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Awa Diouf, Marco Carreras & Fabrizio Santoro

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Summary

Many people argue that mobile money has the potential to increase financial inclusion and improve the livelihoods of poor people in Africa. However, while many African governments impose specific taxes on mobile money transactions, very little is known about their effect on the use of mobile money services.

This study assesses the short- and long-term impact of the tax on money transfer fees that the Kenyan government introduced in 2013. The tax, more specifically an excise duty, was imposed on fees incurred in all money transactions, including mobile money. It was introduced at 10 per cent and increased to 12 per cent in 2018.

Our analysis has two parts. We use country-level data to see if the tax affected the use of mobile money – transaction values and volume – and the number of active mobile money agents.[1] In addition, we use four rounds of nationally representative survey data to estimate changes in the use of mobile money after introduction of the tax.

We find that the excise duty did not have a significant impact on different aggregated indicators relating to the use of mobile money. However, survey data shows that the tax may have reduced the rate of increase in use of mobile money services affected by the changes in tax, such as sending and receiving money, compared to services that were not, like savings and paying bills. Importantly, while the amounts transacted may not change, users send and receive money within households less regularly. In addition, the tax seems to have a more detrimental impact on poorer households, which were less likely to be financially included before the tax was introduced. Larger households also show more negative effects after the tax.

Keywords: digital financial services; mobile money; tax policy in Africa; financial inclusion; Kenya.

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[1] Individuals or businesses that are contracted by mobile money operators to perform services for customers.

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Acronyms

ADF	Augmented Dickey-Fuller
AIC	Akaike's information criterion
ARDL	Autoregression distributed log
CBK	Central Bank of Kenya
CIEA	Composite indicator of economic activity
DFS	Digital financial services
GDP	Gross domestic product
HQIC	Hannan and Quinn information criterion
Ksh	Kenyan shilling
PP	Phillips Peron
SBIC	Schwarz's Bayesian information criterion
SSA	Sub-Saharan Africa
VAT	Value added tax

1 Introduction

The use of mobile money rapidly expanded in sub-Saharan Africa (SSA) after the launch of M-PESA in Kenya in 2007.[2] The mobile money industry processed US$1 trillion worldwide in 2021, a 31 per cent increase on 2020, with SSA being the first market (Awanis et al. 2022). Mobile money, and digital financial services (DFS) more broadly, are considered an important solution to financial exclusion of poorer households, and a key tool in the achievement of Sustainable Development Goals (Lopez 2019). Numerous positive impacts of mobile money have been documented in SSA, notably on poverty, consumption, resilience, savings, women's empowerment and agriculture (Hasibul et al. 2019; Jack and Suri 2011, 2014; Riley 2018, 2020; Suri and Jack 2016). At the same time, SSA countries are under considerable pressure to raise domestic resources to finance development, especially after the COVID-19 pandemic. As DFS rapidly expand, a number of governments in SSA have introduced specific taxes on them – including taxes on money transfers, and/or specifically on mobile money (Matheson and Petit 2020; Mullins et al. 2020). However, advocates of financial inclusion and civil society vehemently warn about the potentially negative effects of these policies. Scientific research is still quite silent in this heated debate, and evidence on the impact of taxes on DFS remains limited.

Mobile money experienced a remarkable success in Kenya. Its use is widespread – 69 per cent of adults aged 15 or over had a mobile money account in 2021, compared to an average of 33 per cent in SSA, and 10 per cent worldwide (Demirgüç-Kunt et al. 2021). In 2013 the government introduced a tax, called an excise duty, at a rate of 10 per cent on 'money transfer services by cellular phone service providers, banks, money transfer agencies and other financial service providers' (Republic of Kenya 2012). On 1 July 2018 the duty was increased to 12 per cent for cellular phone service providers – meaning mobile money transfers – while the rate for transfers by other financial institutions was set at 20 per cent (Republic of Kenya 2018). Part III of Excise Duty Act No. 23 of 2015 defines 'money transfer services' as encompassing sending and withdrawals, which means that the excise duty targets money transfers and withdrawals. However, other transactions – such as paying bills – are not targeted by the duty, as they are not specified in the definition of money transfer services. This tax policy has been set in the context of Kenya, which is quite typical for a low-income country. Kenya collects insufficient revenue, around 15 per cent of Gross Domestic Product (GDP), in line with sub-Saharan Africa (ICTD/UNU-WIDER 2020), and has widespread informality.[3] The Kenyan duty is part of a tax system that is structurally skewed towards having income taxes and value added tax (VAT) as the two main sources of overall tax revenue – they contribute more than a third (ICTD/UNU-WIDER 2020). A further key aspect of the Kenyan environment is that the government is embracing digitalisation, in line with the widespread use of DFS in the population.[4]

Kenya is not the only country applying an excise duty on mobile money transactions. Tanzania and Uganda also apply a tax on fees.[5] However, unlike Kenya, these countries have an excise duty on transaction values in addition to the duty on fees, which makes Kenya the only country in SSA applying a tax only on transaction fees. Some countries – like

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2 M-PESA is a mobile phone-based service launched in Kenya in 2007. It is used for money transfer, payments and microfinancing.

