Mobile money demand in utility bill payments: A WTP estimates from Ethiopia

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ABSTRACT
The boom in mobile money services in developing countries offers new opportunities for expanding digital payments away from cash-based payments. In this study, we assess mobile money demand for utility bill payments and identify factors that affect its adoption in Ethiopia. We use data from urban household survey and dichotomous choice experiment that randomly offer a range of prices for using mobile money to pay utility bills. We find that, on average, households are willing to pay a higher price to use mobile money than the actual price charged by current mobile money service providers for the payment of goods and services in the country. However, demand is sensitive to price changes and is influenced by households' socio-economic characteristics. Our findings suggest strong latent demand for mobile money in processing payments and highlight product diversification's vital role in improving mobile money adoption in the country.

Key words: Mobile money; financial inclusion; willingness-to-pay; Ethiopia JEL Classification: D14; O12; O33

1. Introduction

Financial inclusion plays a vital role in reducing poverty and boosting social mobility as it facilitates borrowing, saving, investment and consumption smoothing (Abor, Amidu, and Issahaku 2018; Prina 2015; Dupas and Robinson 2013; Demirguc-Kunt and Klapper 2012). However, about 2 billion adults have no access to formal financial services worldwide (Demirguc-Kunt et al. 2018). Financial exclusion has been identified as one of the factors behind persistent poverty (Demirguc-Kunt et al. 2018; Barrett et al. 2006; Dupas and Robinson 2013) and as a factor in slowing economic growth and increasing inequality in developing countries (King and Levine 1993; Levine 1997; Demirgüç-Kunt, Honohan, and Beck 2008).

Mobile money (MM), a recent innovation in the financial sector, is expected to reduce financial exclusion and facilitate financial deepening, thus improving the well-being of the poor in developing countries (Demirguc-Kunt et al. 2018).[1] MM allows individuals and households to access basic financial services such as saving, money transfer as well as the purchase of goods and services using their mobile phones. MM promotes remittance exchange among family members and friends, enabling a cheaper and more secure transfer of money, provides relatively secure saving opportunities in rural areas, and facilitates business transactions through reduction of transaction costs (Ahmad, Green, and Jiang 2020; Aker et al. 2011; Blumenstock et al. 2015; Mbiti and Weil 2015). As such, the expansion of mobile money in developing countries can contribute to reducing poverty and enhancing inclusive growth (Ahmad, Green, and Jiang 2020; Jack and Suri 2011, 2014; Suri and Jack 2016; Beck et al. 2018; Aker and Mbiti 2010).

The expansion of MM, mainly driven by the massive expansion of mobile phone ownership, has prompted a dramatic improvement in financial inclusion in sub-Saharan Africa, from 23% in 2011 to 43% in 2017 (Demirguc-Kunt et al. 2018). In 2016, there were 277 million registered MM accounts, more than the total number of bank accounts in the region (GSMA 2017). However, MM expansion varies across countries. Kenya leads, with 90% of adults using mobile money services, whereas only 5.5 percent of adults in Ethiopia use mobile money (Jack and Suri 2011, 2014; GSMA 2017).[2]

While an expanding literature studied the impact of MM on household welfare in developing countries, particularly in Africa (e.g. Kenya: Okello Candiya Bongomin et al. 2018, Jack and Suri 2014, Mbiti and Weil 2015, Jack, Ray, and Suri 2013, Aker and Mbiti 2010, Munyegera and Matsumoto 2016; Uganda: Munyegera, Matsumoto et al. 2014; Tanzania: Riley 2016; Burkina Faso: Ky, Rugemintwari, and Sauviat 2018; Niger: Aker et al. 2016), there is limited evidence on the factors that influence take-up of mobile money for other payments, as opposed to transfers between individuals (Ahmad, Green, and Jiang 2020). Thus, providing rigorous evidence on determinants of MM adoption is needed to provide insights into the role of MM to facilitate financial inclusion in the developing world. Such evidence would also help designing policies that explicitly address MM adoption as a possible mechanism to foster financial inclusion. This study assesses the demand for MM for utility bill payments (UBPs) and identifies factors that affect its adoption using a dichotomous choice experiment that randomly offers a range of prices for using MM for paying utility bills in Ethiopia.

Our study is related to two strands of the literature. First, it is related to the literature that assess the adoption of mobile money in developing countries (Aker and Mbiti 2010; Weil, Mbiti, and Mwega 2012; Munyegera, Matsumoto et al. 2014; Kikulwe, Fischer, and Qaim 2014; Jack and Suri 2011). However, these studies define MM adoption if the household or individual uses MM to send or receive money. However,

there is limited evidence on the adoption of MM for other payments. In this study, MM adopters are households that are willing to take up the MM for utility bill payments regardless of using MM for transferring money. Second, it is related to the literature that assesses the impact of mobile money on welfare. In an RCT setting of cash transfer via MM compared to the manual transfer, Aker et al. (2016) find a positive impact of the MM on women's diet in Niger. They also report cost savings for recipients and the public agency. Blumenstock et al. (2015) evaluated the MM wage payment program in Afghanistan and noted a significant reduction in the disbursing firm's net costs (from fewer ghost workers and other leakages) and savings financial employees' time. In the same vein, Mbiti and Weil (2015) show a reduction in transaction costs (both monetary and security costs) of transferring money compared to the traditional means of money transfers such as Western Union use, MoneyGram, or transport companies. While these studies show positive impacts of MM in terms of reduction in transaction costs for recipients (Aker et al. 2016) and senders (Blumenstock et al. 2015; Mbiti and Weil 2015), we are not aware of a study that evaluate how worth is an improved payment arrangement (mobile money use for utility payments) to households.

The current study contributes to this emerging literature by investigating households' preferences to adopt MM for utility bill payments and assessing the ex-ante impact of the payment system on household welfare using survey data in a context where mobile money adoption for other payments is non-existent. In Ethiopia, nearly 70% of the MM users use the service mainly to receive public transfers, and the rest is largely used for private transfers or remittances (Baza, Rao et al. 2017). By the time of our survey, there was no arrangement for paying utility bills through mobile money in the country.[3]

The expansion of mobile money into other transactions such as UBPs, retail payments, and payments for additional services such as school fees could support wider adoption (Ahmad, Green, and Jiang 2020). Other potential benefits include: making it easier for businesses and government to collect payments; reducing the risk of cash theft (Jack and Suri 2011, 2014; Beck et al. 2018), improving safety for consumers and businesses alike; reducing the risk of misappropriation by cashiers (McKay, Pickens et al. 2010; Donovan 2012), and helping consumers avoid fines (through a quicker transfer of funds and the capacity to send reminders for payments). Moreover, it raises customer's experience with MM and supports strengthening the digital finance infrastructure (Evans and Pirchio 2014).

We randomly offer a range of prices that could be charged for using MM for paying utility bills in a hypothetical scenario and elicit households' willingness-to-pay (WTP) using single bounded dichotomous choice experiment. To test for non-price effects on the WTP, we also randomly vary additional attributes (receiving a monthly reminder for utility bills and the option of requesting an e-receipt for past and current utility bills). The exogenous variations in the price and non-price attributes, together with household survey data, enable us to estimate the demand for MM for UBPs in Ethiopia. Using the survey data, we also estimate probit model to study the factors that affect mobile money adoption.

