as of 2016)*

	<i>Dependent Variable:</i>		
	Natural Log of Mobile Money Agents Per 100,000 People		
	<b>Both Countries</b>	<b>Kenya</b>	<b>El Salvador</b>
ln(Bank Agents/Employees Per 100,000 People)	0.493*** (0.174)	0.335*** (0.102)	0.513** (0.230)
ln(Population Density)	-0.101** (0.051)	-0.241*** (0.057)	-0.150** (0.062)
Education Attendance	-0.008 (0.005)	3.879*** (1.005)	-0.018*** (0.006)
Internet Access	-0.043** (0.018)	12.051*** (3.168)	
Mobile Access		-1.652 (1.128)	
ln(Annual Income)	1.297** (0.604)	1.112 (1.213)	-1.937*** (0.747)
[ln(Annual Income)] <sup>2</sup>	-0.064** (0.029)	-0.089 (0.091)	
ln(Population Abroad Per 100,000 People)	0.504*** (0.095)		0.411*** (0.138)
ln(Minutes to Capital)	-0.101 (0.083)		
ln(Minutes to Nearest Big City)		-0.032 (0.028)	
Kenya Binary (Kenya = 1)	5.264*** (0.648)		
Constant	-8.869*** (3.098)	-1.259 (4.036)	16.011** (6.771)
Observations	305	44	262
R <sup>2</sup>	0.432	0.820	0.296
Adjusted R <sup>2</sup>	0.414	0.779	0.282
F Statistic	24.89*** (df = 9; 295)	19.90*** (df = 8; 35)	21.54*** (df = 5; 256)

Note: \* p < 0.10; \*\* p < 0.05; \*\*\* p < 0.01

The results from the consolidated regression broadly match our hypothesis. The positive coefficient of income together with the negative coefficient of income squared suggests support for the Goldilocks hypothesis. Both are statistically significant. Increased financial inclusion in the form of higher quantities of bank agents / employees per capita suggests greater mobile money success at a statistically significant level. The results also suggest that remittances play an important role in mobile money adoption – population abroad is positive and statistically significant.

In the case of Kenya, we observe (as expected) that banking infrastructure plays an important role. As Kenya lies to the left of the Goldilocks curve's vertex, we expect a positive slope. It is likely that areas with banks have a high enough degree of financial literacy to have a demand for mobile money services. According to the Goldilocks hypothesis, development and income should be positively correlated with mobile money adoption while on the left side of the curve. We find support for the hypothesis in the results. We find banking is positively correlated with agency adoption (and statistically significant). This suggests the complementary intersection of banking and mobile money found by Mbiti and Weil (2011). We also find highly positive and statistically significant values for other measures of development like education attendance and internet access, which is in line with the Goldilocks hypothesis. We find a positive coefficient for income and a negative coefficient for income squared, but neither is statistically significant. There is therefore some support for the Goldilocks hypothesis based on the income data, but we cannot make a stronger claim because we do not observe statistical significance.

Additionally, the negative (and statistically significant) coefficient on population density runs counter to the Goldilocks hypothesis, i.e. that developmental variables in Kenya yield a positive effect. Even more surprising is the negative coefficient on mobile access, although it is not statistically significant. The result is not intuitive and is directly contradicted by the Kenyan household survey regression discussed later in Table 2.2.

We do not include a variable linked to remittances for Kenya because of their lack of importance compared to El Salvador – remittances in Kenya were only 2.5% of GDP in 2015, according to the World Bank. Similarly, we did not use population abroad in the Kenya-only regression. Mobile money is rarely used for foreign remittances in Kenya, but rather for day-to-day transactions (as opposed to Tigo Money in El Salvador, which is much more heavily used for remittances). We therefore choose not to include that data in the Kenya-only regression in order to ensure we analyze variables that impact Kenyan mobile money agent distribution.

The coefficient for minutes to the nearest big city is negative, despite the fact that a greater demand for remittances should drive demand for mobile money services higher. However, a greater distance from the nearest big city is also likely to correlate with lower levels of development. Of course, we try to control for those differences by including variables like population density. Because of data constraints, however, it is not possible to capture all aspects of development that may play a part in the negative coefficient on the amount of time it takes to get to the nearest big city. This impact is not, however, statistically significant. It is therefore

difficult to draw any meaningful conclusions about the impact of increasing the amount of time it takes to get to the nearest big city in Kenya.

