Impact of Mobile Money Adoption on Maternal Health Seeking Behavior: Evidence from Rural Uganda

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April. 2018[1]

ABSTRACT

This study reports an assessment of the impact of mobile money adoption on maternal health seeking behavior. An innovative person-to-person payment technology, mobile money is helping to rapidly expand access to financial services to the poor, thereby promoting financial inclusion in Sub-Saharan Africa. A growing body of literature examines whether adoption of mobile money contributes to rural poor households' welfare improvement. The existing literature, however has not shown whether mobile money is an effective tool to encourage the rural poor to receive health services. I hypothesized that adopting mobile money would motivate rural Ugandan women to receive regular antenatal care and delivery with a skilled birth attendant or at a health care facility. The potential channels are straightforward: by remittances or savings, rural poor households may obtain more cash in hands so women might change their health seeking behavior. By using data of household panel surveys (RePEAT data), standard regression analysis is conducted. This study obtained suggestive evidence of mobile money adoption effect on antenatal care seeking behavior. Meanwhile, the results have failed to reject the null hypothesis for the delivery-related outcome variables. This study suggests that promoting financial inclusion by mobile money motivates rural women to attend regular antenatal care.

Key Words: financial inclusion, mobile money, maternal care, health-seeking behavior

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[1] I first drafted this paper in August 2017 and gave a presentation at the 12th Annual Conference of Japan Health Economics Association in September 2017. This is the revised version which was presented in a seminar held by Professor Josh Angrist at the University of Tokyo in May 2018.

1. Introduction

In developing countries, a large proportion of the population lacks access to basic financial services because the financial infrastructure is not well developed. A process that ensures the ease of access, availability and usage of financial service such as transfer of money is called "financial inclusion" and the importance of promoting financial inclusion is widely recognized by those involved in addressing poverty (Mandira and Jesim 2011). Lack of access to basic financial services makes it difficult for the poor to improve their lives through having a savings, making investments and receiving remittances.

An innovative person-to-person payment technology, mobile money is helping to rapidly expand access to financial services to the poor, thereby promoting financial inclusion in Sub-Saharan Africa. Mobile money is a technology which enables users to send text messages to transfer value (remittance) through mobile phone and reduces the cost of sending money across long distances. A growing body of literature investigates the impact of mobile money on households and examines whether households become more successful in smoothing consumption in the face of shocks (Jack and Suri 2014; Munyegera and Matsumoto 2016); the existing literature has shown that mobile money adoption contributed to improvement in consumption smoothing through enhancing money transfers for risk sharing via informal networks. The previous studies also find that mobile money adoption contributed to increase of savings, educational investment and revenue from agricultural business among poor households (Munyegera and Matsumoto 2017; Sekabira and Qaim 2017; Tabetando 2017).

Meanwhile, mobile money has a potential to attract policy attention of those involved in addressing healthcare issues. Mobile money can alleviate financial resource constraint of households and thereby might make it easier to receive health services. High out-of-pocket health costs and transportation costs are a significant barrier to accessing health services in many

developing countries (Fafchamps and Lund 2003; Uganda Bureau of Statistics and ICF International Inc. 2012; De Weerdt and Dercon 2006). In a non-academic report prepared by the United States Agency for International Development (USAID), Sherri, Heymann, Riley, and Taddese (2013) states that households in Kenya use mobile money to save and pay for services and to receive remittances to cover high out-of-pocket health costs, albeit with neither quantitative nor empirical evidence.

The existing literature of financial inclusion has focused their attention on the effect of microfinance or other types of financial technologies on health-seeking behavior (Dupas 2011). Existing studies showed that supporting poor households to overcome liquidity constraint and motivate saving had been effective for encouraging them to seek health care (Dupas and Robinson 2013; Tarozzi et al. 2014).

However, previous studies have not shown whether rural household changed their health seeking behavior in response to having access to mobile money. That is, more specifically, the existing literature has not shown whether mobile money is an effective tool to encourage potential patients to visit health facilities and receive health services (by bringing more cash in their hands). This is important because one of the most pressing policy debates in health literature today is how we can motivate potential patients to visit health facilities. By using cash, or voucher, or goods, or credits as demand-side financing tools, the existing literature has studied how effective those can encourage potential patients to seek health care (Powell-Jackson and Hanson 2012; Schmidt et al. 2010).

Among health issues, maternal-child care has been a pressing issue in developing countries. Antenatal care is essential in preventing both maternal and infant mortality. The adult lifetime risk of maternal mortality in women from sub-Saharan Africa is the highest among women in

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developing countries. Uganda is included in the top ten countries that comprised 58% of the global maternal deaths reported in 2013. The maternal mortality ratio (maternal deaths per 100 000 live births) in Uganda (360) is 22 times higher than in developed regions (16), which is even higher than the average of developing regions (260) (WHO et al. 2014). A well-designed and well-implemented antenatal care program facilitates detection and treatment of problems such as anaemia or infection during pregnancy; it also provides an opportunity to disseminate health messages to women and their families. ANC from a trained provider at a high-quality health care facility is vital in monitoring the pregnancy and reducing the morbidity risk for the mother and child during pregnancy and delivery (Uganda Bureau of Statistics and ICF International Inc. 2012).

In addition to antenatal care, the benefit of delivering with a skilled birth attendant or at a health care facility versus homebirth have been clearly described in the literature (Halim, Bohara, and Ruan 2011). For example, proper medical attention and hygienic conditions during delivery can reduce the risk of complications and infections that may cause death or serious illness to either the mother or the baby (or both) (WHO et al. 2007). As Manang (2015) studied about Uganda, an increase of health facilities surrounding mothers' residential areas (supply-side change) can obviously improve health seeking behavior of mothers. The existing literature, however, has little to say about the impact of financial inclusion on maternal health seeking behavior.

In this paper, utilizing the RePEAT data of Uganda, this study attempts to fill the gaps. The study conducts standard regression analysis. Statistical inference is conducted in order to assess the mobile money adoption impact on maternal health seeking behavior. This study has chosen variables indicating regular antenatal care visit, facility delivery and delivery assisted by a skilled birth provider as outcome variables.

This study has found suggestive evidence of positive impact of mobile money adoption on antenatal care seeking behavior. The results from falsification tests also support the existence of such an effect. Meanwhile as for delivery-related variables, the study has failed to reject the null-hypothesis that mobile money adoption effect does not exist.

This study contributes to both financial inclusion literature and maternal health literature. The study has showed suggestive evidence that mobile money as a tool of financial inclusion positively affected women's maternal health seeking behavior. Maternal health literature has been searching for an effective tool to motivate women from poor households to receive a proper maternal care. Lack of money has been indicated as a critical problem. Adding to the existing tools such as cash incentives or vouchers, mobile money has indicated potential to become a new tool.

This paper proceeds as follows. Section 2 gives brief background on mobile money and maternal health service environment in Uganda. Section 3 presents key potential channels conveying impact of mobile money adoption to health seeking behavior. Section 4 presents study design and data. Section 5 presents identification strategy and empirical results including falsification tests. Section 6 gives conclusions.

2. Field context

2.1. Overview of mobile money

Mobile money is an innovative, cheap and convenient medium which extends financial services to the poor who have very limited access to formal financial institutions. At most basic level, mobile money is the provision of financial services, mainly remittances, through a mobile device. Mobile money enables users to send text messages to transfer value. Mobile money can be also used to buy goods and services electronically. Mobile money mechanism needs a cash-in, cash-out infrastructure, which consists of a network of "agents", who receive a small commission

for turning cash into electronic value (and vice versa). Mobile money agents are usually existing local businessmen selling airtime cards, who chose the mobile money business as a diversification of their range of services. Mobile Telephone Network, a major mobile money provider in Uganda, has over 30,000 agents, which is significantly larger than the number of commercial bank branches (around 900) (Munyegera and Matsumoto 2016).