We estimate that customers are willing to pay, on average, up to 15 Birr per month[4] to use mobile money for UBPs, highlighting a strong latent demand for MM for other payments. This price is higher than the actual fee charged by mobile money providers for processing payments in purchasing goods and services in the country. Our results also show that consumer demand is sensitive to price changes and is affected by socioeconomic characteristics. The higher the proposed price, the lower the take up rate of MM for UBP. Household head's education level and previous mobile use experience

significantly correlate with WTP. Female-headed and poor households are less likely to express willingness to take up MM services for UBPs if they do not have previous experience using MM. Among potential clients (non-MM users), residents of Hawassa (a regional city) and Halaba (a small town in the south of the country) are more likely to take up MM services for UBP compared to households in Addis Ababa (the capital city). This reflects the fact that households can use the one-stop payment centers to settle all their bills in the capital city. Overall, results suggest that expanding MM for UBPs requires a fine-tuned product that meets different customers' demands rather than a one-size-fits-all product; this is particularly important if one of MM's objectives is financial inclusion.

The rest of the study is organized as follows. The next section provides a brief overview of the Ethiopian financial sector and the utility payment system. Section 3 presents the survey design and describes the data. Section 4 provides the theoretical framework and the empirical model followed by discussions of the results in Section 5. The last section concludes.

2. Financial sector and utility bill payments system in Ethiopia

2.1. Overview of the financial sector

Despite the rapid economic growth over the last two decades, Ethiopia's financial sector is underdeveloped and has very limited outreach than any other developing country (World Bank 2019; Baza, Rao et al. 2017). The share of adults of age greater than 15 years who have an account at a financial institution was 22.8 percent compared to 28.9 percent of Sub-Saharan Africa countries average in 2014 (World Bank 2014). The financial sector is highly regulated and closed to foreign competition; ownership of financial institutions (insurance companies, banks, and MFIs) is restricted to Ethiopians. As of 2017, the financial sector was composed of 18 banks (16 private and 2 public), 17 insurance companies, 37 MFIs and 5 capital goods lease companies (Baza, Rao et al. 2017).

Progress in financial inclusion has also been relatively slow. By the end of 2016, only 26% of Ethiopian adults were using formal financial institutions to save money and 14% to borrow, compared to 11% and 7% in 2011, respectively (Demirguc-Kunt et al. 2018). As a result, households and businesses in the country highly rely on a range of informal financial services (Azomahou and Yitbarek 2015; Dercon et al. 2005); 65% of adults used informal means to borrow, save and take out insurance (DemirgucKunt et al. 2018). Financial institutions' limited services particularly marginalize rural communities, micro and small enterprises and women, in both urban and rural areas. These groups represent a substantial potential market for the financial sector, including mobile money. The rapid penetration of mobile phones can create an inexpensive way of delivering financial services to the unbanked without incurring high operational costs (Munyegera and Matsumoto 2016; Blumenstock et al. 2015).

The first mobile money service in Ethiopia was introduced in 2013 by M-BIRR. Since the introduction of MM the number of service providers is growing. However, the number of subscribers is very limited. By the end of 2017, mobile money reached less than 5% (2 million) of mobile subscribers (Demirguc-Kunt et al. 2018). Like other countries, mobile money allows users to make financial transactions using their mobile phone. Transactions are facilitated by mobile money agents and micro-finance institutions that convert customers' cash deposits into e-float on their mobile SIM card based account. The e-float can be used in various ways: transfer to another person,

pay for goods and services and withdraw at any mobile money agent. Despite this remarkable potential of MM to boost financial inclusion and augment the livelihood of poor house- holds in the country, it has been used, to date, mainly for money transfers (sending and receiving remittances or public social benefits), with very limited use for payments for goods or services (Demirguc-Kunt et al. 2018).

2.2. Utility bill payment system in Ethiopia

Households in Ethiopia are required to visit the various utilities' offices separately to pay their monthly bills. In 2013, a unified utility payment system (implemented through a public-private partnership) was introduced. The partnership arrangement created a unified billing system, 'Lehulu' (meaning 'for everyone' and 'for all services'), that replaced the independent utility payment centers for Ethiopian Electric Utility (EEU), Ethio Telecom and Addis Ababa Water and Sewerage Authority (AAWSA). The single window service allows customers to pay all their utility bills in one place, thereby reducing travel costs (Mesfin and Abera 2016).

Although 'Lehulu' was a unified utility payment system, customers still have to settle their utility payments in person, which often involves lengthy queuing. Due to this challenge, it is common for households to pay a 'bill messenger' to make their utility payments at the relevant utility office or 'Lehulu' center in exchange for around 10 Birr (0.3 USD) per transaction. The one-stop service was also only available in three cities of the country, namely: Addis Ababa, Bahir Dar, and Mekelle; it covered only a relatively small proportion of the country's population. The unified payment system came to an end in 2020 and recently the Commercial Bank of Ethiopia, a state-owned and the largest commercial bank in Ethiopia, started collecting utility bills in Addis Ababa at the branches through the tellers and via its mobile banking application, CBE Birr.[5]

3. Survey design and data description

3.1. Survey design

We surveyed 393 households (197 mobile money users and 196 non-users) in three cities (Addis Ababa, Hawassa, and Halaba) during May 2018. Due to budget constraints, we limited the number of cities surveyed to three cities. Yet, the cities' selection is based on the existing distribution of mobile money users, population size, and existing utility payment arrangements (Table 1). We intended to cover areas with sufficient mobile money users and different setups for utility bill payment systems. Addis Ababa, the capital city, is the largest city in Ethiopia. It has the most mobile money users and has one-stop payment centers for processing UBPs (Baza, Rao et al. 2017). Hawassa and Halaba are regional cities and small commercial towns in the south of the country, respectively. In both Hawassa and Halaba, utility users have to travel to each utility provider (electricity, communication, and water) to make their utility bill payments; this represents existing arrangements for UBPs in most parts of the country.

Following the existing literature, we use stratified random sampling to select households.[6] We stratify the households in each district into households with a mobile money account with the major MM provider in the country and households without mobile money. In stratified sampling, the population is subdivided into different homogeneous

Table 1.: Sampled cities characteristics

	Addis Ababa	Hawassa	Halaba
Number of households[a]	655,118	60,133	48,940
Number of MM agents[b]	126	44	13
Utility bill payments	Lehulu-one stop bill center	Utility center	Utility center
Remark	Capital city	Regional city	Small town

[a] Based on the latest available Ethiopia population and housing census 2007, Accessed from https://www.statsethiopia.gov.et/census-2007-2/

[b] Authors communication with MOSS ICT, April 2018.

