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Mobile money, transfers and social networks

A field study of the use of Tigo Money in Guatemala

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Abstract

This paper analyses the impact mobile money service Tigo Money has on households' transfer behavior within social networks. To be precise, the paper investigates if household that use Tigo Money 1) send and receive more transfers, 2) if they do this with an expanded network, and 3) if they send and receive more transfers for emergency reasons, compared to non-using households. To answer these questions, a survey was conducted in two municipalities in Guatemala. The data was analyzed using OLS estimations.

The results show a significant positive correlation between the use of Tigo Money and the dependent variables, resulting in increased transfer activity among these households. These findings are in line with previous research, and indicate that Tigo Money-using households should handle negative income shocks better. A sensitivity analysis was performed. The models perform worse for the rural subsample, but the results are robust across all estimations for urban and semi-rural subsamples.

Key words: mobile money, transfers, informal insurance, social networks, Tigo Money

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Any errors are my own.

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1 Introduction

Today, more than two billion people in developing countries lack access to formal financial services like savings accounts, credit, insurance and secure methods for payments and transfers (World Bank, 2015:5). At the same time life in developing countries can be risky, as no social security can help in the case of a negative income shock (i.e. illness, job loss). To reduce risk, households exchange money transfers within social networks. This is not always easy or cheap as great distances and mediocre infrastructure increase transaction fees. One solution to these problems could be mobile money. This paper studies the impact of mobile money on transfer behavior among households in Guatemala.

Mobile money transfers funds electronically through the convenience of an individual's cell phone, and it provides a cheaper and more secure option in exchanging money, that in turn improves a household's ability to reduce risk (Gencer, 2010:4). Many believe it has a lot of potential. Experts and workers in the area of development are excited, as they believe mobile money may be a key for widespread financial inclusion (Beck, 2015:16). Additionally, the user demand is there; approximately 300 million users have signed up since mobile money's inception a decade ago. Finally, there is incentive for companies to meet user demand. Every year, the supply of mobile money services increases (GSMA, 2014:15). Currently, the fastest growing market is Latin America. In Guatemala, mobile money service Tigo Money, was launched in late 2012. It allows users to have a digital wallet and to transfer money from their phone account when they want. The funds on the account can then be used for various transactions, often sending and receiving funds from other users, as well as paying bills straight from the mobile phone.

Because of mobile money's infancy, research on its impact on transfer behavior is still lacking (Beck, 2015:29). There is a solid theoretical foundation to build upon because of the ample research on how social networks form and behave (for example see Townsend, 1994; or Fafchamps' collaborative work, 2003 and 2007). However, the problem arises because this research does not incorporate the time and cost saving characteristics of mobile money (Jack and Suri, 2014). Does mobile money affect the transfer behavior between households? So far, the published research indicates yes, as more transfers are being sent and a more complete insurance enjoyed as resource pooling become more efficient (Beck, 2015:29). However, the studies are scarce and only cover a few regions, mainly Sub-Saharan Africa.

The aim of this paper is to further understand how mobile money affects the transfer behavior of households. The goal is contribute to current research in two ways. Firstly, it applies an analytic framework inspired by previous research on social networks, but incorporates the lower transaction costs of mobile money.

Secondly, it also expands the geographical reach of the current research by focusing on Central America and Guatemala, where the financial infrastructure is very different from Sub-Saharan Africa. Throughout the paper, I will answer the following three research questions:

1) Are users of Tigo Money more likely to send and receive transfers than households using other methods?
2) Are users of Tigo Money more likely to send and receive transfer within an expanded network of family members and friends, compared to non-users?
3) Are households using Tigo Money more likely to send and receive transfers for emergency support compared to non-using households?

To answer these questions, survey data was collected in two municipalities in the southwestern part of Guatemala, during the period of October and November of 2015. Given the large sample size and applied survey weights, the results of this paper can be generalized to the target population of these two municipalities. However, I do not advocate that the results can be generalized to any larger region. The survey data is analyzed across various specifications using ordinary least squares (OLS) regressions. Sensitivity analysis is done to test the robustness of the results.

The rest of the paper is structured as follows. Chapter 2 presents information about Guatemala and Tigo Money. Chapter 3 presents and elaborates the theoretical framework used to understand the impact of mobile money, and presents previous research. Next, Chapter 4 presents the methodology used and the survey data. In Chapter 5 the results are presented and analyzed. A discussion surrounding the results can be found in chapter 6. Finally, Chapter 7 provides a conclusion.

2 Background and context

This short chapter provides the reader with more information about Guatemala and the mobile money service Tigo Money.

2.1 Financial inclusion in Guatemala

Situated in Central America, Guatemala borders Mexico and Belize to the north, and to the west is Honduras and El Salvador. Guatemala is a very poor country, and more than half the population lives below the poverty line. Like many other countries, Guatemala still struggles with problems in health, education and poverty. Demographically, the population is highly heterogeneous, as it consists of several different indigenous ethnicities. The biggest group is the Spanish-speaking Ladinos, of mixed Amerindian-Spanish heritage, which accounts for about 60 percent of the population. The other 40 percent are divided among several indigenous groups, each with its own language. About half of the population lives in rural areas (CIA, 2016).

A large percentage of Guatemala's population is not using any formal financial services. Only 40 percent report having an account at a formal financial institution, below average compared to the rest of the region, but still about ten percentage points higher than Sub-Saharan Africa (World Bank, 2015). Where Guatemala, and Latin America, really differs from other developing regions is in banking infrastructure. The number of branches and ATMs per capita is higher than elsewhere (Almazán and Frydrych, 2015:15; Simon, 2012:4). However, there is still a big divide in accessibility between rural and urban areas (Almazán and Frydrych, 2015:11) Guatemala also differs, as the adoption of mobile phone technology is very high, at over 100 percent. This means that there are more mobile phone accounts than people. This number is higher than the Sub-Saharan number (GSMA, 2015:8).

Table 1: Sectors of Guatemala

Sector	% of GDP	% of labor
Agriculture	14	38
Industry	24	14
Service	62	48

2.2 The mobile money service: Tigo Money

The mobile phone operator Tigo is the largest operator in the country, covering more than 52 percent of the population. In 2012 it launched the mobile money service Tigo Money in 2012 (Millicom, 2016). Today it has more than 250 000 users in the country, and more than 3000 authorized agents. The network of agents has rapidly expanded, and the agents are often more accessible than formal financial branches. The agents are rarely only Tigo Money agents; instead it is operated as a side-business in their grocery store, mobile phone store etcetera (Tigo, 2016).

The service works the following way: the service is operated via free text messages, thus allowing the service to be used on any type of mobile phone. To register, one only needs a SIM-card from Tigo, along with some form of valid identification document at the time of registration. Connected to the mobile phone account, is a sort of digital wallet that can hold either cash and/or airtime credit. This airtime credit can be exchanged for cash at any agent. Using the phone, the Tigo Money user can do a number of activities. First, it can receive international remittances. It can also send and receive funds domestically to any mobile phone connected to Tigo (not necessarily Tigo Money). Further, additional airtime can be purchased using the funds in the account. Finally, many of the country's largest companies are affiliated with Tigo Money, allowing its users to pay bills with the funds on their account. The upper limit for transfers is 5000 quetzals in total per month[1]. It is free to receive any international or domestic transfers. To send, there is a fee of between 4 percent to send using your phone, and 6 percent from an agent. This is a lower cost than for other remittance companies such as Western Union or MoneyGram, especially for domestic transfers. There is no interest is earned on the fund in the account (Tigo, 2016).

[1] At the time of writing, 5000 quetzles is equal to about 650 USD (1 USD equals about 7.65 quetzales).

3 Theoretical framework and previous research

To understand how mobile money affects transfer behavior within social networks, a theoretical framework is needed. Without it, research becomes descriptive, as there are no assumptions of correlation or causality: the question, "why?" becomes very difficult to answer. Therefore, a theoretical framework can inform which economic variables to look for, and how they can be expected to behave (Esaiasson et al., 2012:37).

Varian makes an important point about studying new technology: keep your eyes on the households, their choices and behavior (2010:668). The theoretical framework used in this paper is based on previous research on transfers within social networks. Mobile money is in this framework merely a change in the variable for transaction costs

This chapter is structured the following way. Firstly, the theoretical framework is presented and discussed in detail. Secondly, previous research on social networks and mobile money is presented. Lastly, the paper's hypotheses are presented.

3.1 Theoretical framework

This section elaborates in detail how social networks are formed, why they transfer money and how transfer costs are incorporated into the model.

3.1.1 How households view risk

Households' attitudes towards risk differ; some can tolerate more insecurity, while others cannot. Research has shown that amongst the general population, the majority of households are expected to be risk-averse. The main characteristics of risk-aversion is fearing financial risk and avoiding it if possible. If a household is assumed to behave rationally, its attitude towards financial risk is based on expected utility. This is a probability-weighted average of the utility the household can get in a situation from each given outcome. A risk-averse household generally picks the less risky choice, when given two choices having the same expected utility. A risk-averse attitude also implies that a household tries to avoid losses, and it prefers a certain minimum level of utility, rather than exposing themselves to risk in order to increase utility (Perloff, 2009:578-581).