Sub-Saharan African countries—including Kenya, where mobile money first became common—began seeing the entry of mobile money services in 2007 and 2008. Kenya has the highest proportion of adults with a mobile money account, at 58 percent, followed by Somalia, Tanzania, and Uganda with about 35 percent (Demirguc-Kunt et al. 2015). By the mid-2012, Uganda had over 17.6 million mobile money users all over the country (Munyegera and Matsumoto 2016). The high penetration rate tells that Uganda is appropriate for analyzing the effect of mobile money adoption on social welfare.

2.2.   *Overview of maternal health service in Uganda*

In line with the WHO guidelines, the Ministry of Health (MOH) of Uganda recommends that a woman have at least four ANC (antenatal care) visits, the first of which should be made in the first trimester. During these visits, health problems associated with a pregnancy can be detected. In the event of any complications, more frequent visits are advised, and admission to a higher quality health facility may be necessary. Forty-eight percent of women make four or more antenatal care visits during their pregnancy. The median duration of pregnancy for the first antenatal visit is 5.1 months. Those figures are basically consistent to our analysis data. The description table will be shown later (Table 1).

According to the clinical guideline of Uganda (Ministry of Health 2016), antenatal care requires the following three tasks at all visits: addressing identified problems, checking blood

pressure and measuring the symphysio-fundal height (SFH) and foetal heart activity. In addition to those, objective of antenatal care includes the following services as necessary: satisfying any unmet nutritional, social, emotional and physical needs of the pregnant woman, identification of high-risk pregnancy and referral as appropriate, assess of maternal well-being including ultrasound and vaginal (vulval) examination. Those whole package of services is called comprehensive antenatal care and only secured at high quality health facilities. In fact, according to the DHS report, in 2011 only 59 percent of mothers received blood pressure measurements, which is one of the required task of antenatal care (Uganda Bureau of Statistics and ICF International Inc. 2012). This implies that many mothers did not visit health facilities of recommended quality. Women in rural areas are less likely to use an institutional setting than women in urban areas so the population of this study (rural Uganda) might present even a smaller percentage (Uganda Bureau of Statistics and ICF International Inc. 2012).

DHS report 2011 reported that while 57 percent of deliveries in the five years preceding the survey took place at some health facilities, 42 percent of deliveries took place at home. Regarding delivery assistance, skilled providers assisted in the delivery of 57 percent of births, while traditional birth attendants, relatives, friends, or nobody assisted the rest. DHS report 2016 reported improvement of those figures. 73 percent of live births in the 5 years preceding the survey were delivered in some health facilities and almost the same proportion (74 percent) were delivered by a skilled provider.

Uganda government's guideline specifies the quality of health facilities and the target population size and geographic unit that is supposed to be served by each facility level (Ministry of Health 2004). According to the government report and Manang (2015), firstly a village is supposed to have a Health Center I (HCI), which is covers 1000 individuals. A HCI comprises of

a team of community health workers who provide community-based health care services. Secondly, a parish, which includes several villages, is supposed to have a Health Center II (HCII) covering 5000 individuals. The health facility of the lowest administration level with physical establishment is a HCII. This level of facility provides simple preventive and curative care, and outreach services to promote healthy lifestyle. It is not supposed to provide delivery care or comprehensive antenatal care, though sometimes HCII may receive emergency cases and provide partial antenatal care which does not require laboratory testing. Thirdly, the lowest level of facility which provides delivery and comprehensive antenatal care is a Health Center III (HCIII), which covers 20,000 individuals. Every sub-county is supposed to have one HCIII. Finally, the facilities of higher levels all provide comprehensive maternal care. They include a Health Center IV which should be built in every county, and a Health Center V (or hospital) for every district, serving 100,000 and 500,000 individuals, respectively. On top of these levels, there are regional referral hospitals which are expected to cover 2 million individuals and the national referral hospital in the capital city.

The dominant type of health facilities is public-owned. There are relatively a small number of private or NGO health facilities and their quality is mostly HCII level.

The government's health inventory database indicates that there had been a massive increase in the number of health facilities in Uganda. Between 2002 and 2012, the total number of facilities has increased by more than two folds from about 2500 to 5000. While the increase has by large been driven by an increase in the number of HCIIs, the higher-level facilities have also increased.

3. Key potential channels

Why can adoption of mobile money help mothers receive maternal care? To receive maternal car, an expected mother has to bear the direct cost (money she needs to pay at a health facility) and the opportunity cost. As shown in table 1, for receiving antenatal care mother needed to pay

around 2,000 Ush in 2012 and 5,000 Ush in 2015. Considering that a typical rural household spent 3,000 Ush for a meal, one can see that antenatal care cost was not cheap. An expected mother also needed to pay transportation money. Further, she needed to spend around one hour to reach the place for antenatal care and wait for another one hour (shown in table 1). Thus one can see that the opportunity cost is also high. In this section, potential channels of mobile money adoption effect are discussed.

3.1.   *Liquidity constraint and lack of saving technology*

Is liquidity constraint a critical problem hindering mothers from receiving maternal care? In the 2011 Uganda Demographic Health Survey, women were asked what factors would be a significant problem for them in seeking medical care in general (Uganda Bureau of Statistics and ICF International Inc. 2012). Almost half of women said that getting money for treatment was a problem in accessing health care, while almost as many said that distance to a facility was a problem. Responding to the situation, the existing literature attempt to motivate mothers to receive antenatal care by giving them cash transfer or vouchers (Bellows et al. 2013; Jehan et al. 2012; Powell-Jackson and Hanson 2012). Dupas (2011) also pointed out that liquidity constraint and lack of saving technology hindered the poor from seeking health care by referring to several studies (Dupas and Robinson 2013; Tarozzi et al. 2014). While Tarozzi et al. (2014) showed that microfinance (one of a tool of financial inclusion) was effective for encouraging poor households to take health seeking behavior, Dupas and Robinson (2013) found that providing a safe saving technology significantly increased health savings.

3.2.   *Mobile money as a financial inclusion tool*

Mobile money has been shown to be effective for alleviating health shock, increasing consumption and encouraging savings by providing the poor a cheap, safe and convenient tool for

remitting and saving (William Jack and Suri 2014; Munyegera and Matsumoto 2016, 2017). For example, mobile money users receive remittances more frequently from migrant workers in town compared to nonusers. A table showing the statistical increase of remittances for mobile money users by using the RePEAT data of Uganda (data used in this study) is shown in Appendix. In addition to that, a poor household which had no access to bank account can obtain a safe technology for saving money by utilizing mobile money.

Therefore one can see the key potential channels of mobile money helping poor households receive maternal care. Liquidity constraint and lack of saving technology has been an important factor which has hindered poor mothers from seeking maternal care. Financial inclusion tools including microfinance has been found to support overcoming such challenges. Thus adoption of mobile money as a tool of financial inclusion, may also possibly contribute to bringing more accessible cash to poor households and encouraging mothers receive maternal care.

3.3.   *Income effect*

Mobile money adoption definitely should have the effect of increasing income of the rural households. Remittances which people received increased for mobile money users (a table shown in Appendix) compared to non-users. The increase of remittance should include remittances from migrant workers who work in towns; such an increase of remittances can be treated as an increase of income. In this paper I cannot disentangle the liquidity constraint effect and the income effect. The mobile money adoption effect which this paper estimates includes both of the effects.