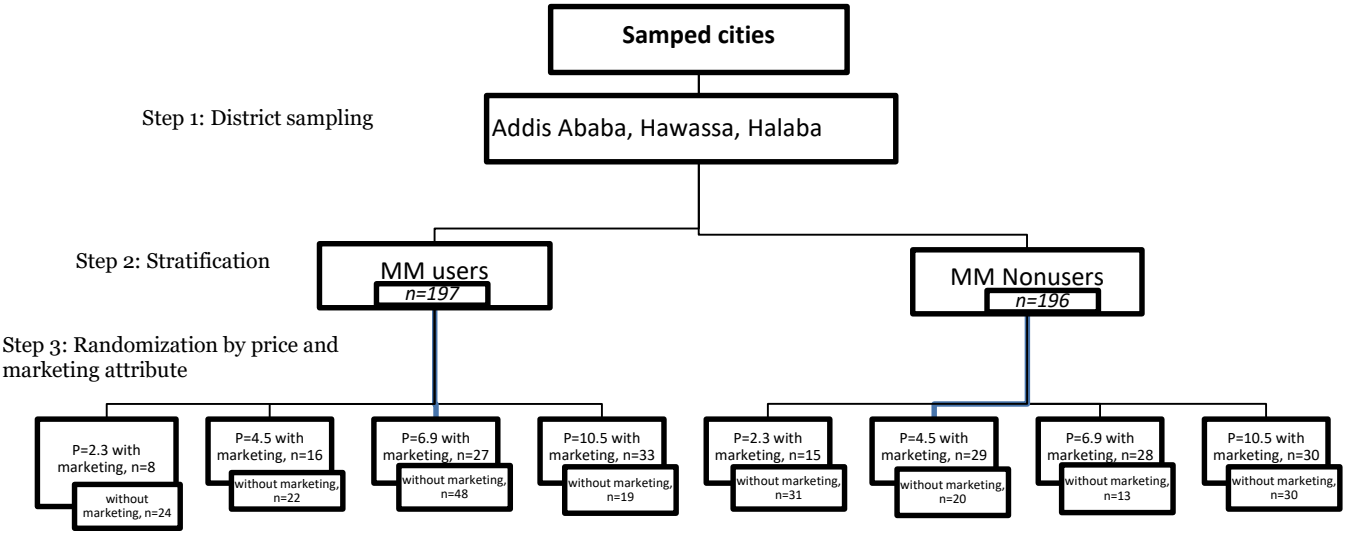
Step 2: Stratification

groups to properly represent the sample (Cochran 1977). Imbens (2011) also shows that stratifying the sample into different strata and randomizing within the strata improves the statistical power.

The sample frame for non-users is based on the list of households in the administrative records of each kebele, excluding households on the MM provider customer lists.[7] The administrative data does not include information on whether the household has a MM account or not, so a simple random sampling would reduce the likelihood of drawing households with MM accounts in our survey.

Using power calculation for detecting small mean WTP difference between the two groups (MM users and non-users) and detecting a minimum detectable effect of 0.1 of the marketing message on the proportion of take up decision for using MM in UBP with 80% power and 2-sided 5% level of significance, the number of households required was 352.[8] We set our sample size at 400 households to account for possible missing households and non-responses. Figure 1 demonstrate the distribution of the surveyed respondents by MM use, price categories, marketing attribute, and cities.[9]

Figure 1.: Sample distribution by price, marketing attribute and city



Once the household sample was set, and households were assigned into one of the groups (mobile money users and non-users), we administered face-to-face interviews. The survey's primary respondents were the head of the household or an adult member of the household. Our survey's interviews began with a short socioeconomic questionnaire that collects information on household composition; socio and economic characteristics of household head and household members; details of utility bill payments; financial access and use; awareness and use of mobile money; financial literacy and trust. [10] To elicit the willingness-to-pay to use mobile money for UBPs, the survey had an independent WTP module. We explained how customers could use MM for UBPs and asked if households would be willing to take the mobile money service for a certain random price. We randomly assigned households into one of the four different price categories (2.3, 4.5, 6.9, and 10.5 Birr for each utility bill per month). Our reference price was Birr 4.5, which was the market price for processing payments for goods and services during data collection.[11]

3.2. Descriptive statistics

Table 2 summarizes the respondents' characteristics in the sample by mobile money use status. Mobile money users tend to be younger than non-users (average age of 36, compared to 40 or non-users). About 27% of non-user households and 19% of user households are female-headed. This is in line with the country's urban population's demographic structure; nearly 30% of households in urban Ethiopia are female-headed (CSA and World Bank 2017).

Using Mobile money to make a payment requires basic literacy (e.g., reading and following the instructions and inputting the numbers). In our sample, mobile money users are indeed more educated than non-users. About 44% of mobile money users have a degree or above, compared to 20% of non-users. Mobile money users live in smaller households than non-users and enjoy a higher standard of living across most of the eight indicators of the Poverty Probability Index (PPI) Scorecard. On average, about 15% of users and 21% of non-users live below the national poverty line, based on the PPI, indicating that the early adopters of mobile money are relatively wealthier.[12]

Most of the households in our sample have both electricity (63%) and water (62%) meters and pay their bills monthly. 17% of the households reported having a fixed telephone line, the same proportion for both users and non-users. About 70% of non-users' own electricity and water meters, in contrast to 56% and 54% of MM users, respectively. Most of the sampled households report paying their bills monthly (electricity bill: 89%; water bill: 91%; and telephone bill: 95%), with monthly payments slightly more common among non-users.

On average, households travel 23 minutes every month to pay for utilities. The average travel time to the bill payment center is 26 minutes for electricity, 24 minutes for water, and 18 minutes for telephones. The difference in travel times for users and non-users is statistically significant: users reported relatively shorter traveling times than non-users. However, there is no significant difference between processing times at the 'Lehulu' centers and the utility branch offices: an average of 28 minutes and 29 minutes, respectively.

In most cases, household heads or their spouses are responsible for making utility bill payments. They spend, on average, nearly an hour (51 to 52 minutes) processing utility payments (traveling to the payment center and queuing to make the payments). Those

Table 2.: Sampled household's socioeconomic characteristics

	Non-users	Users[a]	Difference
Household characteristics			
Household head's Age	40.421	36.066	4.355***
Household head's Sex (Female=1)	0.272	0.193	0.079*
Household size	4.489	3.791	0.698**
Poor	20.683	14.941	5.742***
Education level			
Illiterate	0.056	0.056	0.001
Primary	0.112	0.061	0.051*
Secondary	0.49	0.244	0.246***
Diploma	0.143	0.203	-0.06
Degree and above	0.199	0.437	-0.238***
Access to Utility			
Electricity meter (1=yes)	0.696	0.561	0.135***
Water meter (1=yes)	0.703	0.541	0.162***
Fixed telephone (1=yes)	0.177	0.167	0.01
Utility Bill Payment			
Pays electricity bill monthly (1=yes)	0.859	0.927	-0.068*
Pays water bill monthly (1=yes)	0.876	0.943	-0.067*
Pays fixed telephone bill monthly (1=yes)	1	0.903	0.097*
Utility Payment Processing Time			
Processing time at 'Lehulu' center	30.232	25.468	4.764
Processing time at utility branch office (in minutes)	31.145	26.188	4.957
Travel time (in minutes)			
From home to the electricity payment center	30.175	22.272	7.902***
From home to the water payment center	27.18	20.819	6.361**
From home to the fixed telephone payment center	17.73	18.829	-1.1
Access to Financial Products			
Bank account (1=yes)	0.821	0.964	-0.143***
ATM card (1=yes)	0.428	0.648	-0.220***
MFI account (1=yes)	0.135	0.513	-0.378***
Member of 'Iddir' (1=yes)	0.653	0.503	0.151***
Member of 'Equb' (1=yes)	0.508	0.604	-0.096*
Financial Literacy and Trust			
Financial literacy score (Maximum score=4)	2.495	2.873	-0.378***
Trust mobile money (1= yes)	0.76	0.883	-0.123***
Mobile Phone Ownership			
Respondent owns mobile phone (1=yes)	0.974	0.995	-0.020*
Any household member owns mobile phone (1=yes)	0.856	0.827	0.029
Mobile phone usage			
Making calls (1=yes)	0.979	1.000	-0.021**
Sending texts (1=yes)	0.781	0.979	-0.199***
Receiving texts (1=yes)	0.989	1.000	-0.011
Internet browsing/Facebook use (1=yes)	0.482	0.827	-0.346***
Listening to FM radio (1=yes)	0.628	0.772	-0.143***
Transferring money or making payments (1=yes)	0.136	0.746	-0.610***
Observations	197	196	393

[a] Households with at least one registered mobile money user.