For El Salvador, the effect of income is broadly supportive of the Goldilocks hypothesis. According to the hypothesis, a higher-income developing nation that enjoys a percentage increase in income should be associated with lower mobile money adoption. Because El Salvador would lie to the right of the Goldilocks curve relative to Kenya, it is appropriate to run the regression without income squared. The El Salvador regression also reflects the importance of education and population density, which serve as proxies for development. Measuring population abroad seems to accurately capture a demand for remittances and, consequently, for mobile money services that can transmit those remittances. Because remittances are 17.1% of the country's GDP, it is important to capture this effect (Reuters, 2017).

It is interesting to note the positive statistical relation between financial inclusion and mobile money in El Salvador. There are several possible explanations. First, we believe the data may be flawed because it includes all employees of financial services firms. This aggregation likely includes Tigo Money agents, which would explain a positive correlation. Second, the data are collected at the departmental level and later pro-rated at the municipality level using relative population as the weight (i.e. if a municipality had 10% of a department's population, it was assigned 10% of the department's financial services employees). Ultimately, we believe income, development, and remittance are the key drivers of mobile money in El Salvador.

An important point to consider is the discrepancy between Tigo Money in El Salvador and mobile money adoption in Kenya. Although the former has been highly successful (compared to rollouts outside of Sub-Saharan Africa), it lacks the ubiquity of the Kenyan service. The El Salvador data are roughly contemporary with Tigo Money's introduction, whereas the Kenya data are from 2011 – four years after M-PESA was first introduced.

**Table 2.2 Household Survey (2013 and 2015) Regression Results**

Probit regression		Number of observations = 14,095		
		LR Chi <sup>2</sup> (9) = 6091.57		
		Prob > Chi <sup>2</sup> = 0.0000		
Log likelihood = (5334.83)		Pseudo R <sup>2</sup> = 0.3634		
<i>Dependent Variable:</i>				
Binary: Have you ever used mobile money? (Yes = 1)				
	Coefficient	Standard Error	Conditional Marginal Effects	Standard Error
Income	2.11E <sup>-6**</sup>	(8.69E <sup>-7</sup> )	5.97E <sup>-7**</sup>	(2.45E <sup>-7</sup> )
Income <sup>2</sup>	-1.32E <sup>-13**</sup>	(6.45E <sup>-14</sup> )	-3.74E <sup>-14**</sup>	(1.82E <sup>-14</sup> )
Water	0.011	(0.017)	3.13E <sup>-3</sup>	(4.69E <sup>-3</sup> )
Internet Access	-0.127**	(0.053)	-0.036**	(0.015)
Mobile Access	1.517***	(0.030)	0.429***	(9.50E <sup>-3</sup> )
Commute to Bank	0.052*	(0.029)	0.015*	(8.25E <sup>-3</sup> )
Highest Education Achieved	0.200***	(0.011)	0.056***	(2.99E <sup>-3</sup> )
No Financial Products	-0.626***	(0.036)	-0.177***	(9.84E <sup>-3</sup> )
Urban Binary	0.082***	(0.032)	0.023***	(8.96E <sup>-3</sup> )
2013 Binary	0.303***	(0.029)	0.086***	(8.22E <sup>-3</sup> )
Constant	-0.789***	(0.070)		

Note: \* p < 0.10; \*\* p < 0.05; \*\*\* p < 0.01

The results from the household survey regression offer greater support for the Goldilocks hypothesis. Of note, internet access is now negative and statistically significant (although positive and statistically significant in the Kenya-only regression). This may be due to methodological differences in the data collection. The information provided by the Kenya National Bureau of Statistics does not reveal the

methodology of their data collection. Other development factors (like mobile access, whether the respondent is in a rural or urban region, and the highest education achieved) carry positive coefficients and thus lend greater support for the Goldilocks hypothesis, since Kenya is left of the vertex. Another proxy for development, the primary source of water used by the survey respondent, is positive but not statistically significant. Lastly, income and income squared are positive and negative respectively (and statistically significant), suggesting there is some credence to the U-curve in our initial hypothesis.

The variable used to measure financial inclusion, whether respondents had no bank products, perhaps further sheds light on Mbiti's conclusions (2011): Some exposure to banking-like products is likely to facilitate mobile money adoption. Our results suggest a similar conclusion – if a respondent had no banking products, the respondent was less likely to have used mobile money. Similarly, the effect of increasing the respondent's commute time to bank highlights Kenyans' constraints on banking infrastructure. When commute times are high, the cost of using a bank rather than mobile money rises. It is perhaps here where we observe the clearest example of 'just right' conditions: sufficient exposure to banking to generate demand, but unsatisfactory banking architecture such that a market for mobile money exists.