4. Data and Study design

4.1. *Household level panel survey*

Panel data from household surveys collected in Uganda as part of the Research on Poverty, Environment and Agricultural Technology (RePEAT)[2] project, is used in this study. Among the five survey rounds in 2003, 2005, 2009, 2012 and 2015, I use data from 2009, 2012 and 2015 because the first mobile money service was established in March 2009 by Mobile Telephone Network. The RePEAT data consists of rural household. In the 2003 survey, 94 LC1s[3] were sampled and 10 households were randomly selected from each of the LC1s. In the following surveys, new households were sampled consistently in response to attritions.

4.2. *Retrospective reports on pregnancy related health seeking behavior*

The RePEAT survey questionnaires include questions asking about maternal health seeking behavior in 2012 and 2015[4] rounds (in total 1,684 pregnancy level observations). Specifically mothers provided information about: year of pregnancy, frequency of antenatal care, where they went to receive antenatal care or delivery care, who attended them, modes of travel, fees for the care, travel time and transportation cost to seek the care. Mothers were asked about their delivery history retrospectively. For example, mothers reported at maximum seven past pregnancy experiences responding to a survey round. Further, the surveys allowed family members other than mothers themselves to answer questions related to pregnancies. Thus there is a concern that it may be prone to recall bias (Ravallion 2014). DHS (Demographic Health Survey) avoids

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[2] The RePEAT project was jointly administered by Makerere University, Foundation for Studies on International Development (FASID) and National Graduate Institute for Policy Studies (GRIPS).

[3] LC stands for Local Counsel which is basically equivalent to a village. An LC1 is the second smallest unit of administration in Uganda.

[4] Unfortunately, the 2015 round survey had a critical error on the survey program; many respondents skipped answering pregnancy questions. Thus we have relatively small number of observations from the 2015 round survey.

such a problem by restricting mother's report to the latest pregnancy in the past five years (Uganda Bureau of Statistics and ICF International Inc. 2012). In this study, in order to avoid severe measurement error occurred by recall bias, I only use pregnancy reports of mothers answering about the latest three pregnancy and those of the past three years from the survey year. Further, the responses answered by family members other than mothers themselves are excluded. Those treatments decrease number of observations from 1,684 to 934 and thereby may reduce statistical power. The treatments, however, can improve data accuracy. Thus there is a trade-off between increasing number of samples and improving data accuracy; this study places importance on data accuracy.

Table 1 reports summary statistics for the analysis sample of each survey round. Between 2012 and 2015, the mobile money user percentage increased from 40.8 percent to 54.2 percent. In contrast, the bank account user percentage showed no increase. The percentage of mothers who received regular antenatal care at a health facility increased from 21.0 percent to 29.6 percent. The number of antenatal care visits (including insufficient facilities such as drugstores or homebirth), however, showed no increase. Those figures imply that more mothers had come to receive antenatal care at high quality facilities. This estimate is supported by the change of the cost spent for antenatal care. Both the cost spent for receiving antenatal care and the transportation cost spent increased. In contrast, cost spent for delivery showed a relatively moderate increase. The percentage of mothers who received delivery service by a skilled provider or at a quality facility also showed a relatively moderate increase. The tables showing the results of full-sample are included in appendix.

Table 1: Summary Statistics

	2012 ROUND			2015 ROUND		
	# of obs	Mean	SD	# of obs	Mean	SD
Mother Level characteristics						
Age	417	32.1	8.25	136	36.4	7.16
Education	417	5.1	3.51	136	5.29	3.4
1 if household head	417	.0935	.292	136	.0735	.262
Number of pregnancies	417	2.82	1.56	136	3.52	1.75
Household Level characteristics						
Head Education	378	5.97	3.54	131	5.64	3.78
Total value of assets (Ush)	385	1,050,175	1,750,770	131	1,492,355	6,734,598
Land holding size (acre)	386	5.53	12.1	133	6.47	14.4
1 if having non-agriculture business	386	.549	.498	134	.552	.499
Number of household members	386	11.3	4.52	134	12.9	5.76
Number of migrants sent from household	386	.383	1.15	134	.425	1.05
1 if mobile phone owned	385	.808	.395	131	.824	.382
1 if hold mobile money account	363	.408	.492	131	.542	.5
1 if hold bank account	385	.223	.417	131	.198	.4
Pregnancy Level information						
Year of Pregnancy Termination	781	2,009	1.94	153	2,014	1.19
Antenatal Care related information						
Number of antenatal care visits (including home, drugstore etc)	775	4.69	2.86	151	4.66	3.09
Number of antenatal care visits at a health facility	747	3.27	3.06	151	3.74	3.42
1 if received Regular Antenatal Care (4times,1-1-2, at a health facility)	780	.21	.408	152	.296	.458
1 if received ANC within first trimester at a health facility	779	.347	.476	151	.517	.501
1 if received ANC within second trimester at a health facility	779	.677	.468	151	.722	.45
1 if received ANC 2 times within third trimester	779	.561	.497	151	.51	.502
Cost of taking antenatal care (Ush)	739	1,673	7,758	150	5,489	12,247
Transporation cost of taking antenetal care (Ush)	679	1,029	2,116	147	1,699	3,080
Travel time for antenatal care	740	47.2	44.8	150	40.5	35.5
Waiting time for antenatal care	744	72.3	74.6	149	69.5	82.3
Delivery related information						
Cost of delivery (Ush)	618	15,220	29,364	146	18,750	33,162
Transportation cost for delivery (Ush)	499	3,560	8,662	146	3,059	4,932
1 if delivered by a skilled provider	781	.617	.486	151	.742	.439
1 if delivered at a health facility	769	.368	.483	151	.503	.502
Village level characteristics						
Distance to nearest mobile money agent (km)	89	3.99	3.77	59	2.97	3.57

Notes: Authors' computation based on RePEAT 2012 and 2015. According to the annual Bank of Uganda Report 2012, USD was equivalent to Uganda shilling 2557 in financial years 2011−12. Age is calculated at the year of pregnancy terminated.

4.3.   Other sources of measurement errors

Adding to recall bias of pregnancy reports, there are two major sources of measurement errors. One is round-level collected data, and another is mobile money adoption information. Unlike pregnancy reports which were provided at year-level, the RePEAT data collected household information such as wealth indicators, household structure, occupations, mobile money remittance, and use of telecommunication technology like mobile phones at each survey round (i.e. 2009, 2012 and 2015) only. Community-level information such as distance and travel time to mobile money agents from villages were also only collected at each survey round. Thus when one needs to use those information as control variables, figures of missing years (i.e. 2010, 2011, 2013, 2014) have to be interpolated based on a certain rule[5]. In this paper the simplest methodology of interpolation is taken. The survey year data is copied and substituted to data of missing years. The details of this procedure are shown in Appendix.

The interpolation generates non-negligible measurement errors. In order to deal with the problem, regressions excluding those control variables from round-level information are additionally shown in the regression tables.

Mobile money adoption information is another important source of measurement errors. The RePEAT data contains a questionnaire asking whether households use mobile money at the survey period. The survey also asked in which year households had started to use mobile money. Those information was used for constructing mobile money user dummy of each year. As this study relies on information provided at 2012 and 2015 survey, it may be prone to recall bias. Therefore data

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[5] One can also simply restrict data to those from survey years which are 2009, 2012 and 2015. This treatment decreases sample size significantly but the results we can get are basically consistent to the results shown on this paper.

cleaning of mobile money user dummy for this study was conducted carefully and the detailed procedure is shown in Appendix.