*Significant at the 10% level, **Significant at the 5% level, ***Significant at the 1% level

in Hawassa and Halaba have to process payments at each utility center, which requires triple the effort. If valued at the average unskilled labor wage, the time spent paying utility bills every month represents twice the current cost of mobile money services fee (4.5 Birr per transaction) for processing payments for goods and services.[13]

About 99% of the sampled households own a mobile phone, which indicates an enormous opportunity for mobile money adoption in the country. 87% of the sampled households have at least two members with mobile phones. Most of the households with a mobile phone (88%) report having used a mobile phone for more than 5 years. Households use their phones for making or receiving calls (100%), sending (88%) or receiving texts (100%), internet browsing or Facebook use (66%), listening to FM radio (70%), and transferring money or making payments, 44.6%. 89% of households have a bank account, nearly 54% of households have an ATM card, 33% have accounts with an MFI; and 58% and 56% are members of 'iddir' and 'equb', respectively.[14] Although access to financial services is somewhat lower for non- users on all indicators, it is above national averages. This is partly due to our sample's nature, which is based on urban area and 50% of the sample is drawn from client list of the major mobile money provider who closely works with microfinance institutions. A large proportion of the sampled households (82%) are aware of mobile banking services in their city. Again, the rate of awareness in the sample exceeds the national rates, as a whole, and even for non-users. 63% of non-users are aware of mobile money, whereas the national level of awareness of mobile banking is about 15% (CSA and World Bank 2017). This is also a reflection of our urban sample, drawn in areas where mobile money providers are already active.[15] Mobile money is dominantly used for transferring money, receiving money, and purchasing airtime. The reasons for not using mobile money are a lack of awareness or knowledge of the service (68%), lack of information on the availability of services in their city (6%) and other reasons (26%) such as not having a mobile phone, lack of trust or not considering mobile money as an important financial product.

Using mobile money requires an element of trust. For this study's purpose, we asked respondents whether they would trust mobile money for making the transfer–on a scale of 1 to 5 (distrust a lot, distrust, not sure, trust and trust a lot). Trust in the use of mobile money is high, with 88% of users and 76% of non-users reporting that they would trust mobile banking to transfer remittances. Both groups are more likely to trust mobile money than a stranger or their relatives. Similarly, trust in banks is almost universal in both groups.

Financial literacy was assessed using 4 short questions. The revealed level of financial literacy is high, with respondents correctly answering 2.68 questions on average. Financial literacy was higher among mobile money users than non-users. The figures are roughly in line with national data; financial knowledge ranges between 18% to 42% in smaller towns, while it ranges between 26% and 64% in lagers cities (CSA and World Bank 2017). The descriptive statistics reveals differences in characteristics of MM users and non-users and this supports the use of stratified random sampling that allows us to obtain a sample that best represents the potential population to use MM in utility payment in the country.

4. Theoretical framework and empirical model

4.1. Theoretical framework

We use a random utility model (RUM) due to (McFadden 1974) to explain household's decision to choose among the alternative utility bill payment options. In this model, a household *i* is assumed to choose among the available *j* alternatives and opts for the alternative with highest utility (McFadden 1974; Louviere, Hensher, and Swait 2000). The RUM assumes that household's utility for a payment system, *j*, depends on observable (v) and unobservable (ϵ) components as given in equation 1 below:

$$u_{ij} = v_{ij} + \varepsilon_{ij} \quad (1)$$

The observable component of the utility depends on a vector of specific attributes of the payment system (price and non-price factors) and the socio-economic characteristics of the household that affect choice of payment system, while the unobserved component is assumed to be independently identically distributed unobservable factors. A household chooses payment system 1 over alternative 0, if the utility derived from payment system 1, u_{i1} is greater than the utility derived from 0, u_{i0} (i.e., $u_{i1} > u_{i0}$).

In our case, we provide households with two options: A MM based utility payments or the status quo (cash based payment at the utility bill collection center), since our objective is to understand household preference for MM in utility payments.[16] More specifically, we are interested in the WTP of households for a new product (not yet available in the market, $j = 1$). We present the respondents with two options:

Option 1: whether the household is willing to use the new product ($j = 1$), with a reduction in her income by the amount of the bid price, *B*; or

Option 2: remain with the status quo ($j = 0$), without using the new product and no reduction in her income.

Using the RUM framework as in Hanemann (1984), the utility function for household *i* in the state *j* of the change to be valued (from $j = 0$, the *status quo* and $j = 1$, the final state with the new commodity) can be given as follows.

$$u_{ij} = v_{ij}(m, y, X) + \varepsilon_{ij} \quad (2)$$

where $u_{ij}(.)$ is a function of the new commodity to be valued, *m*, household income, *y*, and household characteristics, *X*, suppressing the prices and quantities of other commodities. $v_{ij}(.)$ is the deterministic part, while ε_{ij} is the random component with mean zero. According to utility maximization, the household prefers the new commodity (or responds '*yes*' if her utility with the new commodity that costs, the bid price (*B*), is at least the same as her utility with the *status quo* (without the new commodity).

$$u_{i1}(m, y - B, X, \varepsilon) \geq u_{i0}(y, X, \varepsilon) \quad (3)$$

Formally, the probability that the household responds '*yes*' is:

$$Pr(yes) = Pr(u_{i1}(m, y - B, X, \varepsilon_{i1}) \geq u_{i0}(y, X, \varepsilon_{i0})) \quad (4a)$$

$$Pr(yes) = Pr(v_{i1}(m, y-B, X) + \varepsilon_{i1} \geq v_{i0}(m, y, X) + \varepsilon_{i0}) \quad (4b)$$

$$Pr(yes) = Pr(\Delta v + \varepsilon \geq 0) \equiv F_{\varepsilon}(\Delta v) \quad (4c)$$

We define the WTP, as the bid price (B) that turns the inequality in Equation 3 into equality as below:

$$u_{i1}(m, y - WTP, X, \varepsilon) = u_{i0}(y, X, \varepsilon) \quad (5)$$

$WTP = w(m, X, \varepsilon)$ is the maximum WTP that shifts household from the *status quo* into using the new commodity, m. In a RUM framework, the WTP is also a random variable, since the researcher does not know it and treats it as a random variable even if the individual knows his WTP with certainty.