Given that households are risk-averse, the question arises how they can avoid risk?

3.1.2 How households can avoid risk

In theory, there are several ways a household can avoid risky financial situations (Perloff, 2009:585-587). First, households can abstain from financially risky decisions, and simply say no to something they deem too unpredictable. Next, the household can obtain more information that enables them to better assess a situation, and more likely reduce risk. Additionally, households should not put all eggs in one basket. Instead, a household should diversify its financial activities and investments. Doing so spreads risk and reduces volatility. Lastly, households can buy insurance to reduce risk since a certain level of utility is secured by doing so.

In developed financial markets, services are available in helping households avoid risk by providing information and transparency. In contrast, there is no market supply with these types of services in developing countries. Finding reliable financial data can be very difficult due to corruption, information asymmetries, and instable social structures, thus making it harder to assess current and future risks. Diversification is also difficult because there is no access to formal financial services, like savings, investment account, or social security; nor are any companies willing to sell individuals insurance because the company cannot afford the high costs of monitoring and enforcing contracts. Eradicating financial risk in a household is impossible. Households are affected by numerous factors like, droughts, crop failures and illnesses, which are out of their control (Todaro and Smith, 2011:730-731).

3.1.3 The lack of formal finance and the formation of social networks

Thus far, two aspects has been covered: households typically dislike financial risk, and avoid it altogether if they are able; in developing countries, there is no market supply of financial services to help households mitigate risk (Perloff, 2009:588; Varian, 2010:229).

What can be done? As it turns out, households have turned to informal financial services instead. For this paper, the most important informal arrangement is risk pooling. What is risk pooling? Statistically, a household is very unlikely to experience a severe negative income shock (for example, a husband breaks his leg and cannot work) because occurrences are rare. However, it if does happen, the household will be in deep financial trouble, as it may be unable to cover the loss in income (either through savings, insurance or loans). However, if several households decide to pool resources, essentially forming a social network, together they are better able to handle any negative income shocks. Why? Because the risk is spread simultaneously amongst more households and their collective resources are increased. This works as long as

there are minimal negative income shocks happening to the same social network at the same time (Frank, 2008:188). As previous research has shown, these social networks vary in size, geographical reach and social composition (Todaro and Smith, 2011: 696). What they do have in common is resource-pooling arrangements to avoid risk.

So far, no attention has been paid to the actual transfers; it is assumed they just happen. In fact, they are modeled as having no fees. However in developing countries, this is far from the truth; the costs are often quite high (Jack and Suri, 2014:1). It is here where mobile money enters the theoretical framework.

3.1.4 The role mobile money and reduced transaction costs

The fact is, there are several types of costs for making transfers within networks. Generally, they can be divided into two types: fixed and proportional. Fixed costs are independent of the size of the transfer. An example is the cost of travelling to and from the Tigo Money agent to send the transfer: no matter if an individual is sending $10 or $100, the bus fare is the same. Another example of a fixed cost is the alternative cost in which the time spent sending the transfer could have been spent on other economic activities. On the other hand, proportional costs depend on the size of the transfer. Fees for transferring funds can be both fixed and proportional (Jack and Suri, 2014:5-6).

The cost of transferring funds is what prevents households to fully smooth consumption within their social network. This is because some of the funds that should have gone to smooth consumption now have to be spent on fees. Fixed costs makes smaller transfers to be postponed because the costs of making the transfer is too great in relation to the amount sent. Basically, if you intend to send $10, but the bus fare is $8, it does not make economic sense to make the transaction. On the other hand, larger transfers make economic sense to send. In relation to proportional costs, all transfers will be sent. However, consumption smoothing will never be complete because the proportional cost will eat away some of the funds available to the receiver (Jack and Suri, 2014:6).

What mobile money technology does is reduce the costs associated with transferring costs. This affects the transfer behavior in three ways: First, as explained above, fixed costs make smaller transfers uneconomical to send. However, if mobile money lowers the cost, more small transfers will be feasible to send. Therefore, the first effect of mobile money will increase transfers sent within the network. Second, higher costs force the network to be more selective when choosing when to transfer. However, now that transfers are cheaper and sent more often, more network members can be involved. For example, without mobile money, only one transfer is sent within the network. Because of lower costs, this transfer can then be broken to two, and more than one household can now share the costs. Hence, the second effect of mobile money is that it includes more members in the network. Third, if the effects of one and two are combined, consumption smoothing is more efficient within the network, and its members are

more insured that they would have been without mobile money (Jack and Suri, 2014:6)

3.2 Previous research

With the theoretical framework in place, it is time to review on previous literature. The first section discusses the research done before mobile money boomed. The next section expands on this literature, as mobile money is incorporated into the analysis.

3.2.1 Research done before mobile money

There have been numerous papers published studying how people in developing countries use social networks to reduce risk and smooth consumption. Townsend (1994; 1995) was an early contributor, using panel data to observe how households in three Indian villages used informal credit markets and intra-village transfers to smooth consumption. With data from Nigeria, Udry (1994) also saw how households tap into informal village networks to mitigate financial risk through small informal loans with state-contingent repayment conditions. Both papers observed how the consumption smoothing is never complete as this is very difficult to achieve.

These initial findings have been confirmed and expanded upon by later research. One example is the work of Grimard (1997), who used data from Cote d'Ivoire to find that consumption smoothing is indeed not complete. Another example is Fafchamps' collaborative work (Fafchamps and Lund, 2003; Fafchamps and Gubert, 2007). With data from the Philippines, they found that transfers in the form of gifts and informal loans are preferred for smoothing risk, rather than selling household assets. Another conclusion is that the main connection within networks is not proximity with other members of the village; instead, social proximity matters more as networks consist of family and friends, and stretch well beyond the local population of the village. These findings are interesting because Townsend and Udry did not seek to examine this, as they only examined networks within a village. More examples of additional research confirming the use of transfers as a tool for insurance and consumption smoothing are Gertler and Gruber (2002), as well as De Weerdt and Dercon (2006). Both papers examine how social networks provide informal insurance against illness. With a different approach, Cox Edwards and Ureta (2003), find that remittances can help households keep their children in school.

My interpretations of these findings are that many social factors, such as kinship and proximity, affect the formation of network. Social factors can be difficult to capture in a dataset. However, the literature proves that households do indeed use transfers (both gifts and loans) within social networks as a form of informal financial service to mitigate financial risk and smooth consumption. But

none of this research incorporated the cost reduction due to mobile money. To find that, one needs to turn to more recent literature.

3.2.2 Recent research incorporating mobile money

As noted by Jack and Suri (2014), there are few research papers published on the implications of lower costs and easier transactions on transfer behavior within networks. However, there is a growing body of literature and more research is being done.

Yang and Choi (2007) were some of the first to look closely at how remittances and transaction costs can be used as a form of informal insurance by households in the Philippines. Aycinena et al. (2010) performed a randomized field experiment amongst immigrants from El Salvador living in Washington D.C., showing that lower transaction fees resulted in an increased frequency in remittances sent. Schulhofer-Wohl (2007) also incorporated transaction costs into his analysis, and finds that the fees do contribute to imperfect insurance, since some of the resources has to be spent on just the transfer itself. Mbiti and Weil's (2014) findings indicate that socioeconomic status matters in mobile money, as shown in M-Pesa users in Kenya. Generally, they were younger, wealthier, better educated, used banking services, were non-farmers, and lived in urban areas. They also reached the conclusion that mobile money increases the frequency of transfers. Finally, Jack and Suri (2011 and 2014), as well as Jack et al. (2013), also focus on the use of M-Pesa. In their work, they explicitly examine how mobile money's lower transaction costs affect transfers. They find that users of M-Pesa both send and receive more remittances, as well as including more households in the network.

These results, analyzing data from both the field and controlled experiments, show a strong indication that reduced costs of transferring money does indeed lead to more economic activity within social networks. The results do infer that users of mobile money send more transfers.

3.2.3 Hypothesis for the rest of the paper

Theory, along with findings of previous research, strongly indicates that mobile money does increase the frequency of transfers. Based on this, I work with the following hypothesis:

- Users of Tigo Money are more likely than no-users to either send or receive a transfer.
- Users of Tigo Money are more likely to send or receive transfer from a more extended social network, here defined as someone outside of the closest family (i.e. not to a spouse, child, parent or sibling).
- Users of Tigo Money are more likely to send or receive a transfer for emergency reasons.

4 Methodology and data

Researchers should always present and discuss their choice of research design. Otherwise, reproducibility suffers and results cannot be independently tested and confirmed (Esaiasson et al., 2012:220). In this chapter, I discuss the design choices for this paper, so the reader understands how the data was collected and analyzed.

In short, a stratified multistage probability cluster sampling design was used, interviewing sampled households about their financial activities, with a focus on their transfers. Surveys are a common method used in development economics with, a rich literature on the topic (United Nations, 2000:4; World Bank, 2000a:55). The collected data is analyzed using OLS regression models.

The first section discusses the field methodology: the survey and questionnaire design. Next, the OLS specification is presented and discussed. The inherent limitations of both methods are addressed throughout the chapter. Finally, the collected data is presented.