5. Empirical Results

5.1. Estimation

5.1.1. Empirical model

The basic empirical model is described by the following equations:

(1) $\quad y_{ijt} = C + \alpha_i + \mu Mmoney_{ijt} + \psi X_{it} + \eta_{jt} + v_{ijt}$

(2) $\quad y_{ijdt} = C + \gamma_j + \mu Mmoney_{ijdt} + \psi X_{it} + \eta_{dt} + v_{ijdt}$

where y_{ijt} is dependent variable such as a dummy variable which takes 1 if regular antenatal care is followed by mother i living in village j at time period t. $Mmoney_{ijt}$ is a dummy variable which takes 1 if the household of mother i uses mobile money. The coefficient μ is the parameter of interest. The specification (1) includes village-time fixed effects (η_{jt}) to control for unobservables such as supply-side effects (i.e. increase of number of health facilities surrounding a village). The specification also includes mother fixed effects (α_i). The specification (2) is a little more relaxed version of the specification (1). The specification (2) uses district-time fixed effects (η_{dt}) instead of village-time fixed effects (η_{jt}), and also includes village fixed effects (γ_j) instead of mother fixed effects (α_i).

As Manang (2015) has shown, the effect coming from supply-side change on maternal health seeking behavior is important in Uganda context. This study attempts to capture such supply-side effect by village-time fixed effects (η_{jt}) or district-time fixed effects (η_{dt}). As Kawungezi et al (2015) pointed out, support (including financial support) by a husband or other household members to expectant mothers is important for encouraging a mother to seek maternal care. In this

study, mother fixed effects (α_i) (and village fixed effects) captures mothers' (villages')
unobservable time-invariant characteristics including cultural background.

5.1.2. Outcome variables

The primary outcome variable is a dummy variable which takes 1 if a mother attended antenatal
care regularly. Following the recommendation of WHO (and previous studies such as Manang
2015), the primary outcome variable takes 1 when a mother conducted at least four ANC (antenatal
care) visits in total. It also requires a mother to attend ANC at least one time in the first trimester,
one time in the second trimester and two times in the third trimester. Furthermore, also by
following the recommendation of WHO, it requires a mother to take ANC at a certain quality
health facility i.e. higher than a Health Center III in Uganda. Thus a mother who seeks ANC at a
low quality facility such as a drugstore or a community health worker office is not treated as 1
because those facilities are not supposed to provide comprehensive antenatal care[6].

This study also covers two delivery related variables, a dummy variable which takes 1 if a
mother received delivery service at a certain quality health facility and another dummy variable
which takes 1 if a mother received delivery service from a skilled birth practitioner. The three
variables above are chosen as outcome variables because they attracted major attention in the
previous studies of maternal health (Chiang et al. 2013; Manang 2015).

Table 2 shows descriptive statistics of stratified samples by mobile money adoption status. One
can see that many pregnancy related variables show clear differences between mobile money users
and nonusers. Those differences, however, would be explained by time, location and other
endogenous variables.

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[6] The RePEAT survey does not ask mothers where they receive ANC for each trimesters. The survey ask the question
more generally.

Table 2: Summary statistics by mobile money adoption status

	Mobile money Non-user			Mobile money User		
	# of obs	Mean	SD	# of obs	Mean	SD
Mother Level characteristics						
Age	426	32.8	8.31	117	35	7.37
Education	426	5	3.42	117	6.11	3.59
1 if household head	426	.0869	.282	117	.0769	.268
Number of pregnancies	426	2.83	1.56	117	3.36	1.61
Household Level characteristics						
Head Education	371	5.93	3.69	106	7.09	4.08
Total value of assets (Ush)	374	911,458	5,114,158	108	1,298,894	1,980,389
Land holding size (acre)	375	3.43	9.73	109	5.86	13.7
1 if having non-agriculture business	376	.495	.501	109	.706	.458
Number of household members	376	11	4.87	109	12.5	5.68
Number of migrants sent from household	376	.327	1.06	109	.358	.866
1 if mobile phone owned	374	.666	.472	108	.935	.247
1 if hold mobile money account	395	0	0	114	1	0
1 if hold bank account	328	.198	.399	111	.315	.467
Pregnancy Level information						
Year of Pregnancy Termination	791	2,009	2.3	143	2,013	1.76
Antenatal Care related information						
Number of antenatal care visits (including home, drugstore etc)	786	4.67	2.86	140	4.8	3.08
Number of antenatal care visits at a health facility	761	3.27	3.03	137	3.78	3.58
1 if received Regular Antenatal Care (4times,1-1-2, at a health facility)	790	.209	.407	142	.31	.464
1 if received ANC within first trimester at a health facility	789	.362	.481	141	.44	.498
1 if received ANC within second trimester at a health facility	789	.677	.468	141	.723	.449
1 if received ANC 2 times within third trimester	789	.54	.499	141	.624	.486
Cost of taking antenatal care (Ush)	752	2,075	8,729	137	3,645	9,023
Transporation cost of taking antenetal care (Ush)	697	1,096	2,222	129	1,432	2,833
Travel time for antenatal care	753	47.4	44.3	137	38.8	37.7
Waiting time for antenatal care	757	71.5	74.6	136	73.6	83.1
Delivery related information						
Cost of delivery (Ush)	632	14,868	29,545	132	20,807	32,489
Transportation cost for delivery (Ush)	522	3,465	7,462	123	3,370	9,878
1 if delivered by a skilled provider	790	.61	.488	142	.789	.41
1 if delivered at a health facility	778	.375	.485	142	.472	.501
Village level characteristics						
Distance to nearest mobile money agent (km)	87	8.81	9.98	54	3	3.68

Notes: Authors' computation based on RePEAT 2012 and 2015. According to the annual Bank of Uganda Report 2012, USD was equivalent to Uganda shilling 2557 in financial years 2011−12. Age is calculated at the year of pregnancy terminated.

5.2.   *Impact on antenatal care seeking behavior*

Table 3 presents results of the basic specifications. Column 1 reports OLS results with no controls for comparison. In column 2, OLS results with year dummies are reported. As the receiving rate of maternal care in general has been gradually improved year by year, the coefficient of interest becomes insignificant. For example, more and more health facilities have been built in Uganda. To deal with such an effect of improvement of health service supply, Column 3 controls for district-time dummies. The district-time fixed effect can capture the effect of district-level supply-side change. In addition to district-time dummies, column 4 controls for age, education and parity dummies which do not require any interpolations. Column 4, however, does not include round-level control variables such as wealth indicators. In this way, one can reduce the potential influence of measurement errors generated by including interpolated variables. But one should compare the results with and without round-level control variable (by comparing column 3 and 4). The results in column 1 through 4 are similar: pregnant women from households that use mobile money are more likely to avail themselves of the required number of antenatal visits compared to women from nonuser. The magnitude of the effect of increasing the probability of receiving regular ANC by adopting mobile money appear to be around 10 percent point (for reference, the percentage of pregnancy observations reported attendance of regular ANC at 2012 round was 21 percent).

The results of the coefficient of interest in column 5 through 7 are less statistically significant, while the estimated magnitudes are consistently positive. Column 5 additionally controls for a village fixed effect. Thus this specification controls for unobserved time-invariant village heterogeneity such as geographic or cultural characteristics. Column 6 controls for village-time fixed effect and thereby can capture the effect of supply-side change at more granular level. The coefficient of interest is, however, insignificant. Column 7 additionally controls for a mother fixed

effect. Therefore this specification controls for unobserved time-invariant individual heterogeneity. This fixed effect may possibly capture individual characteristics of mothers including influence of husbands. The coefficient of interest is significant at ten percent. Although results are not shown in the table, specifications including the round-level controls show similar results in general.