Alternatively, given our contingent valuation question, '*would you be WTP x the bid price* (B)*, for the new commodity*' the individual consumer answers '*yes*' if the bid price (B) is less than his WTP ($WTP \geq B$) and '*no*' otherwise. So, the probability of '*yes*' could be written as in Equation 6:

$$Pr(yes) = Pr(WTP = w(m, X, \varepsilon) \geq B) \quad (6)$$

Let $F_w(.)$ is the cumulative density function (CDF) of WTP and $f_w(.)$ is the corresponding probability density function (pdf). So, the probability of '*yes*' is given:

$$Pr(yes) = 1 - F_w(B) \quad (7)$$

Let the expected value of WTP is, $E(WTP) = \mu$; the variance of WTP, ar$(WTP) = \sigma^2$ and $F_w(.)$ a CDF of standardized variate $\omega = \frac{WTP-\mu}{\sigma}$; then the robability of 'yes' can be written as:

$$\Pr(\text{ yes }) = 1 - F_w(B) = 1 - F_w\left(\frac{B-\mu}{\sigma}\right) \quad (8)$$

Following Cameron (1988), we directly specify a particular CDF for the individual random WTP. Specifically, we assume a standard normal CDF (Φ), Equation 8 is a probit model, where $\alpha = \frac{\mu}{\sigma}$ and $\beta = \frac{1}{\sigma'}$, rewritten as in Equation 9 :

$$\Pr(\text{ yes }) = \Phi\left(\frac{\mu-B}{\sigma}\right) = \Phi(\alpha - \beta B) \quad (9)$$

From the above probit model, we can estimate the expected value of WTP as in Equation 10 using coefficients from the probit regression:

$$E(WTP) = \frac{\alpha}{\beta} \quad (10)$$

4.2. Empirical model

One of the objectives of this study is to estimate the mean WTP for the mobile money in utility payments that is to be introduced in the market. As discussed in Section 4.1, the probability that the respondents answer 'yes ′ to the single bounded hypothetical preference questions, stating her willingness to accept the offer at the bid price, B, can be approximated by a probit model given in Equation 11. Using the take-up of mobile money for UBP by household i, WTP_i, and the randomly assigned prices, B_i, we estimate the following probit model and compute the mean WTP as shown in Equation 10.:

$$\Pr(WTP_i = 1) = \Phi\left(\frac{\mu - B}{\sigma}\right) = \Phi(\alpha - \beta B) \tag{11}$$

Another objective of this study is to examine factors that affect households' takeup of MM for utility payment. To this end, we also estimate a probit equation 12 where the dependent variable ($MMUBP_i$) is a binary variable that takes 1 if the household is willing to take up the offer to use MM for UBP and zero otherwise. B_i is the proposed monthly fee (the bid price) per transaction and X_i is the vector of household characteristics (age, gender, education, poverty status, mobile use, financial literacy, trust), additional attribute of the new service (the option to request an e-receipt for current and past utility bills) and location indicators. α is the constant, β is the coefficient for the bid price, and γ is the vector of the coefficients for X_i.

$$\Pr(MMUBP_i = 1) = \Phi(\alpha - \beta B + \gamma X) \tag{12}$$

5. Results

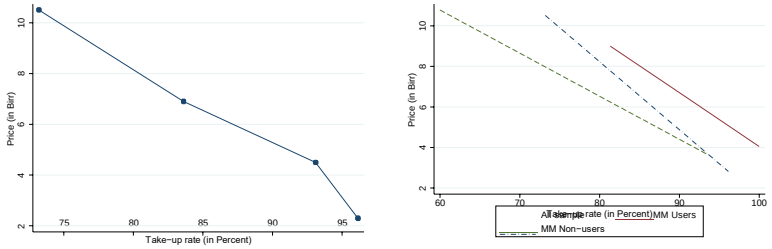
5.1. Potential demand for MM services

We use the results of our survey question, "would you be willing to pay Birr x, to pay your utility using mobile money?", to infer the potential demand for mobile money for utility payment. Figure 2 Panel (a) shows the relationship between price and quantity (proportion of households that are willing to use the service at different prices) for the whole sample. We note about 96.5% of the respondents are willing to use MM at the lowest price, Birr 2.3 per month, while 93.1% are willing to using the service at our reference price (Birr 4.5), the price that mobile money providers charge for processing payments for goods and services. Increasing the price three times, to Birr 6.9, leads to a decline in willingness to pay to 83.6%. Similarly, increasing the price to Birr 10.5 reduces the WTP to 73.2%. Overall, results suggest a negative relationship between price and uptake of MM for UBP.

Figure 2 Panel (b) estimates potential demand for mobile money users and non-users separately. As expected, mobile users have relatively higher demand at each price point than non-users, suggesting users' knowledge and trust in mobile money compared to their non-user peers.

Looking at the demand by city (region), the demand is relatively higher in town (Hawassa), followed by Addis Ababa and Halaba (Figure 3 Panel (a)). This reflects the utility payment options that are available for households in different cities in our

Figure 2.: Potential take-up rate at different prices

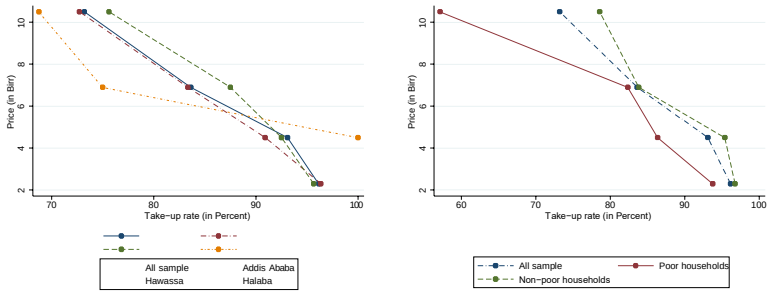


(a) Demand, all sample (b) Demand by user status

sample. In the capital city, Addis Ababa, households can use one-stop payment centers or a 'bill messenger' to settle all their bills, while in Hawassa and Halaba, customers have to go to each of the different utility companies to make the monthly payments which involve lengthy queuing.

Figure 3 Panel (b) estimates the demand by households' poverty status. We note a higher demand among non-poor households compared to their poor peers. Part of the reason for low take-up among the poor might be the product's high price, the reference price (Birr 4.5; is equivalent to 0.09% of urban households' average monthly consumption expenditure.[17] This finding is also in line with the existing empirical evidence on the low adoption rate of innovative financial products such as Weather Index Insurance among poor households in developing countries (e.g., Karlan et al. 2014 and Awel and Azomahou 2015).

Figure 3.: Potential take-up rate at different prices



(a) Demand by location (b) Demand by poverty status

The results reveal two interesting findings for MM providers. First, there is significant potential demand for using mobile money for other payments such as UBPs across metropolitan, regional and small cities. Second, the potential demand is sensitive to price. For instance, if we set the price of using MM for UBPs at 4.5 Birr — the cur- rent market price for paying for goods or services using mobile money — the potential take-up rate will be 93.1%. Providing a 50% subsidy (reducing the price from 4.5 to 2.3 Birr) would only slightly raise the take-up (to 96.5%). A 50% increase in the current market price (raising the price from 4.5 to 6.9 Birr) or a 133% increase (raising the price from 4.5 to 10.5 Birr) would significantly reduce the potential takeup. However, most consumers would still take up the service: 83.6% and 73.2% at 6.9 and 10.5 Birr, respectively.

5.2. Estimating WTP for MM

Table 3, Columns 1-3 provide the baseline regression results from a probit regression model. As we noted previously, price negatively and significantly affects WTP (column 1). There is also no significant effect of including additional marketing features such as monthly reminders and receipt (column 2). Neither the sign nor the significance of the price's coefficient is affected by controlling location (column 3). In column 4, we include the dummy variable 'MM user' and control for strata fixed effect and our results remains unchanged.