## 6. Conclusion

Policymaking and research should remember that several conditions are required for the success of mobile money: appropriate regulatory structures, a well-run telecommunications provider with large market share, and, of course, the mobile money platform itself. Nevertheless, this paper suggests that ‘just right’ conditions exist. In particular, factors such as development, income, banking, and remittances can explain much of the variance across regions or households.

This paper focuses on the broader brushstrokes of the mobile money Goldilocks curve first introduced in Figure 1. A closer examination of the intersection between existing financial inclusion and mobile money adoption is merited. Our Kenyan household survey analysis (alongside the existing literature) begins to shed light on this, but much more analysis is needed. For example, it would be interesting to study tipping points or network effects in rural communities (i.e. if there is a threshold after which mobile money becomes popular). Similarly, our results and the literature have not conclusively established whether mobile money is a competing or complementary service to traditional banking. We suspect the truth lies somewhere in the middle. Further empirical and theoretical research is especially important for nations which we believe are to the right of the curve’s vertex, such as El Salvador, where research has been limited.

Future research on mobile money, however, may ultimately have to rethink the applicability of these Goldilocks conditions. The growth of mobile money in developed nations (such as Swish and Venmo) complicates our argument about how

mobile money adoption behaves. In nations such as Sweden and the U.S., the interaction between financial inclusion and mobile money is perhaps even more interesting and less intuitive.

# Appendix

## i. Defining Mobile Money

As discussed, mobile money serves as a platform for transactions from one entity to another, typically person-to-person payments, airtime top-up, or bill payments. However, mobile money is not equivalent to mobile banking, a virtual platform provided by a financial institution that offers more sophisticated banking functions such as checking and savings accounts, brokerage services, etc.

Furthermore, it is important to note that the types of mobile money differ across Africa and Latin America – but especially in the latter. Because of greater financial inclusion in the wealthier nations, consumers have access to more sophisticated mobile tools that go beyond mobile money, but are not strictly mobile banking. These services can sometimes function as a hybrid of mobile money and payment cards through goods such as pre-paid cards. Furthermore, there are examples of joint ventures between telecom providers and banks, such as Transfer in Mexico between Telcel and Banamex.

In Africa, various countries still use airtime top-up as a proxy for cash, but this is too crude to be considered mobile money. This has been particularly successful in Zimbabwe (Heinrich, 2014). In South Africa, where Safaricom cancelled M-PESA, consumers have access to mobile money type services by sending it through the food retailer Shoprite. New and innovative platforms such as BitPesa, where non-Kenyans residents can send money over bitcoin which is then converted to M-PESA, can be

hybrids of a crypto-currency and mobile money platform that bypass traditional remittance channels such as Western Union.

Broadly speaking, mobile money services can be disaggregated into being driven by a mobile operator, a payments company, or a bank (or some combination). For a mobile operator-driven service (e.g. Tigo Money) a person has to have a mobile subscription to that telecom provider. Generally, these platforms succeed in countries with greater levels of telecommunications market concentration. By contrast, bank-driven payment systems are more commonly found in countries with higher rates of financial inclusion, such as Cuenta Movil in Chile or Caixa in Brazil (Sanín, 2015).

## **ii. Mobile Money in East Africa and Latin America**

The spread of mobile money in Africa and Latin America has been uneven across countries. M-PESA in Kenya remains the global successful case study of how mobile money can transform the exchange of money in a country. Launched by telecom provider Safaricom in 2007, the service has 21 million users in a country with a population of 45 million (Ondieki, 2016). In recent years, M-PESA has expanded from just providing basic payments to now offering micro-finance and basic banking tools. In fact, the service was calculated to add \$4.06bn to the Kenyan economy in 2015 (Ibid.). However, for a variety of reasons, M-PESA (or similar) services have failed to gain traction throughout the entire region. For example, M-PESA grew slowly in Tanzania because of the regulatory environment, a fragmented telecom sector, and remittance dynamics (Camner et al., 2009).

Mobile money results are equally varied across Latin America. On a relative basis, mobile money markets have been far more successful in low-income nations than in high-income nations. In particular, El Salvador, Honduras, and Paraguay have perhaps experienced the greatest adoption of mobile money services in the region (on a per capita basis). Telecom provider Millicom's mobile money services in these countries count 3.35 million active users (Almazán and Frydrych, 2015). This white paper explores the factors that led to widespread adoption in Paraguay – specifically, a supportive regulatory environment and a bottom-up agent distribution

network (similar to M-PESA's rollout). The Central Bank of Paraguay approved several mandates that legalize and regulate electronic payment systems (Peña, 2015).

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