4.1 Field methodology

Nearly all data regarding the use of mobile money in Central America is either aggregate macro data, or anecdotal case studies. Therefore, I decided to conduct a survey, as it allows me to gather data about my target population, their transfer behavior, and the use of mobile money at the individual household level.

4.1.1 Target population and uptake area

The survey was conducted in the municipalities of Panajachel and Santa Cruz La Laguna[2]. They were chosen because they represent very different sides of Guatemala. Panajachel is a larger urban area, divided in four sectors. The municipality of Santa Cruz, on the other hand, can be characterized as semi-rural and indigenous, and includes an additional five rural villages in the administrative unit. Panajachel and Santa Cruz have an established user base for Tigo Money, whereas no data could be found about the adoption rate for the rural villages.

[2] However, the name is almost always shortened to just Santa Cruz, something that will be done throughout the rest of this paper.

These three types of locations, i.e. urban, semi-rural and rural, are very different. Panajachel is growing, and is well connected to the rest of the country. Therefore the city is the economic hub for surrounding municipalities, providing a range of different financial services, such as bank branches, and a more developed service sector. Semi-rural Santa Cruz can only be accessed by boat, and has only a few businesses. However, it does have a Tigo Money agent. The rural villages are even less connected, with virtually no service sector. Two villages are only accessible by boat, while the other three are located up in the mountains, more than a one-hour car ride away from Santa Cruz.

Table 2: Demographic data over target population

	Population	% Ladino	% Indigenous
Panajachel	17361	36	59
Santa Cruz	7983	1	99

4.1.2 Sampling design

To ensure enough interviews were conducted in the rural villages, I decided to geographically stratify the target population into ten strata based on local administrative units, which includes Panajachel's four urban sectors, Santa Cruz and the five rural communities. This division is appropriate, as these units cover the entire target population, are large enough and do not overlap, and are relatively internally homogenous (United Nations, 2005:14; Kumar, 2006:16)

A cluster design was used to reduce the costs of, and time spent, traveling between households (United Nations, 2008:54). Due to differences in the household listings, the sample frames differ between strata. Surprisingly, Santa Cruz and the rural communities had a complete, and up-to-date household listing. Therefore, simple random sampling was used to select clusters, each cluster consisting of five households. In the next step, every household in the cluster was interviewed. Finally, in some of the smaller rural communities, disproportionate sampling was used to ensure enough households were interviewed (Kumar, 2006:17)

Due to rapid increase in population in the previous years, there was no complete or up-to-date household listing for Panajachel. To limit the risk of sampling bias, I asked for an official map of the city's streets, and made this my sampling frame instead (Esaiasson et al., 2012:175). Thus, the cluster sampling was based on spatial information about city streets. First, in each neighborhood, three streets were randomly selected. Then, systematic sampling was used, and every second household on each street was interviewed. However, I suspect that not every street and alley would be marked on the map, and there might be some sampling bias for Panajachel.

In some of the strata, some households were occupied by foreigners (mainly Americans and Europeans). Since they did not belong to the target population they were omitted from the sampling frame (United Nations, 2005:21). Important to note, users of Tigo Money were oversampled in both the rural and urban strata

to ensure enough interviews were conducted so that a meaningful comparison could be made between users and non-users.

Another potential issue for survey sampling is non-response; some household cannot, or will not participate. For this study, non-response due to unwillingness was not a problem. When a household was approached, it very rarely opted out of participation. Instead, non-response was more common because no one was home, less so in rural areas, and a bit more common in Panajachel. When no individual was present in the household, the solution was to move on to the next household.

Finally, since both municipalities had updated data on the general demographics of their population, the sample was weighted according to location and ethnicity, to further minimize with sampling bias (Esaiasson et al., 2012:180).

4.1.3 Interviews and the questionnaire

For each sampled household, an interview was conducted with the person responsible for transfers. To build rapport with the interviewee, they were guaranteed anonymity and then briefly informed about the survey (Esaiasson et al., 2012:238).

However, there can be complications surrounding interviews and the design of questionnaires, and they need to be addressed. One problem can be blanks, which is when answers to individual questions are missing. This was not an issue for my questionnaire due to two factors. First, the interpreter that conducted the interview filled out the answer sheet, and respondents could not skip a question (which happens when respondents fill out questionnaires on their own). Second, no questions were of sensitive nature. For example, drug use or sexual questions were not asked. The most sensitive question asked was regarding food security but they were worded in such a way as to not judge or offend anyone. These questions were adapted from well-tested surveys (Kumar, 2006). Additionally, I tried to keep response bias and interviewer effect to a minimum, as two local women conducted the interviews and I was not present to skew answers.

Another problem in household surveys can be recall bias, which is when people have difficulty remembering the correct answer to a question regarding the past. I dealt with this issue in three ways. First, I limited my recall period to four week, a very sensible timeframe. Second, I asked about activities that were out of the ordinary (i.e. incoming transfers), and omitted daily activities. Third, I used funnel sequences: the questions in my survey go from more general to specific (USAID, 2006:7-12). Take transfer for example: the first question will ask if there have been any transfers. Then the questions that follow ask for more details like, whom, why, and how.

To address potential errors with translation, two independent translators “back translated” the questionnaire: one translated the surveys to Spanish and the other translated it back to English. This way, any inconsistencies could be addressed. The women conducting the interviews were fluent in both Spanish and Kaqchikel, as the latter is the primary language in many households (World Bank, 2000:53-54). Finally, except for continuous variables like age, I utilized closed-ended

questions. This constraints the answer that respondents can give, but makes the household data much easier to handle and analyze (Esaiasson, 2012:230). To ensure that the multiple answers were sensible, they vetted through the local non-profit organization as well as Tigo Money agents.

4.1.4 Testing the survey design: the field test

Finally, I conducted a field test. It is a crucial step, as it controls for the limitations listed in previous sections: the sampling process, the interview situation and its robustness of the questionnaire. For the test, fifteen households were randomly sampled, the number needed to detect the majority of the problems (World Bank, 2000a:55; Kumar, 2006:14). The outcome of the test resulted in some formulations being tweaked and additional answer alternatives were added.

4.2 Description of the survey data

As it is common, the questionnaire consisted of different modules, and the following was information was solicited (United Nations, 2005:38): basic household demographics were asked, occupation, and recent transfer activity. Additionally, data was gathered on the household's use of financial services, such as savings, loans and insurance[s]. Finally, questions were asked about mobile phone ownership and any use of Tigo Money[3]. The individual questions in the survey were adapted from previous surveys. The literature stresses the importance of this, as semantics take time to work through (Esaiasson et al., 2012:241; World Bank, 2000a:55). In total, 467 interviews were completed.

Demographic information about the sample can be seen below. Overall, there are big differences between the urban, semi-rural and rural subsamples. Households in Panajachel are generally more educated, use more financial services, especially insurance coverage, and is more likely to possess at least one mobile phone. The use of financial services is much lower in Santa Cruz and the rural villages: with low rates of savings and almost no insurance coverage.

Table 3: Summary statistics

Variables	Mean	St.d	Min	Max
Age (years)	35.9	13.7	18	86
Education (years)	6.2	5.5	0	24
Food security (0-9)	6.1	2	0	9
Nr. of adults	3.4	1.8	1	11
Nr. of assets	1.4	0.6	0	4
Nr. of transfers	0.3	0.5	0	4

[3] For the complete questionnaire used, please see Appendix A.

Table 4: Summary statistics for subsamples

Variables (mean values)	Total	Rural	Semi-rural	Urban
Age (years)	35.9	38.7	38	33.9
Education (years)	6.2	1.3	3.7	9.4
Food Security (0-9)	6.1			
Number of adults	3.4	2.8	3	3.8
Number of assets	1.4			

Table 5: Frequency table for household statistics

Variables	Total	Rural	Semi-rural	Urban
Save	197 (42.2%)	19 (15.6%)	10 (11.4%)	168 (65.4%)
Loan	120 (25.7%)	29 (23.8%)	25 (28.4%)	66 (25.7%)
Insurance	64 (13.7%)	7 (5.7%)	0 0	57 (22.2%)
Mobile Phone	423 (90.6%)	106 (86.9%)	79 (89.8%)	238 (92.6%)
Use Tigo Money	105 (22.5%)	3 (2.5%)	32 (36.4%)	70 (27.3%)
Occupation				
Business operator	152 (32.6%)	1 (0.8%)	2 (2.3%)	146 (58%)
Public	17 (3.6%)	2 (1.6%)	1 (1.1%)	14 (5.5%)
Agriculture	45 (9.6%)	30 (24.6%)	2 (2.3%)	13 (5.1%)
Dayworker	179 (38.3%)	68 (55.7%)	68 (77.3%)	43 (16.7%)
Other	74 (15.9%)	21 (17.2%)	15 (17.1%)	38 (14.8%)
Extra Income	118 (25.3%)	8 (6.6%)	22 (25%)	88 (34.2%)

4.3 Econometric modeling

In this section, the OLS model is specified in detail, and then I discuss the basis for the explanatory variables used. Lastly there is a section discussing the limitation of cross-sectional studies.