Since our interest is to estimate the average WTP for MM for UBPs in the whole sample, we rely on the baseline regression (Table 3 column 2) where we only account for the price and marketing feature of the new product, MM for UBPs.[18] The estimated mean WTP is Birr 15 per transaction, using Eq 10 ($WTP = \frac{a}{\beta}$) and estimates in Table 3 column 2. The mean WTP is more than twice the actual market price charged by mobile money service providers for processing payments for goods and services in the country.[19] To check the difference in demand among MM users and non-users, we estimated the mean WTP for mobile money users and non-users using results in Table 3, column 4. The average WTP among users is significantly higher (Birr 15.8) than among non-users (Birr 12.5).

The high estimated average WTP highlights the potential of product diversification to improve the uptake of MM. While we are aware that the estimated WTP (based on stated preference) could differ from revealed preference or actual market behavior due to possible hypothetical bias, Cameron et al. (2002) show that predictions from hypothetical stated preference are comparable to actual market behavior. Furthermore, we have attempted to minimize the bias by providing a dichotomous choice of a carefully set range of prices considering different regions that allow us to assess the potential demand.

5.3. Correlates of MM Takeup

Table 4 presents the determinants of households take up of MM for UBP. In column 1, we account for the transaction fee, marketing features (receiving reminder and electronic receipt), household head's age and sex, and the household's highest educational level. Price and education significantly affect the take up of the MM for UBPs. In column 2, we further account for the household's poverty status, and results remain unchanged. In column 3, we include additional regressors on the respondent's experience using mobile phones, financial literacy level, and trust in the MM provider. Except for the trust in the MM, the additional covariates are not significant. In columns 4 and 5, we include location and MM use dummies, respectively, and find no significant effects on the take up of MM for UBP.

After accounting strata fixed effects, including a dummy variable that takes a value of 1 for MM users and zero otherwise, results in Column 5 reveal that transaction fee (the MM services price) has a negative and significant effect on the MM service's take up. An increase in price by one Birr leads to a 16.2 percentage points decline in the probability of adopting the MM for UBP. This indicates the sensitivity of households to MM service fees to adapt to the new payment system. Education of the household head has a positive and significant impact on the decision to take up MM; households with degree and diploma level of education are 76 and 73 percentage points more likely to use MM for UBP. This could partly capture the literacy effect of educated household heads who could be more able to operate mobile handsets. Alternatively, it

Table 3.: Willingness to pay model: Probit estimates

	(1)	(2)	(3)	(4)
Price (transaction fee)	-0.138***	-0.138***	-0.137***	-0.143***
	(-4.84)	(-4.80)	(-4.75)	(-4.88)
Marketing		0.007	0.010	0.050
		(0.04)	(0.06)	(0.30)
Halaba[a]			-0.063	-0.044
			(-0.26)	(-0.18)
Hawassa			0.101	0.148
			(0.57)	(0.81)
MM user				0.474***
				(2.82)
Constant	2.029***	2.027***	1.994***	1.778***
	(8.88)	(8.67)	(8.18)	(7.03)
Pseudo R-square	0.077	0.077	0.079	0.104
LR chi2	25.45***	25.45***	25.97***	34.12***
Observations	393	393	393	393

Outcome variable: Willing to pay for utility payment

[a] The Capital City, Addis Ababa, is the reference.

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

could capture the high opportunity cost of the educated household heads that would prefer the MM for UBP compared to the status quo payment system that requires traveling to the utility bill centers and queuing to process payments. The latter claim is more likely in our case since experience in using a mobile phone and financial literacy that could account for the household's literacy effects are insignificant.

Similarly, trust in the MM provider increases the take up of the MM for UBP by 54 percentage points. This could capture the security and timeliness of transferring money, which is relatively more secure and delivered timely by the MM provider since it is an automated payment system from the household's MM account to the utility provider MM account. The remaining regressors in column 5, namely marketing features, household head's age, sex, household's poverty status, mobile money use, mobile phone use, and household location, are all insignificant.

Disaggregating the data between MM users and potential clients (non-users) brings additional insights. Both groups are sensitive to price, and more educated household heads are consistently more likely to take up the service. However, it is only among non-users that gender of the household head, poverty status, trust in mobile money, and location significantly affect the take up (Table 5). Among non-users, those residing in Hawassa and Halaba are more likely to take up MM than those in the capital city, Addis Ababa, reflecting the lack of utility payment options in the regional cities.

Overall, estimates support the notion that reducing transaction costs is one of the key drivers in MM services' adoption. Besides, mobile money providers that established reputable experience with the customers are instrumental in facilitating the take up of MM for UBP. However, it is plausible to assume that households' unobservable characteristics may affect decision to adopt MM for UBP and hence our estimates. For robustness check, we consider Probit model with sample selection. Appendix B

Table 4.: Correlates of MM for UBP Take up: Probit estimates

	(1)	(2)	(3)	(4)	(5)
Price	-0.154***	-0.154***	-0.158***	-0.162***	-0.162***
	(-5.02)	(-5.01)	(-4.80)	(-4.83)	(-4.83)
Marketing	-0.006	-0.021	0.012	0.021	0.026
	(-0.03)	(-0.12)	(-0.07)	(-0.11)	(-0.14)
Household head characteristics					
Age	-0.001	0.001	0.005	0.007	0.007
	(-0.15)	(-0.07)	(-0.63)	(-0.94)	(-0.94)
Female	-0.282	-0.28	-0.316	-0.253	-0.244
	(-1.42)	(-1.40)	(-1.54)	(-1.17)	(-1.12)
Highest educational attainment[a]					
Illiterate	0.024	0.05	0.136	0.118	0.095
	(-0.07)	(-0.14)	(-0.35)	(-0.3)	(-0.24)
Primary	-0.078	-0.054	-0.105	-0.118	-0.128
	(-0.27)	(-0.18)	(-0.34)	(-0.39)	(-0.42)
Diploma	0.868***	0.843***	0.769**	0.747**	0.734**
	(-2.98)	(-2.88)	(-2.55)	(-2.48)	(-2.42)
Degree	0.863***	0.839***	0.789***	0.781***	0.767***
	(-3.86)	(-3.71)	(-3.28)	(-3.17)	(-3.07)
Poor		-0.005	-0.006	-0.008	-0.008
		(-0.72)	(-0.90)	(-1.19)	(-1.14)
Mobile use:					
Text			0.215	0.266	0.255
			(-0.75)	(-0.91)	(-0.86)
Internet			-0.024	0.016	-0.005
			(-0.11)	(-0.07)	(-0.02)
Financial literacy			0.07	0.084	0.079
			(-0.61)	(-0.72)	(-0.68)
Trust MM			0.560***	0.549**	0.541**
			(-2.63)	(-2.55)	(-2.51)
City[b]					
Halaba				0.16	0.154
				(-0.53)	(-0.51)
Hawassa				0.301	0.304
				(-1.38)	(-1.39)
User[c]					0.076
					(-0.37)
Intercept	1.922***	1.963***	1.097**	0.838	0.839
	(-5.45)	(-5.47)	(-2.17)	(-1.53)	(-1.53)
Pseudo R-square	0.165	0.166	0.199	0.205	0.206
LR chi^2	54.19***	54.70***	63.34***	65.28***	65.42***
N	391	391	381	381	381

Outcome variable: Take-up of MM for utility payment

[a] Household head with secondary education is the reference.