3 As of 2015, the informal economy employed an estimated 12.5 million people, or 82.8 % of the workforce, according to the Economic Survey 2016 (Kenya National Bureau of Statistics 2016).

4 According to the World Bank's GovTech Maturity Index, which assigns a 0-1 score and a grouping across four categories (A, B, C, D) as an indicator for the state of a country's public sector digital transformation, Kenya ranks in group B (with few other African countries), indicating a government significantly focusing on and investing in technology.

5 Rwanda applies VAT on fees for mobile banking services provided by telecommunication companies.

Ghana, Cameroun, Zimbabwe, Nigeria and Chad – target transaction values, and other countries – such as Benin, Congo, Democratic Republic of Congo and Côte d'Ivoire – base their taxes on the operators' turnover. These instruments can be applied to different kinds of money transfers or withdrawals, but can also applied with a flat or *ad valorem* rate. Governments mainly justify excise duties on DFS by the need to collect more domestic tax revenue and to tax the informal sector (Clifford 2020). However, it is unclear whether SSA countries' mobile money markets are developed enough to sustain DFS-specific taxation, which user category is supporting the tax burden, and whether these taxes will deter mobile money adoption and financial inclusion. The main objective of this study is to assess the role of taxation in shaping adoption and use of mobile money in Kenya. More specifically, we try to answer the following question: what are the short- and long-term impacts of the Kenyan excise duty on the use of mobile money?

We have two methodological approaches. First, we use Central Bank national-level data on monthly use of mobile money and other socioeconomic characteristics to track usage patterns in both the short and long term, and to see whether the excise duty implemented in 2013 and modified in 2018 affected usage. Secondly, we use detailed household survey data, collected from 2008 to 2014 for a panel sample of about 3,000 respondents in Kenya. We first map the main characteristics of mobile money users in Kenya with this information. Then, through a fixed effects estimation, we produce more granular estimates of the impact on different indicators of mobile money usage after implementation of the 2013 excise duty.

Our results suggest that the Kenyan excise duty did not significantly alter mobile money usage at the macroeconomic level according to aggregated national data. However, the microeconomic analysis gives more insight into the effect of the excise duty on fees for different uses and transaction purposes. We find that the increase in adoption of mobile money in 2014 was greater for transactions not affected by the tax, such as paying bills and savings, rather than sending and receiving money – which were affected by the tax. We also find that, while the amounts transacted do not change, users send/receive mobile money to/from a household member less regularly. This shows that, even if the excise duty did not significantly decrease overall transaction values and volume in Kenya, it slowed down expansion of transactions that were affected – leaving transactions that were not affected unaltered. The impact seems to be more negative for poorer and larger households – categories that were less likely to be financially included before introduction of the tax.

With this study we contribute to the very thin literature around the impact of taxation on DFS. As shown by an evidence gap map on enablers, barriers and impacts of DFS, there is still a lack of robust evidence on the effect of DFS macroeconomic policies, notably taxation, on DFS usage (Mader et al. 2022). Current literature on the impact of specific taxation on DFS usage is dominated by descriptive and qualitative analysis. We attempt to add to this with a more robust methodology, considering both macroeconomic and microeconomic levels.

We contribute to several studies around the excise duty in Kenya. While many studies suggest that the excise duty has been imputed to final consumers (Muthiora 2015; Fehling 2019; GSMA 2020), the causal effects of the levy on financial inclusion remain unclear. On the one hand, some authors warn about a potentially negative effect of the tax on adoption of mobile money, mostly in the long term (Ndung'u 2019). On the other hand, two quantitative studies find a non-significant effect of the tax on use of mobile money. Fehling (2019) uses a difference-in-difference approach to assess mid-term impact of the excise duty on use of mobile money, comparing Kenya with the East African region. The author finds that the observed decline in mobile money usage after implementation of the tax is a 'regional trend' and not specific to the levy. Herbling (2013) points out that, despite the excise duty, mobile money values increased in August 2013 compared to the same period in 2012. One of the

reasons behind this is expansion of mobile money services for the payment of bills (water, electricity, rent and shopping). In addition, the study specifies that this non-significant effect of the tax derives from the benefits of using mobile money being greater than the extra cost caused by the tax. Finally, the different tax rates for bank and mobile money services could lead people to use mobile money instead of banking services.