4.3.1 Model specification

Each of the three models has a binary dependent variable, and they are analyzed using OLS regressions. The use of OLS on binary outcome variables procedure is widespread in economics, and it provides more transparency as the model is easier to implement and interpret (Donkers and Melenberg, 2002). Coefficients of independent variables indicate how much the variables affect the probability that the outcome of interest will happen. The null hypothesis for all three models is that using Tigo Money has no effect on the dependent variable. If the null hypothesis is rejected, the models have statistical significant effect on the outcome variable.

All three models include the same sets of independent variables. The general specification is the following:

$$Y = \beta 1 + \beta 2User + \beta 5HH_{Finances} + \beta 3HH_{Demographics} + \beta 4HH_{Occupation} + \beta 6Location + \varepsilon$$

Where Y is the outcome of interest, *User* is a dummy for whether or not the household has at least one Tigo Money user in the last 4 weeks, $HH_{Finances}$ is a set of dummy variables for savings, loans, insurance and the number of household assets. $HH_{Demographics}$ is a group of variables on the household demographics; $HH_{Occupation}$ is a set of dummy variables of income generating activities, and finally *Location*, a categorical variable distinguishes whether the household is located in an urban, or semi-rural or rural area

To test robustness, each model is built up gradually by adding a new set of control variables in several steps (White and Lu, 2014:195). This allows a deeper understanding of the model's independent variables, and how they affect the dependent variable.

Thus, in full detail, the general specification is the following:

$$Y = \beta 1 + \beta 2User + \beta 3Savings + \beta 4Loans + \beta 5Insurance + \beta 6Assets + \beta 7Age + \beta 8Education + \beta 9Language + \beta 10Adults + \beta 11FoodSecurity + \beta 12MainOccupation + \beta 13ExtraIncome + \beta 14MobilePhone + \beta 15Location + \varepsilon$$

The above specification will be used throughout the analysis. What will be altered is the dependent variable. For Model 1, the dependent variable has two outcomes: either the household has received or sent a transfer in the last 4 weeks, or it has not. For Model 2, the dependent variable is: in the last 4 weeks, has the household sent or received a transfer within an expanded network, or not. Expanded network is defined as transferring with a relative or friend (i.e. someone that is not a spouse, child, parent or sibling). Finally, in Model 3 the dependent variable is: in the last 4 weeks, has the household sent or received a transfer that is classified as emergency, or not.

4.3.2 Testing the model specifications

The data was checked for normality, which led to the detection and correction of some coding errors. All estimations are done with robust standard errors, which are used to avoid heteroscedasticy. The estimations are also controlled for multicollinearity; none was detected. Finally, to test the robustness of the basic specification, a sensitivity analysis is performed. This way, any differences between subgroup and the baseline specification can be detected and analyzed (Magnus and Vasnev, 2013:3; Clarke, 2006:2). The results of the sensitivity analysis are presented in the next chapter.

4.3.3 Limitations of cross-sectional data and OLS

The survey data used in this study is cross-sectional, meaning it represents a snapshot of the world. Just like there are limitations to the survey methodology, there are inherent limitations with cross-sectional data and OLS. These limitations are addressed in this section.

One of the most obvious limitations with cross-sectional data is that it cannot be used to detect causality. Since the data is only a snapshot of economic activities, it cannot detect any dynamics within, and between the variables. What cross-sectional data can indicate is, correlation between variables and how strong the correlation is. This is definitely a drawback when compared to panel data (Doss, 2006:9). However, cross-sectional studies have their merits as well. One merit is that it is often a much cheaper alternative to longitude studies, which require a commitment in both time and resources. Cross-sectional studies can therefore be a useful tool for discovering new correlations, or empirically testing theoretical concepts in the field.

Another problem with cross-sectional data is reverse causation. Since it cannot trace causality, one cannot determine what is causing what. As an example, if people already receive numerous transfers, does this result in the individual being more likely to sign up for Tigo Money (which might further increase their frequency of transfers)? Again, this was something I could not test for because I did not have panel data to track the economic activities of the households in my sample. However, the theoretical framework is based on research with panel data,

and my findings are in line with results of panel data. If it turns out that households that transfer a lot do sign up for Tigo Money, it reinforces the fact that mobile money does provide benefits for households.

4.3.4 Explanatory variables

This section briefly elaborates the expected effect of some of the variables included in the model (Doss, 2006:12). For a detailed discussion, I refer the reader to chapter three where the theoretical framework for this study was presented.

The inclusion of *User* is obvious, as the use of Tigo Money is of great interest. It is assumed to have a positive effect on the dependent variables. $HH_{Finances}$, with *Savings*, *Loans*, *Insurance* and *Assets*, is included as the variables are expected to have a negative effect on the dependent variable. In $HH_{Demographics}$, the number of adults is expected to increase the number of transfers, as it could indicate access to a larger social network.

5 Results

In this chapter the results from the OLS estimations are presented and analyzed. Each model is discussed separately. Lastly, the result from the sensitivity analysis is elaborated.

Overall, the results are robust even as more sets of independent variables are added. More importantly, I find that the use of Tigo Money has a significant positive correlation with an increased transfer activity for households.

5.1 Model 1: Probability of participating in a transfer

This model examines which independent variables affect the probability of a household either sending or receiving a transfer. As seen in Table 6, summary statistics indicate that users of Tigo Money participate in more transfers on average; 0.88 during the recall period compared to just 0.06 for non-users.

Table 6: Transfers	Total	Non-users	Users
Average number of transfers	0.25	0.06	0.88

The results for Model 1 can be seen in Table A. Column (4) shows that users of Tigo Money are almost 69 percent more likely to participate in a transfer compared to non-users. This positive correlation is significant at the one percent significance level. The result is in line with findings in previous literature, as well as the theoretical framework.

As some variables could affect only sending, Column (5) shows the result when the depended variable is a dummy if the household has sent a transfer. Again the use of Tigo Money significantly correlates with transfer activity, as household using mobile money are 22 percent more likely to send a transfer than non-user. The effect is significant at the one percent level. *Savings* is also significantly affecting the outcome, and indicates that households with savings transfer more to other households. Instead of simply holding the money, the household may choose transfer it to other households (for example see Udry, 1994). Column (6) shows which variables affect the probability of a household receiving a transfer, and once more *User* is significant at the one percent level.

Loans is significant across all specifications, with a positive effect on the probability of receiving a transfer. The effect was not expected. However, a loan could indicate a lack of resources, and that receiving transfers are beneficial for the household. The result also suggests that household in need of resources, utilize both transfers and financial services. This discussion will be resumed in the next chapter, as the variable *Loans* will behave unexpectedly in more models.

Table A: estimation on probability of sending or receiving transfer.

VARIABLES	(1) Set 1	(2) Sets 1 and 2	(3) Sets 1,2,3	(4) Full	(5) To send	(6) To receive
User	0.659***	0.659***	0.664***	0.648***	0.219***	0.429***
	(0.053)	(0.052)	(0.051)	(0.051)	(0.036)	(0.057)
Savings	-0.051**	-0.068**	-0.061**	-0.042	-0.019*	-0.024
	(0.021)	(0.027)	(0.025)	(0.027)	(0.011)	(0.029)
Loans	0.093**	0.103**	0.1**	0.097**	0.017*	0.08**
	(0.042)	(0.04)	(0.039)	(0.039)	(0.009)	(0.04)
Insurance	0.044	0.029	0.015	0.024	0.016	0.008
	(0.049)	(0.043)	(0.039)	(0.039)	(0.02)	(0.043)
Assets	0.011	0.006	0.017	0.01	0.0001	0.01
	(0.013)	(0.015)	(0.012)	(0.012)	(0.036)	(0.014)
Age		0.002	0.001	0.001	-0.001**	0.002*
		(0.001)	(0.001)	(0.001)	(0.0002)	(0.001)
Education		0.006	0.007*	0.008**	0.0002	0.008*
		(0.004)	(0.004)	(0.004)	(0.001)	(0.004)
Adults		-0.006	-0.002	0.001	0.008**	-0.007
		(0.005)	(0.005)	(0.005)	(0.003)	(0.005)
Spanish		-0.019	-0.014	-0.004	0.016	-0.019
		(0.032)	(0.029)	(0.03)	(0.014)	(0.032)
Food security		0.013**	0.012*	0.006	0.002	0.003
		(0.007)	(0.006)	(0.006)	(0.003)	(0.006)
Business operator			-0.001	0.007	-0.008	0.016
			(0.038)	(0.037)	(0.011)	(0.037)
Dayworker			0.003	-0.019	0.003	-0.022
			(0.03)	(0.03)	(0.008)	(0.03)
Other			0.121**	0.114*	0.042**	0.072
			(0.06)	(0.06)	(0.017)	(0.062)
Public			0.025	0.019	-0.014	0.033
			(0.046)	(0.046)	(0.019)	(0.054)
Extra Income			-0.026	-0.033	-0.008	-0.025
			(0.024)	(0.024)	(0.012)	(0.025)
Mobile Phone			-0.091	-0.1	-0.005	-0.095
			(0.065)	(0.065)	(0.009)	(0.065)
Semi-rural				0.155***	0.083***	0.072
				(0.054)	(0.01)	(0.054)
Urban				-0.042	0.004	-0.046
				(0.031)	(0.013)	(0.033)
Constant	0.027	-0.114	-0.047	0.001	-0.02	0.021
	(0.021)	(0.075)	(0.066)	(0.066)	(0.026)	(0.065)
Observations	467	467	467	467	467	467
R-squared	0.437	0.453	0.479	0.494	0.257	0.285

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The other significant variables for the full model (4), are *Education* ($p<0.05$), *Other* ($p<0.1$) and *Semi-rural* ($p<0.01$), each with a positive effect. The effect of education might at first seem small, but since it is measured in years the effect adds up. The significance of *Semi-rural* is interesting, as it indicates that households in Santa Cruz, without formal financial services but with a Tigo Money agent, are more likely to participate in transfers.