[b] The Capital City, Addis Ababa, is the reference.

[c] Households with at least one registered mobile money customer.

Table 5.: Correlates of MM for UBP Take up: Disaggregated estimates by mobile money use status

	MM users	MM non-users
Price	-0.129**	-0.223***
	(-2.14)	(-4.62)
Marketing	-0.058	-0.081
	(-0.19)	(-0.32)
Household head characteristics		
Age of the household head	-0.003	0.016
	(-0.29)	-1.4
Female household head	0.237	-0.497*
	-0.61	(-1.75)
Highest educational attainment[a]		
Illiterate	0.345	-0.242
	-0.57	(-0.39)
Primary education	0.241	-0.367
	-0.43	(-0.92)
Diploma	1.036**	0.322
	-2.03	-0.79
Degree and above	0.910**	0.840**
	-2.33	-2.09
Poor	0.003	-0.021**
	-0.26	(-2.05)
Mobile use:		
Text	1.549**	-0.033
	-2.01	(-0.09)
Internet	-0.468	0.314
	(-0.93)	-1.03
Financial literacy	-0.14	0.209
	(-0.70)	-1.25
Trust in MM	0.317	0.754***
	-0.75	-2.66
City[b]		
Halaba	-0.083	0.778
	(-0.18)	-1.63
Hawassa	0.42	0.548*
	-1.16	-1.74
Intercept	0.665	0.88
	(0.61)	(1.21)
Pseudo R-square	0.202	0.277
LR chi2	26.01**	50.63***
N	195	186

Outcome variable: Take-up of MM for utility payment

t statistics in parentheses, * p < 0.10, ** p <0.05, *** p <0.01

[a] Household head with secondary education is the reference.

[b] The Capital City, Addis Ababa, is the reference.

present the estimates. The findings and overall conclusions are consistent with the previous results we report in Table 4 and Table 5.

5.4. Exante impact estimates of MM on household welfare

In this section, we highlight the costs and benefits of MM services for UBPs, comparing the costs of providing the service with its benefits based on the elicited WTP estimates. We narrowly define household welfare as the net benefits to the household from using MM for UBPs, which is measured using a consumer surplus (CS) approach. CS is the difference between what consumers are willing to pay and what they actually pay for the transaction. If the introduction of MM for UBPs increases welfare (a positive CS), it can be considered welfare enhancing.

The consumer WTP is based on the stated average WTP estimates in section 5.2, which is 15 Birr per transaction. To approximate what consumers would actually pay per transaction, we use the current market price (Birr 4.5 per transaction) which represents the acceptable supply-side cost. The consumer surplus is therefore 10.5 Birr per transaction, which suggests a potential welfare enhancing effect of the MM use in utility payments. The average WTP shows how consumers, on average, value the new commodity; this represents the value of the benefits they expect to derive from the commodity. MM for UBPs is a hypothetical market commodity, as these services were not available during our data collection. However, the price of similar market commodities could be a good proxy for the cost of providing MM for UBPs.

6. Conclusion

Mobile money is widely promoted based on the premise that it increases efficiency, improves digital transactions' transparency, security/safety (avoiding carrying cash), and convenience of value-added features. Studies also documented positive effects of MM in terms of increased remittances, improved risk-sharing, and welfare (Jack and Suri 2014).

Previous studies investigated drivers of MM adoption in sending and receiving remittances (Jack and Suri 2014; Mbiti and Weil 2015), use as saving commitment device (Ky, Rugemintwari, and Sauviat 2018). In this study, we contribute to the literature focusing on the use of MM in payments by analyzing household preference for MM for utility payments. We use household survey data from MM users and non-users in three Ethiopian cities. We also examine the potential impact of using Mobile money for utility payments on household welfare.

The study presents evidence of the potential demand for using mobile money for utility bill payments in Ethiopia's urban areas. We estimate that households are willing to pay up to Birr 15 per month, on average, to use mobile money for utility payments. The estimated WTP is higher than the market price charged by mobile money providers to process payments for goods and services. The findings suggest a substantial latent demand for the MM for other payments. The positive difference between the average WTP and the market price also highlights the product's potential profitability to provide mobile money services for UBPs.

Adopting MM services is primarily influenced by the transaction fees (or price), trust about the MM provider, and household level of education. The negative effects of price and positive effects of education and trust highlight the importance of reducing transaction costs of the MM to improve its take up. The result also suggests that

expanding MM for UBPs requires a fine-tuned product that meets different customers' demands rather than a one-size-fits-all product; this is particularly important if one of MM's objectives is financial inclusion.

Comparing the average WTP estimate and the current cost (transaction fee of MM service), our findings suggest a welfare gain from using mobile money for UBPs. The enhanced consumer welfare is likely achieved by reducing transaction costs (reduced opportunity costs of travel to utility bill payment center, reduced risk of cash theft, among others). Our argument is also supported by other MM adoption drivers (price sensitivity, high level of education, and trust in the MM provider) that implicitly reveal the households' high opportunity cost in using the country's current utility payment system.

Our results have important policy implications. MM adoption could be improved by diversifying the MM services away from the existing use in private remittance and social transfer, given the substantial latent demand for MM in utility payment. MM services can play a positive role in improving household welfare by reducing transaction costs. The positive impact of MM service for UBP also suggests both MM service and utility providers should take steps to meet the potential demand and benefit from the opportunities.

We are aware of some limitations presented by our study. The sample we have at hand, from 3 cities in Ethiopia, makes it difficult to extrapolate our findings at a country level. Further studies should analyze the issue under more diverse conditions to understand the potential demand at a country level. We also caution that our WTP estimates are based on households' stated preference, which may be overestimated due to possible hypothetical bias. An interesting research avenue could be to look at the potential demand and effects of expanding MM for utility payments and other public revenue collection schemes in a randomized control trial addressing the issue of hypothetical offers.

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Notes

[1]MM is different from mobile banking, where customers access their bank accounts through their cell phones. Using MM, customers transact only through mobile network operators and are not required to have a bank account with a financial institution (Aker and Mbiti 2010).

[2]Ethiopia is home to over 60 million people aged 18 and above and had nearly 51 million mobile subscribers by 2016 (GSMA 2018).

[3]see section 2.2 for detail discussion in utility payment arrangements in Ethiopia.

[4]approximately about 0.55 USD at 1st June 2018 exchange rate of 27.346 Birr per US dollars [5]https://addisfortune.net/articles/cbe-to-take-over-electronic-utility-billing-from-kifiya/

[6]Often stratified sampling is used to draw a representative sample from a population with heterogeneous groups (see Arnab (2017) and Cochran (1977) for detail discussion.)

[7]Kebele is the lowest administrative unit in the country.

[8]Details of the sample size determination is provided in Appendix A.

[9]It is important to note that MM user sample represents the country's primary MM provider customers but not the country's total mobile money users. Regarding non-users, the sample provides a good representation of the non-users in each city. Overall, given the representative characteristics of the sampled cities and the existing utility payment arrangements, our results are likely to be replicated in other countries.

[10]The survey questionnaire was prepared in consultation with different stakeholders and was pilot tested.