More broadly, we contribute to the growing literature around DFS taxation on the African continent. Focusing on Uganda, Congo, Côte d'Ivoire and Malawi, Clifford (2020) points out a negative effect of mobile money taxation on financial inclusion, with a decrease in demand for mobile money services and an increase in demand for cash. For instance, in Uganda the 1 per cent tax on mobile money transactions in July 2018 caused a drop in person-to-person transfers of more than 50 per cent by August 2018. These taxes can also negatively impact mobile money agents. In Congo and Uganda, some agents stopped their activities due to the reduction in transactions (Clifford 2020). However, this study does not provide enough information on the magnitude of the effect. In a different context, Katusiime (2021) analyses, with a time series estimation, the Ugandan specific tax implemented in 2018 as a determinant of mobile money use, and finds a negative and significant effect. Due to the 2018 mobile money tax, mobile money usage – calculated 'by dividing the total value of all mobile money transactions in a given period by the number of transactions in that period' (Katusiime 2021: 8) – declined by 0.7 per cent in the short run, while in the long run the decline was 0.8-0.9 per cent (Katusiime 2021). In Tanzania, some authors point out that the excise duty on fees could negatively impact the poorest consumers, because fees are relatively higher for low transaction amounts (Maganga 2019; Ramadhan 2019). On the political front, mobile money taxes created a lot of protest and disagreement from key stakeholders. In Ghana, after the announcement of the levy applied on May 2022 on electronic transaction values, surveys show that most of the population disagreed with the levy and would stop using mobile money after implementation of the tax (Afrobarometer 2022; Amoah and Amoah 2022). Mobile money has been largely adopted in SSA due to its cost effectiveness, mainly linked to reducing transaction costs (Jack and Suri 2014). However, taking the example of the recent Ghana e-levy, Quartey and Nyarko (2022) emphasise that the tax considerably reduced the cost effectiveness of mobile money. Another study on the Ghana e-levy highlights that the tax burden is regressively distributed among informal workers in Accra, raising the equity implications of these policies (Anyidoho et al. 2022).

We also speak to policy. The evidence produced here aims to directly inform the heated discussions around the feasibility of taxing digital financial services, and the repercussions this could have on financial inclusion. While robust knowledge from other contexts is necessary to provide a more comprehensive picture, this study suggests that taxing mobile money, when it is adequately developed and widespread in the population, may not hamper its use. The rising trend in usage at the macroeconomic level seems to support the decision of the government around excise duty. At the same time, policymakers must adequately consider the negative repercussions these policies can have on specific user categories. As we show in this paper, categories that were less likely to be financially included before the tax – larger and poorer households – are also those for which the impact is more concerning. This evidence raises some questions that governments should consider around equity and support for more disadvantaged groups, in addition to questions about how these groups can benefit from the increased revenue from DFS taxation.

The paper proceeds as follows. In the next section we present data sources and characteristics, as well methodological approaches at the macro and micro levels. In Section 3 we present and discuss our results on the short- and long-term effects of the excise duty on transaction fees. Section 4 discusses results and concludes.

2 Data and methodology

2.1 Data sources

We use two sources of data to examine how the excise duty on transaction fees affected use of mobile money in Kenya. At the macroeconomic level we use monthly data from the Central Bank of Kenya (CBK) on mobile money usage and other socioeconomic characteristics. At the microeconomic level, we use household survey data collected before and after first implementation of the tax in 2013.

At macro-level, data is available for the period 2007m3 – 2021m12, and mostly obtained from the CBK and the National Bureau of Statistics. This is the case for information relating to mobile money transactions, agents and registered accounts, inflation, interest rate, exchange rate and monetary indicators (M1 and M2). Information on COVID-19 is obtained from Dong et al. (2020). The Composite Indicator of Economic Activity (CIEA) has been calculated following the work of Ndirangu et al. (2014), due to the lack of official monthly information on GDP. Appendix 1 gives more information relating to derivation of the CIEA.