The results consistently imply that mobile money adoption may possibly have a positive effect on mothers' decision to receive regular ANC. The results indicate that mobile money adoption may possibly have the effect of around ten percent point increase of receiving regular ANC. The statistical significance levels are, however, insufficient when one controls for village level and mother level fixed effects. Thus one should conclude that statistical results found so far are only suggestive evidence.

Table 3: Regular Antenatal Care

Outcome variable: 1 if mother receive Regular Antenatal Care (4times,1-1-2).							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1 if HH uses mobile money	.101***	.0567	.111**	.117**	.0989*	.115	.174*
	(.0318)	(.0336)	(.0527)	(.0471)	(.0502)	(.0999)	(.089)
Age			-.00302	-.0019	.00123	.00228	-.0657*
			(.00273)	(.00261)	(.00279)	(.00375)	(.0328)
Education (year)			-.00946	-.0031	-.003	.00422	
			(.00853)	(.00626)	(.00775)	(.0104)	
Parity			-.00526				
			(.0159)				
1 if HH has mobile phone			-.0272				
			(.0546)				
Number of HH members			-.002				
			(.00321)				
Number of migrants in HH			.0174				
			(.0163)				
Asset of HH (log)			.0272				
			(.0222)				
Land size of HH (log)			.00127				
			(.00998)				
HH Head Education			.00699				
			(.00863)				
1 if HH has non-agriculture business			.0425				
			(.0391)				
Observations	932	932	853	932	932	932	932
R-squared	.00757	.0207	.3	.284	.31	.629	.905
Year dummy		Yes					
Year*District			Yes	Yes	Yes		
Village FE					Yes		
Year*Village						Yes	Yes
Mother FE							Yes
Controls*			Yes	Yes	Yes	Yes	Yes

* p<0.1, ** p<0.05, *** p<0.01
Notes: Standard errors are clustered at district level. Controls* include age, education, and parity dummies.

5.3.   *Impact on delivery care seeking behavior*

Table 4 presents results of the specifications to examine mobile money adoption effect on facility delivery dummy and skilled birth attendant dummy. Column 1 and 6 report OLS results control for year dummies. While those specifications show significant estimates of coefficient of interest, when one controls for time-location dummies, the results come out to be insignificant. Column 3 through 5 and 8 through 10 control for year-district dummies or year-village dummies. The coefficient of interest in those specifications consistently show insignificant results.

Table 4: Delivery-related outcome variables

Outcome variables:	1 if facility delivery					1 if skilled birth attendants				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1 if HH uses mobile money	.128***	.0942**	.0436	.0799	.106	.124**	.0547	.0608	.102	.13
	(.0431)	(.0424)	(.0762)	(.0655)	(.179)	(.0451)	(.0431)	(.0778)	(.0668)	(.153)
Education (year)		.0202***	.0133*	.0154***	.0117		.0215***	.0201**	.0183**	.0177
		(.00621)	(.00691)	(.00553)	(.00909)		(.00563)	(.00815)	(.00779)	(.0106)
Age		-.00174	-.00232	-.0000197	.00215		-.0036	-.00304	-.0028	-.000445
		(.0026)	(.00319)	(.003)	(.0047)		(.00255)	(.00309)	(.00261)	(.00557)
Parity		-.00988	-.0361*				-.0252	-.0378*		
		(.0172)	(.0188)				(.0148)	(.0185)		
1 if HH has mobile phone		.042	.0131				.0389	.0158		
		(.0612)	(.0652)				(.0589)	(.0736)		
Number of HH members		-.00212	-.00576				-.0046	-.00965		
		(.00455)	(.00652)				(.00396)	(.00574)		
Number of migrants in HH		.0157	.0488**				.0216	.0406**		
		(.0269)	(.0235)				(.0131)	(.0155)		
Asset of HH (log)		.0823***	.0619***				.0701***	.0413**		
		(.0153)	(.0197)				(.0134)	(.0175)		
Land size of HH (log)		.00685	.00167				.000912	-.00457		
		(.00552)	(.00876)				(.00655)	(.0101)		
HH Head Education		-.0113*	-.00227				-.00779	-.00496		
		(.00576)	(.00728)				(.00674)	(.00829)		
1 if HH has non-agriculture business		.00896	.003				.0343	.0371		
		(.0481)	(.0548)				(.0549)	(.0596)		
Observations	920	841	841	920	920	932	853	853	932	932
R-squared	.0251	.0889	.285	.257	.564	.0274	.105	.268	.247	.573
Year dummy	Yes					Yes				
Year*District			Yes	Yes				Yes	Yes	
Year*Village					Yes					Yes
Controls*			Yes	Yes					Yes	Yes

* p<0.1, ** p<0.05, *** p<0.01
Notes: Standard errors are clustered at district level. Controls* include age, education, and parity dummies.

5.4. *Potential endogeneity*

In previous studies of mobile money including several studies of Uganda using the RePEAT data (Munyegera and Matsumoto 2016, 2017; Tabetando 2017), IV estimate was used to control for the endogeneity of mobile money users who were shown to have larger consumption or educational investments compared to non-users. In those studies, reverse causality was one of their concern (i.e. people who wanted to consume more adopted mobile money). This study, however, did not adopt IV estimation because the concern of endogeneity between mobile money adoption and our outcome variables are not severe. It is not convincing to argue that people started to use mobile money for receiving more antenatal care. In other words, a mother might have started using mobile money as a cheaper and convenient platform to receive remittances from their members in towns, in order to avail herself to receive regular ANC. In fact, the survey (in RePEAT data) which asked about the purpose of using mobile money presented that people said that they use mobile money for remitting daily spending or educational spending. This means that it is not plausible to argue that people started to use mobile money for health spending.

5.5. *Falsification test and robustness check*

One may imagine that the mobile money users and non-users were systematically different and that the "mobile money adoption effect" shown above could be explained by the observed / unobserved characteristics which could have existed even in the absence of mobile money. I run regressions for the antenatal care variable used above on a placebo mobile money dummy. In this estimation, I use a sub-set of observations which are from 2006 to 2009. The placebo mobile money dummy takes a value of one in 2008 and 2009 for the people who used mobile money in

2015; it takes a value of zero for the rest of the observations in the sub-set[7]. The results are shown in Table 5. The coefficients are consistently shown insignificant and almost zero. As the mobile money service began in 2009 and at the beginning there were few users in rural area, the results indicate that the outcome variable was not significantly different between mobile money users and non-users before the penetration of the mobile money service.

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[7] I also conduct a falsification tests by using a slightly different placebo mobile money that takes a value of one in 2009 for the people who used mobile money in 2015. The regression table is presented in Appendix. The results are consistent to what I argue here.

Table 5: Falsification test: placebo mobile money dummy for 2006~2009

Outcome variable: 1 if mother receive Regular Antenatal Care (4times,1-1-2).						
	(1)	(2)	(3)	(4)	(5)	(6)
1 if HH uses mobile money	.00502	.00629	-.00833	-.0198	-.00919	.0167
	(.0468)	(.0579)	(.0706)	(.0678)	(.0778)	(.095)
Age			-.00369	-.00169	.00218	.00408
			(.00471)	(.00392)	(.00453)	(.00626)
Education (year)			-.0138*	-.00426	-.00816	-.00213
			(.0068)	(.00632)	(.00674)	(.00949)
Parity			-.0153			
			(.031)			
1 if HH has mobile phone			-.119*			
			(.0674)			
Number of HH members			-.00808			
			(.00714)			
Number of migrants in HH			.0419			
			(.0354)			
Asset of HH (log)			.0276			
			(.0389)			
Land size of HH (log)			.0137			
			(.00855)			
HH Head Education			.021			
			(.0136)			
1 if HH has non-agriculture business			.0364			
			(.0613)			
Observations	455	455	408	455	455	455
R-squared	.0000333	.0117	.226	.187	.213	.526
Year dummy		Yes				
Year*District			Yes	Yes	Yes	
Village FE					Yes	
Year*Village						Yes
Controls*				Yes	Yes	Yes

* p<0.1, ** p<0.05, *** p<0.01
Notes: Standard errors are clustered at district level. Controls* include age, education, and parity dummies. Mother fixed effect model is omitted due to insufficient number of observations. The placebo mobile money dummy takes a value of one in 2008 and 2009 for the people who used mobile money in 2015; it takes a value of zero in 2006 and 2007 for the rest of the observations in the sub-set.