Finally, surprisingly neither *Insurance* nor *Assets* are significant in any of the models. Thus, so far it seems like the variables for household finances do not have the expected behavior.

5.2 Model 2: Probability of extended network

In the second model, the dependent variable is the probability of sending or receiving a transfer within a more expanded network, which is defined as someone that is a relative or friend, but not a close family member (spouse, child, parent or sibling). Table 7 shows how this type of transfer is more common among Tigo Money users than for non-users: about every fifth transfer for the latter group, but for users it is more than half of all transfers.

Looking beyond summary statistics, the regression results can be seen in table B. Once more the results clearly show that *User* has a strong positive correlation with the probability of receiving or sending transfers within an expanded network. The effect is significant at the one percent significance level across the three versions of the fully specified model. The results indicate that users of Tigo Money are 45 percent more likely of transferring with a more diverse range of participant. Previous literature supports this result. This result holds for columns (5) and (6) as well.

In the full model, all four variables in the subgroup $HH_{finances}$ are significant for at least the ten percent level: *Savings*, *Loans*, *Insurance* and *Assets*. Again *Loans* has a positive effect, as does *Assets*. In addition, the results are different for Column (5) or (6). Now the location dummy for Santa Cruz is significant at the one percent level. The correlation is positive for sending transfers, but negative for receiving. This result strongly indicates that households in Santa Cruz send more within a wider network compared to other subsamples, but that they also receive less.

Table 7: Transfers to expanded network

	Total		Non-users		Users	
Transfer to:	Nr	%	Nr	%	Nr	%
Family	56	51.9	18	81.8	38	44.2
Extended	52	48.1	4	18.2	48	55.8
Total	108	100	22	100	86	100

Table B: Transfers to expanded network

VARIABLES	(1) Set 1	(2) Sets 1 and 2	(3) Sets 1,2,3	(4) Full	(5) To send	(6) To receive
User	0.449***	0.437***	0.442***	0.445***	0.174***	0.265***
	(0.051)	(0.051)	(0.051)	(0.051)	(0.036)	(0.049)
Savings	-0.031*	-0.05*	-0.047**	-0.05**	-0.016	-0.033
	(0.018)	(0.026)	(0.024)	(0.025)	(0.011)	(0.024)
Loans	0.066*	0.07*	0.073*	0.0735*	0.011	0.061
	(0.038)	(0.036)	(0.037)	(0.037)	(0.008)	(0.038)
Insurance	-0.035	-0.045	-0.058*	-0.059*	0.019	-0.077**
	(0.03)	(0.032)	(0.034)	(0.034)	(0.02)	(0.033)
Assets	0.012	0.011	0.02*	0.021*	0.003	0.019*
	(0.01)	(0.012)	(0.011)	(0.011)	(0.011)	(0.011)
Age		-0.0001	-0.001	-0.001	-0.001**	-9.99e
		(0.001)	(0.001)	(0.001)	(0.0002)	(0.001)
Education		0.003	0.002	0.002	-0.0004	0.002
		(0.003)	(0.003)	(0.003)	(0.001)	(0.003)
Adults		0.005	0.007	0.007	0.008**	-0.001
		(0.004)	(0.005)	(0.005)	(0.003)	(0.004)
Spanish		0.027	0.033	0.032	0.02	0.012
		(0.026)	(0.026)	(0.027)	(0.014)	(0.027)
Food security		0.004	0.003	0.004	0.0004	0.004
		(0.005)	(0.005)	(0.005)	(0.002)	(0.005)
Business operator			0.012	0.01	-0.007	0.017
			(0.035)	(0.035)	(0.01)	(0.033)
Dayworker			-0.012	-0.01	0.002	-0.013
			(0.023)	(0.023)	(0.007)	(0.021)
Other			0.065	0.066	0.046***	0.021
			(0.052)	(0.052)	(0.017)	(0.052)
Public			0.048	0.048	-0.017	0.066
			(0.047)	(0.047)	(0.017)	(0.05)
Extra Income			-0.031	-0.03	-0.012	-0.017
			(0.022)	(0.021)	(0.011)	(0.02)
Mobile Phone			-0.075	-0.073	-0.005	-0.069
			(0.058)	(0.058)	(0.008)	(0.057)
Semi-rural				-0.018	0.034***	-0.058***
				(0.02)	(0.011)	(0.017)
Urban				0.012	0.007	0.005
				(0.023)	(0.013)	(0.021)
Constant	0.004	-0.043	0.019	0.008	-0.017	0.027
	(0.019)	(0.048)	(0.051)	(0.05)	(0.024)	(0.044)
Observations	467	467	467	467	467	467
R-squared	0.325	0.334	0.355	0.356	0.208	0.191

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

5.3 Model 3: Probability of emergency transfers

In model 3, it is investigated which variables affect the probability of a household sending or receiving an emergency transfer. Table 8 indicates that users of Tigo Money send and receive more transfers for emergency reasons.

Table 8: Transfers for emergency reasons

	Total		Non-user		User	
Reason	Nr	%	Nr	%	Nr	%
Emergency	33	7.1	6	18.2	27	25.7
Other	71	92.9	16	81.8	55	74.3
Total	104		22		82	

As can be seen, for users of Tigo Money one third of all transfers are for emergency reasons, compared to one in five for non-users. The results of the regression model provide more info, as seen in Tabel C.

As with previous models, *User* is positively correlated with the probability of receiving or sending an emergency transfer. The effect is significant on the one percent significance level. However, the correlation is weaker than in previous models. Overall the result, except for the effect of Tigo Money, seems less robust than previous models. This is true for the column (5) and (6) as well. There might be several reasons for this, which will be discussed in detail in the next chapter.

5.4 Sensitivity analysis

This section further tests the robustness of the models. I do this in two ways: by dividing the sample into subsamples, and then by trying a new specification.

In the first sensitivity analysis, the observations are divided into three subsamples based on their geographical location: rural, semi-rural and urban. Then each subsample goes through the same estimations as above. The results can be found in Appendix B, and presents several interesting findings. To begin with, the general results are not valid for the rural subsample. *User* is not significant in any of the specification. Instead, twice *Loans* is significant at the five percent significance level with a positive effect, and *ExtraIncome* is significant once, also with a positive effect. The model is having a hard time to estimate transfer activity for the rural subsample, which reduces the robustness of the baseline models.

When running the models for Santa Cruz and Panajachel, the results are very different. *User* is significant again, and the coefficient is even larger. Overall, for Santa Cruz and Panajachel the same variables are significant, and the coefficients are generally larger. The exception is the Santa Cruz subsample in Model 2, where the variables *Savings*, *Loans*, *Insurance* and *Assets* lose their significance. This is likely due to the fact, that in the main sample it is mostly the households in

Table C: Probability of transfers for emergency reasons

VARIABLES	(1) Set 1	(2) Sets 1 and 2	(3) Sets 1,2,3	(4) Full	(5) To send	(6) To receive
User	0.449***	0.167***	0.169***	0.165***	0.056***	0.109***
	(0.051)	(0.04)	(0.04)	(0.04)	(0.015)	(0.038)
Savings	-0.031*	-0.039	-0.038	-0.035	-0.0001	-0.035
	(0.018)	(0.024)	(0.023)	(0.024)	(0.003)	(0.024)
Loans	0.066*	0.063*	0.061	0.061	0.012**	0.049
	(0.038)	(0.036)	(0.038)	(0.038)	(0.005)	(0.038)
Insurance	-0.035	-0.006	-0.009	-0.006	0.001	-0.008
	(0.03)	(0.029)	(0.032)	(0.032)	(0.008)	(0.031)
Assets	0.012	0.005	0.008	0.009	0.001	0.008
	(0.01)	(0.011)	(0.01)	(0.01)	(0.003)	(0.009)
Age		-4.14e	-0.001	-0.001	-0.0002	-0.0003
		(0.001)	(0.001)	(0.001)	(9.69e)	(0.001)
Education		0.002	0.002	0.002	0.0003	0.001
		(0.003)	(0.003)	(0.003)	(0.001)	(0.003)
Adults		-0.002	-0.001	-0.001	-0.001	0.001
		(0.003)	(0.004)	(0.004)	(0.001)	(0.004)
Spanish		-0.029	-0.028	-0.026	-0.002	-0.025
		(0.026)	(0.026)	(0.027)	(0.004)	(0.027)
Food security		0.002	0.002	0.001	0.001	1.04e-05
		(0.004)	(0.005)	(0.005)	(0.001)	(0.005)
Business operator			0.028	0.025	-0.005	0.031
			(0.032)	(0.031)	(0.004)	(0.031)
Dayworker			0.013	0.005	2.65e-05	0.005
			(0.016)	(0.016)	(0.003)	(0.016)
Other			0.055	0.05	0.001	0.05
			(0.05)	(0.049)	(0.008)	(0.049)
Public			0.006	0.002	-0.008	0.01
			(0.032)	(0.032)	(0.008)	(0.03)
Extra Income			0.005	0.002	0.008	-0.006
			(0.019)	(0.019)	(0.007)	(0.018)
Mobile Phone			-0.059	-0.058	-0.0002	-0.058
			(0.058)	(0.058)	(0.003)	(0.058)
Semi-rural				0.055*	0.054***	0.001
				(0.029)	(0.01)	(0.027)
Urban				0.009	-0.001	0.01
				(0.018)	(0.003)	(0.02)
Constant	0.004	0.004	0.046	0.044	-0.001	0.045
	(0.019)	(0.043)	(0.046)	(0.045)	(0.01)	(0.044)
Observations	467	467	467	467	467	467
R-squared	0.325	0.103	0.117	0.120	0.093	0.079