[11]http://www.m-birr.com/pricing.html

[12]The PPI is based on Chreiner and Chen that uses the poverty line Birr 3,774 (229 USD) per year in 2010 price. Our poverty estimate closely mimic poverty estimates of the National Planning Commission for urban areas in Ethiopia, which stood at 14.8% in 2016 (CSA and World Bank. 2017).

[13]The minimum wage for unskilled labour in the public sector is around 420 Birr (USD 22) per month or around 3 Birr per hour (CSA and World Bank 2017).

[14]'Iddir' is a voluntary association, usually formed among friends, colleagues, and neighbors, to provide the resources for carrying out funeral rituals; while 'Equb' is a voluntary association that regularly pools fund and rotates them among members (Azomahou and Yitbarek 2015).

[15]Estimates show that 65.4%, 52.8%, and 27.1% of individuals aged 18 and above are familiar with mobile banking in Addis Ababa, large towns, and small towns, respectively (CSA and World Bank 2017).

[16]Previous research has extensively used various techniques that can be used to estimate WTP by eliciting consumer preferences for new products and services including public goods (Jedidi and Zhang 2002). Widely applied methodologies for measuring hypothetical WTP include contingent valuation (CV) (e.g., Mitchell, Carson, and Carson 1989) and conjoint analysis (e.g.,Kohli and Mahajan 1991). CV is designed to obtain value estimates of WTP in the absence of a market (for instance for public goods) or before the introduction of a product into the market, either by asking consumers to directly state the maximum price they are willing to pay for a given product or to decide whether they would buy a product at a specific price (Kalish and Nelson 1991; Wertenbroch and Skiera 2002). We use the CV approach to study households' preference for mobile money payment for UBPs in Ethiopia. Our choice of method is based on its practicality and simplicity in the context of our study. The simplicity of the method – it demands less knowledge from the respondent than other methods such as conjoint analysis and discrete choice experiments – makes CV our preferred hypothetical method, particularly given the relatively low educational level of many of the respondents.

[17]The average monthly consumption expenditure was Birr 4,986 in 2016 (CSA and World Bank 2017).

[18]However, if one is interested in estimating the average WTP for a particular group (for instance, poor or female-headed households only), then the estimation of WTP should rely on the extended regression provided in Table 4.

[19]The WTP, Birr 15, is equivalent to 0.3% of urban households' average monthly consumption expenditure (Birr 4,986), based on the 2015/16 Household Consumption Expenditure Survey (CSA and World Bank 2017).

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Appendix A. Sample size determination

Since our survey is concerned with several outcome indicators (four indicators), first, we separately made sample size determination for the key indicators to achieve our research objective. Second, we selected the largest sample size which is closer to the sample size estimated for three of the four indicators and it falls within our budget limit.

i) Sample size for mean WTP: Suppose the current mean WTP (mWTP) for good arrangement in UBP is 1 Birr (The assumption is based on anecdotal evidence of the fee for the one-stop utility payment). In view of its benefit, introduction of the MM in UBP could increase the mWTP into 2.3 Birr with standard deviation of 6.9. In order to detect the change in mWTP from 1 to 2.3 Birr with power of 80% at 5% level of significance, we need a sample size of 224.

ii) Sample size for two sample means WTP: The sample size required for detecting the difference in mWTP for the two strata (mWTP of MM users=2.3 Birr and mWTP of MM non-users=2) is 352, with power of 80% at 5% level of significance assuming equal standard deviation between the two groups.

iii) Sample size for two proportions: In order to assess the proportion of take-ups of MM in UBP, we assume the proportion of take-up by non-users is less than 0.5, given no experience with MM; while the existing users are more likely to take-up more than 0.5. To detect a 0.15 difference in take-up between the two groups, we need a total sample size of at most 340.

iv) Sample size required for detecting 0.1 MDE of the marketing message on WTP: The required sample size to detect a 0.1 minimum detectable effect of the marketing message on the proportion of take-up decision for using MM in UBP with 80% power and 2-sided 5% level of significance is 302 equally split between those that receive the marketing message and the comparison group. Based on 3ie-sample size minimum detectable effect excel calculator (See Sheet 7.1.3, Table 3.1) discussed in Djimeu and Houndolo (2016).

Appendix B. Correlates of MMUBP Take-up: Probit model with sample selection estimates

In our survey, we elicited information on the takeup of MM for utility payment from both MM users and non-users. For both groups, we elicit their preference to takeup MM for utility payment. However, let us assume that the takeup decision of MM for utility payment is observed only if the household is a MM user. Further, assume that the reason for not using the MM is related to the unobserved factors that affect the takeup decision of MM for utility payment. This is a case of endogenous sample selection and a probit estimate that ignores the endogenous sample selection is not consistent.

This section estimates a probit model with sample selection. We model the outcome equation, whether the household takeup the MM for utility payment, as a function of household head's age, sex, education, financial literacy level, trust about the MM provider, and experience using a mobile phone. In the selection equation where the

outcome variable captures whether the household is an MM user or not, we include all the covariates from the outcome equation and add two exclusion (instruments) variables. The instrument variables we used are: the ownership of a bank account (*bankacct*) and microfinance account (*mfiacct*). Our argument for using these instrument variables is that households that own bank or MFI account are likely to use MM. However, there is no direct effect of owning either bank or MFI account on the household decision to takeup MM for utility payment.

The results in Table B1 are qualitatively similar to those estimates from the probit model in Table 4. Besides, the correlation between errors from the selection and errors from the outcome equation is positive but insignificant, failing to reject the hypothesis of no endogenous selection (ρ=0). The unobserved factors that increase likelihood of being in the sample (becoming MM user) do not correlate with the unobserved factors that reduce the takeup of MM for utility payment. The result suggests an ignorable sample selection and our probit estimates in Table 4 and Table 5 are consistent.

Table B1.: Correlates of Take-up: Probit model with selection

	Outcome equation: (Take-up of MM for UBP=1)	Selection equation: (MM user=1)
Household head characteristics		
Age	-0.002	-0.005
	(0.26)	(0.82)
Female	0.168	-0.345*
	(0.49)	(1.80)
Highest educational attainment[a]		
Illiterate	0.609	1.253***
	(1.14)	(3.65)
Primary	0.374	0.640**
	(0.75)	(2.21)
Diploma	1.118***	0.426*
	(2.82)	(1.87)
Degree above	1.027***	0.536***
	(3.36)	(2.77)
Poor	0.00	-0.016**
	(0.01)	(2.61)
Mobile use:		
Text	1.685***	0.736**
	(2.67)	(2.11)
Internet	-0.296	0.655***
	(0.64)	(3.43)
Financial literacy	-0.08	0.091
	(0.56)	(0.9)
Trust MM	0.404	0.303
	(1.12)	(1.49)
City[b]		
Halaba	0.052	0.266
	(0.14)	(1.05)
Hawassa	0.37	0.14
	(1.13)	(0.407)
Price (transaction fee)	-0.102**	
	(2.12)	
Marketing	-0.009	
	(0.03)	
Exclusion restrictions		
Bank account		-1.4
		(1.40)
MFI account		1.205***
		(7.03)
Constant	-0.473	-2.202***
	(-0.46)	(-3.93)
Log-likelihood	-235.56	-51.47
Wald statistics	31.87***	
Wald test of indep. equation ($\rho=0$): p-value	0.139	
Observations	381	