As a robustness check, instead of the outcome variable of taking regular antenatal care of four times, I also run regressions for an outcome variable of taking antenatal care of five times (holding at least 1-1-2 time for each trimester). The regression results presented in Appendix show that the magnitude of mobile money adoption effect on the alternative outcome variable is, in general, similar to our main outcome variable.

6. Discussions and Conclusions

6.1.   Difference of impact between ANC and delivery

Section 5 has presented suggestive evidence of the existence of a positive impact of mobile money adoption on ANC seeking behavior. The results of table 4, however, indicates failure of rejecting the null hypothesis of zero treatment effect. This difference might be explained by the difference of supply-side change.

Figure 1 shows the change of percentage of villages with health facilities. The increase rate of health facilities which can provide ANC has quickly diminished after 2012. The supply-side improvement on ANC actually seems to be stagnated at around 90 percent. In contrast, the increase rate of health facilities which can provide delivery care has been kept high until recently. In 2014, the percentage of villages with health facilities for delivery care was still less than 80 percent so there was room for growth.

Thereby one can estimate that supply-side effects on delivery care was larger than those on antenatal care. If so, the improvement of ANC seeking behavior might be easier to detect compared to the improvement of delivery care seeking behavior. Then it must make it more difficult for this study to show statistically significant effect of mobile money adoption on delivery care.

Figure 1: Change of percentage of villages with health facilities
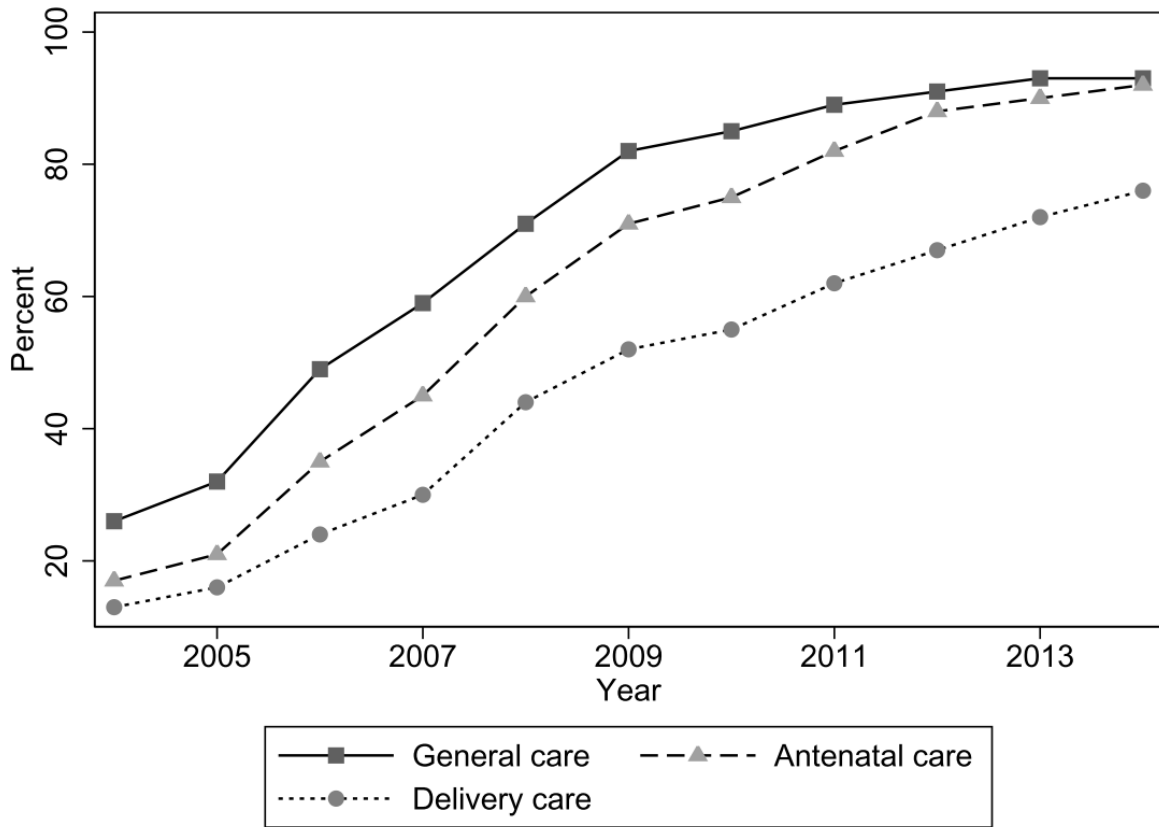
Source: Adopted from (Manang 2015)

6.2. Does mobile money adoption have a positive impact on ANC seeking behavior?

Based on the main regression results of table 3, one can conclude that this study provide suggestive evidence of the existence of mobile money adoption impact on ANC seeking behavior. The mobile money adoption impact on ANC seeking behavior is statistically significant even if one controls for time-location dummies. Time-location dummies represent supply-side change so the specifications allow for heterogeneity coming from health facility increase or transportation improvement. But this explanation is not so convincing when one controls for time-location

dummies at village level because the results become less significant (10 percent significance). The specification which includes mother fixed effects also shows consistent results. Mother fixed effects can control for time-invariant mother-level characteristics such as her own preference or support by a husband or other household members (only if those are time-invariant).

If the mobile money adoption impact on ANC seeking behavior exists as suggested by this study, the magnitude seems to be around 10 percentage points increase of probability (to attend regular ANC). This magnitude is relatively large. A previous study on providing cash incentives in order to encourage women to attend ANC visits found that women who received the incentives were 4.2 percentage points more likely to take ANC visits.

This study shows promise for future research of financial inclusion effects on maternal health. The design of this study is largely affected by data limitation. To deal with recall bias, one needs to reduce the sample size and restrict observations to reliable reports. If not, the outcome variables suffer from severe measurement errors. Further, as most of control variables including mobile money agent distance were collected at round-level, if the outcome variables were collected at year-level, one has to interpolate the control variables by a certain methodology. This manipulation, however, makes new measurement errors.

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Paper title:

Impact of Mobile Money Adoption on Maternal Health Seeking Behavior: Evidence from Rural Uganda

May. 2018

1. Interpolation methodology

Interpolation of household level data and community level data is implemented in a following manner. Data of three round (2009, 2012 and 2015) is copied to each year surrounding the round years.

Table: Interpolation of household level data

Year of pregnancy	Household level data	
2007	2009	Copied
2008	2009	Copied
2009	2009	Original Round
2010	2009	Copied
2011	2012	Copied
2012	2012	Original Round
2013	2012	Copied
2014	2015	Copied
2015	2015	Original Round

Notes: Household level data includes wealth indicators and household structures and else.
Source: Computed by author.