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panajachel that contribute to their significance. However, when only looking at Santa Cruz, they matter much less as is seen in the Table B2 in Appendix B. Finally, in Model 1, it is peculiarly that *Mobilephone* has a negative coefficient. I checked to see if this result was due to outliers, but found none. To summarize, overall the results of the first sensitivity analysis reinforce the results of the baseline models, especially for the significance and effect for the use of Tigo Money.

Next, I added squared variables for *Age* and *Education* to the baseline specification, to see if this provides a better fit. I also removed the dummy *Savings* and *Loans*, and instead include dummies only for households that save using a bank account or received a loan from a bank (i.e. a formal financial institutions). These were included to test the robustness of *User*, and to investigate the effect of formal financial institutions. The results are included in Appendix C.

The inclusion of the *Age^2* and *Education^2* have little to none influence on the estimations, as they fail to be significant in any of the models. This indicates that the probability of increased transfer activity is not correlated with any of the variables for age. *Education*, the original non-squared variable, is significant in some models, but never at the one percent significance level. Additionally, the coefficient is often very small.

More can be said about the dummy for the use of formal financial services. Overall the significance for *Savings at bank* disappears, and *Insurance* is significant only once (again with a positive effect, like in the baseline model). This suggest that the use of formal financial services does not matter for whether or not a household will participate in a transfer within an informal social network. *Loans at bank* is still significant in two models. In addition, the coefficient is still positive. This confirms the findings of the baseline models, as there is a positive correlation for both *Loans*, and *Loans at bank*, and increased transfer activity. Thus, this confirms the idea that households combine different financial services if able.

6 Discussion

First are the results from the previous chapter discussed in detail, focusing on the significance and effect of the variables of most interest. Then, the discussion is about the model in general, its specifications and performance.

6.1 The results

Except for the rural subsample, Tigo Money had a significant positive effect across the three models. The results indicate that the use of Tigo Money is significantly correlated to an increased probability to participate in a transfer, and to do so in an expanded network. In addition, usage is significantly correlated with an increased probability to send or receive transfers for emergency support. The findings are in line with results of previous research.

Attention should also be given to the variables for household finances: *Savings*, *Loans*, *Insurance* and *Assets*. The assumption was that they would have a negative affect on transfer behavior. As it turns out, the results suggest a more complex relationship. When significant, *Savings* had a negative effect, which means that households with savings are less likely to participate in any transfers, no matter the network extent or reason behind the transfer. This behavior was expected, as savings indicate that a household is in possession of some resources that could be used in case of a negative income shock.

Loans, when significant, always correlates positively with transfer participation. This was not expected and it is difficult to identify the need for the transfer. On the one hand, a loan indicates a lack of money, and indirectly a need for transfers. On the other hand, a loan could also indicate entrepreneurship, as the money could be used for investments of some sort. Therefore it is unclear whether the transfer is to offset a negative income shock, or used by the receiving household as investment capital. Since no data was collected about negative shocks nothing can be said about the situation for the individual household. Nonetheless the transfer indicates that transfers are a way of getting money when needed, and that households combine different sources of credit if possible.

Insurance behaves like expected when significant, as it is negatively correlated with receiving a transfer from a more extensive network. This makes sense, as insurance provides the type of financial protection the transfer is supposed provide as well. It could be an indication that insurance and transfers are substitutes rather than complements. Additionally, it could be the case that people with insurance are less likely to contact households that are more socially distant (relatives and friends), and instead turn to closer family members for transfers.

Assets is only significant for one model: it increases the probability of participating in an expanded network. The variable is significant only at the ten percent level, and it has a positive effect on transfer activity. I had expected a negative effect, as assets owned are indicators for household wealth.

It is bit surprising that the number of adults in a household does not seem to matter for transfer behavior. It is only significant for households in Santa Cruz that send transfers to a relative or friend. One could spontaneously believe more adults would correlate with more access to different networks, and therefore more transfer activity. However, the result does not go against previous research, as the literature has shown that the formation of social network is more complex than a numbers game. Or to put it another way: it is the quality of the bond between households that matters, not the quantity.

Semi-rural, the variable indicating if the household is located in Santa Cruz, is significant in each model. Except for one instance, the correlation is always positive for transfer activity: thus, households in Santa Cruz are more likely to participate in a transfer than other subsamples. This can be interpreted in two ways. On one hand, the significance could be an outcome of the proximity of a Tigo Money agent, combined with the lack of other financial institutions. This also suggests how mobile money fills the gap left by formal financial institutions. On the other hand, more research is needed, as Santa Cruz could just be an outlier in its intensity of transfer activity.

6.2 The models

The performance of the models fluctuates depending on the specification and subsample. For a start, Tigo Money fails to be a significant variable for understanding more about transfer behavior for the rural subsample. This is no surprise, considering the very low number of people using the service in this area. I tried to correct this by oversampling rural communities, but as it turns out the average number of transfers is very low. I still decided to include the subsample in my analysis, and the applied survey weight greatly reduces the risk for any estimation biases due to the rural sample. The models perform better with the subsamples of Santa Cruz and Panajachel. The first sensitivity analysis, except for the rural subsample, confirms the robustness of the baseline specifications.

There are still some issues I would like to address. A problem every researcher in social sciences struggle with is potentially omitted variables, as does this study. Firstly, as discussed above, the use of Tigo Money could not be used to understand the transfer behavior in the rural subsample. It is clear that other independent variables are needed for an appropriate estimation. I am also aware of the fact that model 3, on the probability of receiving an emergency transfer, most likely suffers from omitted variables. Few variables are significant, and the overall fit is not great. If possible, I would advocate the inclusion of more data on negative shocks at household, village and regional level, as it would probably better explain the circumstances under which households send and receive

emergency transfers. Much of the cited research uses this type of data. At the outset of specifying model 3, I was aware of the fact that I probably lacked adequate data. Despite this, I decided to analyze emergency transfers in order to better compare my findings with previous research. Even though my cross-sectional study probably suffers from omitted variables, my results indicate how the use of Tigo Money positively correlates with emergency transfers being sent and received. These findings add to the growing body of research, especially since this study is conducted in an underrepresented region. As mentioned earlier in this paper, this ability of cross-sectional studies to empirically test interesting theories should not be underestimated.

Additionally, it would be interesting to see how my estimation would have performed with more data on the size of the household network. Unfortunately, to gather data that detailed was not feasible for this study.

Finally, the impact formal finance has on transfer activity is unclear. In the baseline model, each variable has a different effect. When only including dummies for formal finance, the significance of several variables mostly disappears. Primarily, this confirms the overall impact of Tigo Money, as it does not matter whether or not the households are financially included. Additionally, it shows that households are able, and willing, to mix formal and informal services to reach their financial goals.

7 Conclusions

Transfers within informal social networks play a big role in many developing societies, as they allow household to reduce risk. However, high transaction costs lower the level of protection enjoyed by the households. Mobile money is one way to lower these cost.

This paper investigates the mobile money service called Tigo Money, and if it has an impacts on the transfer behavior of household. Survey data is used from two municipalities in Guatemala. The data is weighted accordingly, and OLS estimations are used for the analysis.

The results strongly indicates that Tigo Money indeed is positively correlated with an increased probability of sending and receiving more transfer, doing so with a more extensive network of household, and participating in an informal insurance network. These findings are in line with theory and the result of previous research. The results are robust for semi-rural and urban subsamples over several different model specifications. However, the model is less successful in estimating the transfer behavior in rural subsamples, as too few users and transfers were recorded in the survey data.