For the analysis at micro-level, we use five rounds of nationally representative household survey data collected in 2008, 2009, 2010, 2011 and 2014.[6] Researchers Tavneet Suri (MIT) and William Jack (Georgetown University) collected this data to study the impact of mobile money (M-PESA) use and growth in Kenya (Jack et al. 2013; Jack and Suri 2009, 2014; Suri et al. 2012).[7] Table 1 shows information for each survey round, also indicating how the number of accounts and number of agents expanded over the period covered by the five survey rounds.

Table 1 Survey timeframe and key indicators across rounds

Survey round	Round 1	Round 2	Round 3	Round 4	Round 5
Time frame	Aug-Oct 2008	Oct 2009-Jan 2010	May-Aug 2010	Mar-June 2011	June-Sep 2014
Sample households	3,000	2,016	1,513	1,649	1,688
Number of accounts (million users)	4	8	13	14	25.4
Number of agents	4,000	16,000	20,000	28,000	125,000

Source: The M-PESA Household Survey: Data Note (Suri and Jack n.d.)

Survey rounds collected information on both households and individual M-PESA users, if any. The first part of the questionnaire asked for basic household composition through a careful listing exercise – demographic data, household wealth and assets, characteristics of dwelling, consumption, positive and negative shocks, and remittances. The modules also include a detailed section on mobile phone ownership and usage at household level. For M-PESA usage, the second part of the questionnaire asked about 30 types of service performed through M-PESA, the frequency of these uses, and average amounts sent/ received to/from household members, spouses and employers/employees. Surveys were carried out with heads of households, or their spouses if they were absent after three visits.

We acknowledge at least four limitations with the survey data. First, attrition rates across rounds are particularly high, especially between rounds 1, 2 and 3. The authors tried to

[6] However, 8% of the national population in areas of Northern Kenya had to be dropped for logistical reasons.

[7] The database can be accessed at https://dataverse.harvard.edu/dataverse/mobilemoney.

contact households that left the survey in rounds 4 and 5 again. Albeit high, attrition rates are relatively comparable to similar surveys in developing countries. Second, and probably most importantly, currently round 4 of the 2011 survey is not available. This forced us to only use four rounds in our study – 2008, 2009 and 2010 before introduction of the tax, and 2014 afterwards. Third, the survey data does not provide information on usage of other traditional and digital financial services. Finally, for confidentiality, the authors removed all variables that contained personally identifiable information. Some information, such as household location, could have been very useful in our analysis, but has not been shared. Some variables, such as weekly expenses, agents' location and ownership of housing, cannot be used in our analysis as they are missing in some rounds.

2.2 Methodology

Time series estimation. For the macro analysis based on time series, we modelled the money demand function following the work of Katusiime (2021), who built their analysis on the theoretical framework of quantity theory of money. As such, the demand for mobile money is a function of income, interest rate, inflation and exchange rate.

$$MM^d = f(Y, INT, INFL, EXCH) \quad (1)$$

To estimate the impact of the introduction of the tax on mobile money transactions in 2013, and the following change in 2018, we implemented an autoregressive distributed lag (ARDL) testing approach, following Pesaran et al. (2001).

The advantages of ARDL compared to similar cointegration models are related to the possibility for the variables to be integrated at different orders, and that the underlying variables are integrated of order one, order zero or fractionally integrated. In addition, an ARDL model is more efficient with small sample data, accounts for endogeneity, and bounds test can be performed even at different orders of integration across variables.[8] As the presence of variables with orders of integration I(2) makes the F-statistics of the bounds test invalid, a unit-root test is performed before proceeding with the analysis. The base model used for this analysis is presented in Equation (2).

$$\Delta MM_t = \alpha_0 + \sum_{k=1}^{n1} \beta_{1k} \Delta MM_{t-k} + \sum_{k=1}^{n2} \beta_{2k} \Delta \mathrm{TAX}_{t-k} + \sum_{k=1}^{n3} \beta_{3k} \Delta \mathrm{MMR}_{t-k} + \sum_{k=1}^{n4} \beta_{4k} \Delta \mathrm{CIEA}_{t-k} + \sum_{k=1}^{n5} \beta_{5k} \Delta \mathrm{INFL}_{t-k} + \sum_{k=1}^{n6} \beta_{6k} \Delta TB_{t-k} + \sum_{k=1}^{n7} \beta_{7k} \Delta \mathrm{ER}_{t-k} + \sum_{k=1}^{n8} \beta_{8k} \Delta FI_{t-k} + \sum_{k=1}^{n9} \beta_{9k} \Delta \mathrm{COVID}_{t-k} + \gamma_1 MMR_{t-1} + \gamma_2 TAX_{t-1} + \gamma_3 CIEA_{t-1} + \gamma_4 INFL_{t-1} + \gamma_5 TB_{t-1} + \gamma_6 ER_{t-1} + \gamma_7 FI_{t-1} + \gamma_8 COVID_{t-1} + \varepsilon_t \quad (2)$$

Where *MM* is the dependent variable, looking at different outcomes:

1. natural logarithm of the average mobile money transaction, calculated as a ratio of total value of all mobile money transactions over the number of transactions;
2. the natural logarithm of total transaction values expressed as Ksh billion transaction per 100,000 people;
3. the natural logarithm of total transaction volumes expressed as millions of transactions per 100,000 people;
4. the natural logarithm of total number of agents per 100,000 people.