2. Procedure of constructing mobile money user dummy

The RePEAT data includes four types of information which one can use to construct a mobile money user dummy at year-level: mobile money user dummy at 2012, mobile money user dummy

at 2015, the year in which a user had started to use mobile money account (collected at 2012 survey), and the year in which a user had started to use mobile money (collected at 2015 survey).

By utilizing those, this study constructed a mobile money user dummy which was matched to pregnancy observations. When data indicated that while pregnancy terminated in a certain year and the household started to use mobile money in the same year, this study treated the birth as provided by a mobile money user.

3. Table of full sample

Table 1: Summary Statistics

	Full Sample					
	2012 ROUND			2015 ROUND		
	# of obs	Mean	SD	# of obs	Mean	SD
Mother Level characteristics						
Age	633	31.1	8.58	224	35.6	7.85
Education	633	5.34	3.57	224	5.63	3.73
1 if household head	633	.0774	.267	224	.0536	.226
Number of pregnancies	633	2.55	1.49	224	3.16	1.74
Household Level characteristics						
Head Education	537	6.04	3.75	213	5.92	3.79
Total value of assets (Ush)	547	1,064,076	1,747,522	213	1,481,294	5,598,190
Land holding size (acre)	548	5.93	13.8	215	5.79	11.8
1 if having non-agriculture business	548	.549	.498	216	.565	.497
Number of household members	548	11.4	4.68	216	13.9	7.15
Number of migrants sent from household	548	.42	1.18	216	.454	1.06
1 if mobile phone owned	547	.781	.414	213	.817	.388
1 if hold mobile money account	516	.417	.493	213	.563	.497
1 if hold bank account	547	.225	.418	213	.23	.422
Pregnancy Level information						
Year of Pregnancy Termination	1,431	2,008	2.89	253	2,013	2.43
Antenatal Care related information						
Number of antenatal care visits (including home, drugstore etc)	1,385	4.71	2.7	239	4.76	3.04
Number of antenatal care visits at a health facility	1,336	3.35	3.04	238	3.79	3.4
1 if received Regular Antenatal Care (4times,1-1-2, at a health facility)	1,421	.252	.434	248	.343	.476
1 if received ANC within first trimester at a health facility	1,393	.378	.485	239	.51	.501
1 if received ANC within second trimester at a health facility	1,393	.696	.46	240	.713	.454
1 if received ANC 2 times within third trimester	1,393	.549	.498	240	.546	.499
Cost of taking antenatal care (Ush)	1,336	1,660	7,408	232	5,162	11,209
Transporation cost of taking antenetal care (Ush)	1,239	1,140	2,825	236	1,592	2,903
Travel time for antenatal care	1,351	48.9	44.1	237	38.7	34.7
Waiting time for antenatal care	1,333	76	77	229	64.4	74
Delivery related information						
Cost of delivery (Ush)	1,106	15,342	31,768	238	19,477	39,975
Transportation cost for delivery (Ush)	923	3,357	7,980	238	3,397	5,741
1 if delivered by a skilled provider	1,431	.615	.487	249	.751	.433
1 if delivered at a health facility	1,403	.396	.489	247	.559	.498
Village level characteristics						
Distance to nearest mobile money agent (km)	89	3.99	3.77	65	2.82	3.44

Notes: Authors' computation based on RePEAT 2012 and 2015. According to the annual Bank of Uganda Report 2012, USD was equivalent to Uganda shilling 2557 in financial years 2011–12.

Table 2: Summary statistics by mobile money adoption status

	Mobile money Non-user			Mobile money User		
	# of obs	Mean	SD	# of obs	Mean	SD
Mother Level characteristics						
Age	650	32	8.73	178	33.2	8.46
Education	650	5.24	3.49	178	6.42	3.83
1 if household head	650	.0738	.262	178	.0562	.231
Number of pregnancies	650	2.51	1.49	178	3.11	1.62
Household Level characteristics						
Head Education	523	6.01	3.76	161	7.05	3.99
Total value of assets (Ush)	532	862,728	4,336,249	164	1,364,095	2,156,326
Land holding size (acre)	532	3.84	10.8	165	6.18	13.5
1 if having non-agriculture business	532	.521	.5	165	.685	.466
Number of household members	532	11.3	5.11	165	13.1	5.99
Number of migrants sent from household	532	.368	1.09	165	.43	.97
1 if mobile phone owned	532	.654	.476	164	.896	.306
1 if hold mobile money account	561	0	0	170	1	0
1 if hold bank account	418	.206	.405	167	.317	.467
Pregnancy Level information						
Year of Pregnancy Termination	1,459	2,008	3.19	225	2,012	1.8
Antenatal Care related information						
Number of antenatal care visits (including home, drugstore etc)	1,404	4.67	2.71	220	4.98	2.99
Number of antenatal care visits at a health facility	1,358	3.33	3.03	216	3.93	3.48
1 if received Regular Antenatal Care (4times,1-1-2, at a health facility)	1,446	.252	.434	223	.354	.479
1 if received ANC within first trimester at a health facility	1,410	.382	.486	222	.495	.501
1 if received ANC within second trimester at a health facility	1,412	.693	.462	221	.738	.441
1 if received ANC 2 times within third trimester	1,412	.536	.499	221	.629	.484
Cost of taking antenatal care (Ush)	1,355	1,896	7,939	213	3,978	9,357
Transporation cost of taking antenatal care (Ush)	1,270	1,162	2,833	205	1,525	2,883
Travel time for antenatal care	1,374	48.9	44	214	37.7	34.2
Waiting time for antenatal care	1,351	74.9	76.6	211	70.2	76.9
Delivery related information						
Cost of delivery (Ush)	1,140	14,601	31,034	204	24,308	43,489
Transportation cost for delivery (Ush)	966	3,262	7,099	195	3,876	9,588
1 if delivered by a skilled provider	1,456	.613	.487	224	.781	.414
1 if delivered at a health facility	1,428	.404	.491	222	.527	.5
Village level characteristics						
Distance to nearest mobile money agent (km)	91	8.2	9.04	61	2.94	3.51

Notes: Authors' computation based on RePEAT 2012 and 2015. According to the annual Bank of Uganda Report 2012, USD was equivalent to Uganda shilling 2557 in financial years 2011–12. Age is computed at the year of pregnancy terminated.

Table 3: Regular Antenatal Care

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			Outcome variable: 1 if mother receive Regular Antenatal Care (4times,1-1-2).				
1 if HH uses mobile money	.103***	.0839**	.0356	.0498	.0324	.0481	.145
	(.0315)	(.0382)	(.0458)	(.0438)	(.0452)	(.092)	(.152)
Age		-.000559	-.000792	-.000985	.0000475	.00123	.0199
		(.0022)	(.00244)	(.00216)	(.00222)	(.00257)	(.0179)
Education (year)		-.00321	-.00218	.00401	.00336	.00375	
		(.00627)	(.00751)	(.00627)	(.00796)	(.00994)	
Parity		-.0129*	-.0167				.0413
		(.00733)	(.0142)				(.0657)
1 if HH has mobile phone		.0474	.0163				.17
		(.0406)	(.0513)				(.175)
Number of HH members		.00589*	.003				-.00147
		(.00311)	(.00316)				(.0379)
Number of migrants in HH		-.00578	.00379				-.00284
		(.0164)	(.0188)				(.048)
Asset of HH (log)		.0146	.00122				-.0304
		(.0127)	(.0128)				(.0611)
Land size of HH (log)		-.00115	.000148				-.00411
		(.00669)	(.00757)				(.0222)
HH Head Education		.00343	.0033				-.0293
		(.00399)	(.00553)				(.032)
1 if HH has non-agriculture business		-.00137	.0274				.0136
		(.0328)	(.0424)				(.0643)
Observations	1,669	1,506	1,506	1,669	1,669	1,669	1,506
R-squared	.00624	.0204	.244	.223	.227	.52	.787
Year dummy		Yes					
Year*District			Yes	Yes	Yes		
Year*Village						Yes	Yes
Mother FE							Yes
Village FE					Yes		
Controls*				Yes	Yes	Yes	Yes

* p<0.1, ** p<0.05, *** p<0.01
Notes: Standard errors are clustered at district level. Controls* include age, education, and parity dummies.