With the rapid development in the field of mobile money more research is needed. In this paper I only studied the effect mobile money has on transfer activity, but I did not try to answer why households adopt the technology, or what practical impact more transfers have on the wellbeing of the household members. Therefore, there is plenty to interest researchers in behavioral economics and microfinance. First, more needs to be known about the adoption of mobile money, especially since many groups suffer from digital illiteracy and have difficulties adopting modern technology even though it would benefit them. Secondly, more can be done to map transfer behavior: who sends to whom? And why? Panel data or transfer journals would provide useful data. Another interesting topic would be to use methods of big data analysis to search for any patterns among all the millions of transactions taking place. Thirdly, what impact does more transfers have on the household. Are the transfers mostly used for support in the case of negative income shocks, or is the money invested in schooling, assets or any income-generating activities? Finally, as this paper shows the mixed effects household finances have on transfer activity, it would be interesting to investigate the relationship between informal and formal financial services. This would also be of interest for public institutions, as mobile money could impact financial markets.

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Appendix A

	Part 1: Charactersitics of the household				Part 2: The use of mobile phones		Part 3: Occupation Questions 7-9 refer to the last 7 days.			
HOUSEHOLD	1. How old are you?	2. Your education?	3. Which language do you speak at home? Spanish..1 Kaqchikel..2 Other..3	4. Including you, how many adults live in this dwelling?	5. Does your household posses at least one mobile phone? Yes..1 No..2 (-> 7)	6. Has anyone in your household used Tigo Money in during the last 4 weeks? Yes..1 No..2	7. Of the adults in this household: how many work outside of the home?	8. What is the most important income of this household. Agricultural..1 Crafting..2 Tourism...3 Public sector..4 Private Company ..5 Private individual..6 Vending...7 Dayworker..8 Unemployed..9 Other..10		9. Does your household has any extra income from any of the following? Agricultural..1 Crafting..2 Tourism...3 Public sector..4 Private Company ..5 Private individual..6 Vending...7 Dayworker..8 Unemployed..9
	Years	Years	Code	Number of:			Number	Type	Code	Code
1										
2										
3										
4										
5										
6										
7										

Community/Neighborhood:_____ Date:_____

Ask: I wonder if it is posible to talk to the person responsable for sending and receiving transfers in this household.

	Part 4: Food security					
	Questions 10-12 refer to the last 4 weeks.					
HOUSEHOLD	10. Did you worry that your household would not have enough food? Yes..1 No..2 (-> 11)	If so, how often did this happen? Rarely..1 Sometimes..2 Often..3	11. Were you or any household member not able to eat the kind of foods you preferred because of a lack of resources? Yes..1 No..2 (-> 12)	If so, how often did this happen? Rarely..1 Sometimes..2 Often..3	12. Did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food? Yes..1 No..2 (-> 13)	If so, how often did this happen? Rarely..1 Sometimes..2 Often..3
		Frequency		Frequency		Frequency
1						
2						
3						
4						
5						
6						
7						

Community/Neighborhood:_____ Date:_____

	Part 5: Household finances								
	Questions 13-16 refer to your household.								
HOUSEHOLD	13. Does your household save any money? Yes..1 No..2 (-> 14)	If so, does your household save in any of the following ways? Cash at home..1 Bank account..2 Cooperative..3 At a relative..4 At a friend..5 Other..6	14. Has your household borrowed any money in the last 6 months? Yes..1 No..2 (-> 15)	If so, exactly where did your household borrow? Bank..1 Pawnshop..2 Government agency..3 Landlord..4 Employer..5 Cooperative..6 Relative...7 Friend..8 Other..9		15. Does your household have any form of insurance coverage? Yes..1 No..2 (-> 16)	If so, from where does your household get this coverage? Through a household member ..1 Employer..2 Government program..3 Bought through a private insurer..4 Paid for by relative..5 Other..6		16. ¿Does your household own any of the following assets? Land..1 Land for farming..2 Real estate..3 Boat..4 Car..5 Livestock..6 Business..7 Other..8
		Code		Type	Code		Type	Code	Code
1									
2									
3									
4									
5									
6									
7									

Community/Sector:_____ Date:_____

During the last 4 weeks, has anyone in your household received or sent financial help (remittances, transfers or credit) from someone that is not part of this household or lives in this dwelling? For example, financial support from family members living in other communities, friends or neighbors? If so, please tell me more about these transfers.

HOUSEHOLD NR	**Did you receive or send the transfer?** 1) Reveived **2)** Sent	**Which type of transfer was it?** 1) Money 2) Credit	**How do you know the person that received/sent the transfer?** 1) Spouse 2) Parent 3) Son/daughter 4) Sibling 5) Relative 6) Friend 7) Other	**Travel time to where the other person lives** Do not fill if the person lives abroad. Hours / Minutes	**Which method did you use to send/receive the transfer** 1) Sent in cash 2) In person 3) Tigo Money 4) Western U/Money Gram etc 5) Bank 6) Other	**What was the sum of the transfer?** 1) 0–25Q 2) 26-150Q 3) 150-1000Q 4) 1000Q or more	**What was the reason for sending/receiving the transfer?** 1) Emergency reasons 2) A loan/credit 3) To repay a debt 4) Regular support 5) No particular reason 6) Other	**Are you expected to repay the transfer?** 1) Yes 2) No

Appendix B

Table B1: Probability of transfer, divided by subsample

VARIABLES	(1) Rural	(2) Semi-rural	(3) Urban
User	0.222	0.900***	0.659***
	(0.252)	(0.109)	(0.0571)
Savings	0.0535	-0.280*	-0.0438
	(0.0881)	(0.144)	(0.0271)
Loans	0.165***	0.0248	0.0945**
	(0.0635)	(0.0933)	(0.0457)
Insurance	-0.0482	-	0.0208
	(0.123)		(0.0413)
Assets	0.0109	-0.0216	0.00890
	(0.0366)	(0.100)	(0.0118)
Age	0.00178	0.0114**	0.000395
	(0.00243)	(0.00456)	(0.00120)
Education	0.0223	0.00241	0.00747*
	(0.0155)	(0.0147)	(0.00424)
Adults	-0.0189	-0.0823***	0.00393
	(0.0165)	(0.0207)	(0.00535)
Spanish	-0.138	-	-0.00751
	(0.104)		(0.0309)
Food security	0.000600	0.0528	0.00439
	(0.0125)	(0.0327)	(0.00670)
Business operator	-0.0223	-0.337	0.0450
	(0.0755)	(0.262)	(0.0403)
Dayworker	-0.0411	-0.0864	0.0194
	(0.0443)	(0.266)	(0.0342)
Other	0.0297	0.126	0.160**
	(0.0884)	(0.299)	(0.0770)
Public	-0.0314	-0.366	0.0600
	(0.0635)	(0.287)	(0.0517)
Extra Income	-0.0137	-0.0897	-0.0216
	(0.0958)	(0.0824)	(0.0256)
Mobile Phone	-0.0903	0.264***	-0.141*
	(0.0975)	(0.0799)	(0.0811)
Constant	0.0471	-0.536	-0.0141
	(0.160)	(0.384)	(0.0734)
Observations	122	88	257
R-squared	0.175	0.527	0.555

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table B2: Probability of expanded network, divided by subsample

VARIABLES	(1) Rural	(2) Semi-rural	(3) Urban
User	0.311	0.418***	0.453***
	(0.243)	(0.0970)	(0.0563)
Savings	0.00183	-0.0581	-0.0504*
	(0.0184)	(0.0547)	(0.0270)
Loans	0.118**	0.0410	0.0653
	(0.0464)	(0.0301)	(0.0451)
Insurance	-0.0505	-	-0.0631*
	(0.0448)		(0.0377)
Assets	0.0189	-0.00267	0.0223*
	(0.0174)	(0.0303)	(0.0126)
Age	0.00284	-0.000699	-0.00150
	(0.00179)	(0.00126)	(0.000963)
Education	0.00501	-0.00734	0.00116
	(0.00528)	(0.00688)	(0.00292)
Adults	-0.0108	-0.00117	0.00681
	(0.0100)	(0.00977)	(0.00543)
Spanish	0.0500	-	0.0235
	(0.0312)		(0.0285)
Food security	0.00316	0.00892	0.00450
	(0.00582)	(0.0128)	(0.00613)
Business operator	-0.0663	-0.114	0.0371
	(0.0614)	(0.104)	(0.0366)
Dayworker	-0.0106	-0.0203	0.00877
	(0.0291)	(0.0369)	(0.0264)
Other	-0.0364	0.00365	0.123*
	(0.0375)	(0.0572)	(0.0709)
Public	-0.0141	-0.399***	0.0826
	(0.0386)	(0.115)	(0.0523)
Extra Income	-0.0895*	-0.0349	-0.0185
	(0.0521)	(0.0298)	(0.0242)
Mobile Phone	-0.0352	0.00566	-0.0846
	(0.0519)	(0.0157)	(0.0728)
Constant	-0.0966	0.000250	0.0384
	(0.110)	(0.0912)	(0.0582)
Observations	122	88	257
R-squared	0.297	0.376	0.370

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B3: Probability of emergency transfer, divided by subsample

VARIABLES	(1) Rural	(2) Semi-rural	(3) Urban
User	0.327	0.478***	0.127***
	(0.246)	(0.105)	(0.0424)
Savings	0.00986	-0.159	-0.0318
	(0.0131)	(0.119)	(0.0258)
Loans	0.0943**	0.0106	0.0546
	(0.0431)	(0.0437)	(0.0459)
Insurance	-0.0414	-	0.00493
	(0.0382)		(0.0351)
Assets	0.0166	0.0489	0.00700
	(0.0165)	(0.0677)	(0.0108)
Age	0.000982	-0.000773	-0.000759
	(0.000987)	(0.00272)	(0.000909)
Education	0.00245	0.00312	0.000753
	(0.00446)	(0.0132)	(0.00264)
Adults	-0.0120	-0.0335	0.000144
	(0.00939)	(0.0204)	(0.00430)
Spanish	0.0439	-	-0.0226
	(0.0292)		(0.0289)
Food security	-0.00203	0.0205	-0.00151
	(0.00347)	(0.0217)	(0.00560)
Business operator	0.00477	0.108	0.0449
	(0.0254)	(0.147)	(0.0329)
Dayworker	0.00850	0.0362	0.0159
	(0.0231)	(0.0577)	(0.0191)
Other	-0.0130	0.126	0.0827
	(0.0316)	(0.133)	(0.0698)
Public	0.0137	-0.591***	0.0166
	(0.0186)	(0.182)	(0.0368)
Extra Income	-0.0671	-0.0430	0.0111
	(0.0508)	(0.0481)	(0.0219)
Mobile Phone	-0.0643	0.0237	-0.0691
	(0.0499)	(0.0372)	(0.0720)
Constant	0.0228	-0.111	0.0709
	(0.0537)	(0.159)	(0.0519)
Observations	122	88	257
R-squared	0.303	0.348	0.104

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix C

Table C1: Probability of sending or receiving transfer, added Age^2, Education^2 and formal finance dummies

	(1)	(2)	(3)
VARIABLES	Full	To send	To receive
User	0.641***	0.219***	0.423***
	(0.0527)	(0.0361)	(0.0574)
Savings at bank	-0.00495	-0.0114	0.00648
	(0.0243)	(0.0141)	(0.0262)
Loans at bank	0.110*	0.0334**	0.0764
	(0.0643)	(0.0169)	(0.0666)
Insurance	0.0333	0.0144	0.0189
	(0.0450)	(0.0203)	(0.0480)
Assets	-0.000756	-0.00171	0.000953
	(0.0137)	(0.00754)	(0.0159)
Age	-0.000366	-0.00161	0.00125
	(0.00395)	(0.00129)	(0.00407)
Age2	2.30e-05	1.29e-05	1.01e-05
	(4.28e-05)	(1.34e-05)	(4.31e-05)
Education	0.0155**	0.00268	0.0128**
	(0.00636)	(0.00218)	(0.00608)
Education^2	-0.000488	-0.000154	-0.000334
	(0.000308)	(0.000124)	(0.000296)
Adults	-0.00144	0.00674**	-0.00818*
	(0.00454)	(0.00330)	(0.00478)
Spanish	-0.00437	0.0164	-0.0208
	(0.0295)	(0.0142)	(0.0317)
Food security	0.00253	0.00172	0.000811
	(0.00592)	(0.00259)	(0.00606)
Business operator	0.00960	-0.00892	0.0185
	(0.0362)	(0.0118)	(0.0357)
Dayworker	-0.0212	0.00102	-0.0222
	(0.0309)	(0.00888)	(0.0298)
Other	0.120**	0.0395**	0.0806
	(0.0602)	(0.0167)	(0.0625)
Public	-0.00282	-0.0185	0.0156
	(0.0459)	(0.0206)	(0.0534)
Extra income	-0.0314	-0.00928	-0.0222
	(0.0242)	(0.0128)	(0.0253)
Mobile Phone	-0.0950	-0.00424	-0.0908
	(0.0658)	(0.00819)	(0.0665)
Semi-rural	0.164***	0.0859***	0.0785
	(0.0538)	(0.01000)	(0.0540)
Urban	-0.0708**	-0.00392	-0.0669**
	(0.0333)	(0.0123)	(0.0334)
Constant	0.0523	-0.00388	0.0562
	(0.107)	(0.0444)	(0.111)
Observations	467	467	467
R-squared	0.490	0.259	0.280

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table C2: Probability of expanded network, added Age^2, Education^2 and formal finance dummies

VARIABLES	(1) Full	(2) To send	(3) To receive
User	0.436***	0.174***	0.263***
	(0.0510)	(0.0357)	(0.0483)
Savings at bank	-0.0221	-0.0113	-0.0108
	(0.0209)	(0.0134)	(0.0190)
Loans at bank	0.105	0.0231	0.0824
	(0.0653)	(0.0156)	(0.0662)
Insurance	-0.0569	0.0177	-0.0746**
	(0.0358)	(0.0199)	(0.0342)
Assets	0.0141	0.00242	0.0116
	(0.0126)	(0.00681)	(0.0140)
Age	-0.00282	-0.000609	-0.00221
	(0.00347)	(0.00123)	(0.00345)
Age^2	3.03e-05	2.20e-06	2.81e-05
	(3.66e-05)	(1.29e-05)	(3.59e-05)
Education	0.00725*	0.00120	0.00606*
	(0.00401)	(0.00194)	(0.00348)
Education^2	-0.000350	-9.70e-05	-0.000253
	(0.000227)	(0.000109)	(0.000199)
Adults	0.00410	0.00724**	-0.00314
	(0.00437)	(0.00316)	(0.00381)
Spanish	0.0339	0.0213	0.0126
	(0.0256)	(0.0140)	(0.0255)
Food security	0.00226	0.000369	0.00189
	(0.00526)	(0.00249)	(0.00491)
Business operator	0.00971	-0.00754	0.0172
	(0.0326)	(0.0112)	(0.0310)
Dayworker	-0.0148	0.000997	-0.0158
	(0.0220)	(0.00747)	(0.0198)
Other	0.0674	0.0445***	0.0229
	(0.0471)	(0.0162)	(0.0474)
Public	0.0317	-0.0201	0.0519
	(0.0446)	(0.0178)	(0.0481)
Extra income	-0.0301	-0.0130	-0.0171
	(0.0222)	(0.0119)	(0.0210)
Mobile Phone	-0.0705	-0.00407	-0.0664
	(0.0553)	(0.00730)	(0.0553)
Semi-rural	-0.0151	0.0351***	-0.0502***
	(0.0206)	(0.0114)	(0.0170)
Urban	-0.0110	0.00203	-0.0130
	(0.0233)	(0.0117)	(0.0210)
Constant	0.0627	-0.0200	0.0826
	(0.0939)	(0.0410)	(0.0907)
Observations	467	467	467
R-squared	0.353	0.209	0.191

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table C3: Probability of emergency transfer, added Age^2, Education^2 and formal finance dummies

VARIABLES	(1) Full	(2) To send	(3) To receive
User	0.161***	0.0563***	0.105***
	(0.0397)	(0.0145)	(0.0375)
Savings at bank	-0.0133	0.00521	-0.0185
	(0.0175)	(0.00641)	(0.0166)
Loan at bank	0.0991	0.0164	0.0827
	(0.0661)	(0.0105)	(0.0657)
Insurance	-0.00720	0.00180	-0.00900
	(0.0334)	(0.00685)	(0.0332)
Assets	0.00205	-0.00177	0.00382
	(0.0115)	(0.00328)	(0.0113)
Age	-0.000641	-0.000759	0.000118
	(0.00317)	(0.000484)	(0.00319)
Age^2	6.45e-06	7.23e-06	-7.76e-07
	(3.08e-05)	(5.05e-06)	(3.09e-05)
Education	0.00628*	0.000425	0.00585*
	(0.00364)	(0.00123)	(0.00346)
Education^2	-0.000287	-1.37e-05	-0.000273
	(0.000193)	(6.26e-05)	(0.000183)
Adults	-0.00215	-0.00137	-0.000774
	(0.00344)	(0.00130)	(0.00328)
Spanish	-0.0249	-0.00164	-0.0232
	(0.0252)	(0.00426)	(0.0251)
Food security	-0.000210	0.000234	-0.000444
	(0.00489)	(0.00102)	(0.00486)
Business operator	0.0226	-0.00560	0.0282
	(0.0286)	(0.00476)	(0.0286)
Dayworker	-0.000440	-0.000864	0.000424
	(0.0155)	(0.00402)	(0.0151)
Other	0.0489	0.000662	0.0482
	(0.0435)	(0.00777)	(0.0438)
Public	-0.0156	-0.0111	-0.00444
	(0.0290)	(0.00957)	(0.0263)
Extra income	0.000894	0.00810	-0.00720
	(0.0199)	(0.00628)	(0.0193)
Mobile Phone	-0.0566	-0.000459	-0.0561
	(0.0546)	(0.00310)	(0.0548)
Semi-rural	0.0615**	0.0556***	0.00582
	(0.0289)	(0.0105)	(0.0270)
Urban	-0.00817	-0.00280	-0.00537
	(0.0188)	(0.00406)	(0.0181)
Constant	0.0518	0.0175	0.0343
	(0.0910)	(0.0198)	(0.0909)
Observations	467	467	467
R-squared	0.129	0.095	0.087

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1