Table 4: Delivery-related outcome variables

Outcome variables:	1 if facility delivery					1 if skilled birth attendants				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1 if HH uses mobile money	.123***	.0768**	.012	.0476	.0149	.121***	.0335	.0359	.0672	.0274
	(.0398)	(.0334)	(.0591)	(.0557)	(.125)	(.0402)	(.041)	(.0567)	(.0558)	(.0952)
Education (year)		.0154***	.00944	.0118*	.0101		.0146**	.0137*	.0162**	.0151*
		(.00542)	(.00649)	(.00628)	(.00643)		(.00548)	(.00676)	(.00628)	(.00755)
Age		-.00276	-.00447*	-.00209	-.000666		-.00538**	-.00509**	-.00427*	-.00257
		(.00197)	(.00237)	(.00232)	(.00252)		(.00224)	(.00233)	(.00235)	(.00308)
Parity		-.00772	-.0369				-.017	-.0314*		
		(.0142)	(.0221)				(.0126)	(.0178)		
1 if HH has mobile phone		.0645	.0532				.0106	.0182		
		(.062)	(.0651)				(.0473)	(.0547)		
Number of HH members		.0025	-.000994				-.00146	-.00577		
		(.00378)	(.00473)				(.00372)	(.0035)		
Number of migrants in HH		-.00433	.0144				.0111	.0277*		
		(.019)	(.0224)				(.0143)	(.0151)		
Asset of HH (log)		.0545***	.059***				.068***	.0633***		
		(.0164)	(.0183)				(.00962)	(.0115)		
Land size of HH (log)		.0129**	.00789				.00722	.00133		
		(.00603)	(.00865)				(.00526)	(.00655)		
HH Head Education		-.00946*	-.00949				-.0044	-.00713		
		(.00478)	(.00634)				(.00513)	(.00598)		
1 if HH has non-agriculture business		.0203	.0169				.0292	.0195		
		(.0381)	(.044)				(.0363)	(.042)		
Observations	1,650	1,485	1,485	1,650	1,650	1,680	1,513	1,513	1,680	1,680
R-squared	.0222	.072	.265	.224	.517	.0232	.0873	.262	.23	.527
Year dummy	Yes					Yes				
Year*District			Yes	Yes				Yes	Yes	
Year*Village					Yes					Yes
Controls*				Yes	Yes				Yes	Yes

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

Notes: Standard errors are clustered at district level. Controls* include age, education, and parity dummies.

4. Mobile money increases remittance

Table: Statistically significant increase of remittances

Table 4A. *Mobile money and household remittances. Dependent variable: measures of remittances*

Dependent variable:	1 if received remittances		# of remittances		Amount of remittances	
	(1)	(2)	(3)	(4)	(5)	(6)
Variable	Probit	OLS	OLS	FE	OLS	FE
1 if used mobile money	0.0706*	0.0581*	0.843**	0.940*	0.360***	0.381*
	(0.0399)	(0.0324)	(0.421)	(0.525)	(0.133)	(0.220)
Constant		0.0273	−5.028**	−1.772	5.066***	5.080***
		(0.190)	(2.441)	(3.354)	(0.872)	(1.253)
District*time		Y	Y	Y	Y	Y
Observations	1,682	1,682	1,682	1,682	1,682	1,682
R-squared		0.228	0.188	0.261	0.278	0.286
Number of households				841		841

Robust standard errors are reported in parentheses. Asterisks *, ** and *** represent significance the 10%, 5% and 10% levels, respectively. Additional controls include household size, a dummy for household mobile phone possession, log of asset value, log of land size owned as well as gender, age, and education level of household head.

Notes: RePEAT data in Uganda of 2009 and 2012 round were used.

Source: Adopted from (Munyegera and Matsumoto 2016)

5. Falsification test: another placebo mobile money dummy for 2006~2009

	(1)	(2)	(3)	(4)	(5)	(6)
Outcome variable: 1 if mother receive Regular Antenatal Care (4times,1-1-2).						
1 if HH uses mobile money	.0477	-.00562	-.0584	-.0798	-.0309	.0402
	(.073)	(.0959)	(.11)	(.104)	(.116)	(.142)
Age			-.00375	-.00168	.0022	.00413
			(.00475)	(.00392)	(.00451)	(.00633)
Education (year)			-.0141**	-.00461	-.00834	-.00183
			(.0066)	(.00629)	(.00669)	(.00941)
Parity			-.0169			
			(.0318)			
1 if HH has mobile phone			-.115*			
			(.0669)			
Number of HH members			-.00786			
			(.00709)			
Number of migrants in HH			.042			
			(.0355)			
Asset of HH (log)			.0284			
			(.039)			
Land size of HH (log)			.0136			
			(.00845)			
HH Head Education			.0206			
			(.0138)			
1 if HH has non-agriculture business			.0376			
			(.0612)			
Observations	455	455	408	455	455	455
R-squared	.00176	.0116	.227	.189	.213	.526
Year dummy		Yes				
Year*District			Yes	Yes	Yes	
Village FE					Yes	
Year*Village						Yes
Controls*				Yes	Yes	Yes

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

Notes: Standard errors are clustered at district level. Controls* include age, education, and parity dummies. Mother fixed effect model is omitted due to insufficient number of observations. The placebo mobile money dummy takes a value of one in 2009 for the people who used mobile money in 2015; it takes a value of zero for the rest of the observations in the sub-set.

6. Robustness check: alternative outcome variable

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Outcome variable: 1 if mother receive Antenatal care 5 times (at least 1-1-2 for each trimester)							
1 if HH uses mobile money	.0624*	.0299	.104*	.095*	.0675	.0519	.0919
	(.0336)	(.042)	(.0584)	(.054)	(.0545)	(.0983)	(.111)
Age			-.0036	-.00191	.000886	.00119	-.0868***
			(.00247)	(.00223)	(.0027)	(.00335)	(.0198)
Education (year)			-.00586	-.000237	-.000055	.00639	
			(.00826)	(.00611)	(.00743)	(.00989)	
Parity			-.008				
			(.0154)				
1 if HH has mobile phone			-.00182				
			(.0479)				
Number of HH members			-.000763				
			(.00334)				
Number of migrants in HH			.0151				
			(.0155)				
Asset of HH (log)			.0151				
			(.0249)				
Land size of HH (log)			.00343				
			(.00912)				
HH Head Education			.0044				
			(.00827)				
1 if HH has non-agriculture business			.0426				
			(.044)				
Observations	932	932	853	932	932	932	932
R-squared	.00313	.0129	.283	.267	.288	.622	.909
Year dummy		Yes					
Year*District			Yes	Yes	Yes		
Village FE					Yes		
Year*Village						Yes	Yes
Mother FE							Yes
Controls*				Yes	Yes	Yes	Yes

* p<0.1, ** p<0.05, *** p<0.01
Notes: Standard errors are clustered at district level. Controls* include age, education, and parity dummies.

7. References

Munyegera, Ggombe Kasim and Tomoya Matsumoto. 2016. "Mobile Money, Remittances, and Household Welfare: Panel Evidence from Rural Uganda." *World Development* 79(25101002):127–37.