We acknowledge that each of the selected outcomes of interest, if considered independently, may not give a complete overview of the scenario of interest. For example, a decline in the

[8] Consequently, pre-testing the order of integration of the variables is not required.

average mobile money transaction may not necessarily imply a negative outcome. If additional poorer people have taken up mobile money services, or mobile money is used more widely to pay small bills, you would expect the average (a figure of relatively little value) to fall. At the same time, we believe that each of the four selected outcomes of interest shows light on different parts of the overall scenario of interest.

TAX is either two dummy variables denoting the beginning of the tax on mobile money transactions in 2013 and its change in 2018, or one variable reporting the tax rate. *MMR* is the number of mobile money registered accounts. *CIEA* is the Composite Indicator of Economic Activity. *INFL* is the inflation rate, measured as the first difference of the natural log of the consumer price index. *TB* is the interest rate on 91-day Treasury Bills. *ER* is the natural logarithm of the nominal exchange rate with the US dollar. *FI* indicates financial innovation, calculated as the natural logarithm of M2/M1. *COVID* is either the natural logarithm of the number of deaths reported monthly in Kenya, or a dummy to indicate the beginning of the COVID-19 pandemic. Coefficients of the parameters β_{1k}-β_{9k} will provide estimates for the short term, while long-term effects will be provided by the coefficients of the parameters γ_1-γ_8, normalised by α_0.

The macro analysis allows us to capture short- and long-term average impacts of the excise duty on mobile money adoption at country level. However, since operators offer many services, and these are differently impacted by the levy, it is relevant to see if the effect of the tax differs according to use. Hence, we use survey data before and after first implementation of the tax to analyse its effects at user level.

Before running more robust econometric methods on impacts, we present descriptive findings and stylised facts around mobile money usage. For simplicity, we focus on the most recent round available before the introduction of the duty – data collected in 2010. Apart from descriptive and exploratory analysis on usage, we also run more structured correlational analysis through ordinary least squares (OLS). In the OLS framework outcomes are key usage indicators, such as: (i) probability of the household having a member who is an M-PESA-registered user, (ii) different type of uses from these users, and (iii) frequency of usage. We create an indicator variable for being a frequent user and amounts of usage transformed in logs.

Always relying on the survey data, we then attempt to identify shifts in mobile money usage over time, and explore the role that the duty might have played. We exploit the panel nature of the survey data, described in Table 1, and the fact that data is available for periods before (2008, 2009, 2010) and immediately after (2014) introduction of the duty. More precisely, we run a set of fixed effect regressions to evaluate the impact of different time periods on several outcomes of interest. The first is the probability of using mobile money to perform different types of transactions: sending, receiving, paying bills and saving. We focus particularly on these activities as descriptive preliminary evidence shows they are the most common uses in 2010, the closest time period to introduction of the duty. The second outcome is likelihood of being a 'frequent user' of mobile money. We also consider the amounts involved in different types of transactions. Finally, we consider the purpose of use as an outcome.

The regressions we estimate are based on equation 2, where Y_{it} is one of the relevant outcomes listed above. The coefficients of interest are β_1, β_2, and β_3, which capture the effect of three dummy variables corresponding to each time period of interest – 2008, 2009 and 2014 – while 2010 is used the reference year and thus omitted. γ_i captures the fixed effects – all the observable and unobservable factors that remain fixed over time, within individual respondents, during the time period. They include demographic factors, such as location and

household size, as well as gender and level of education for both the respondent and head of household. In addition, we control for features varying over time as captured by X_{it} – these are variables such as monthly income, yearly income and number of mobile phones in the household. As discussed in Section 4, these variables are important explanatory factors for using mobile money. It is prudent to include these factors in the fixed effect regression framework, which by definition does not automatically capture them. ε_{it} is an error term, which we make robust to heteroskedasticity.

$$Y_{it} = \beta_0 + \beta_1 2008 + \beta_2 2009 + \beta_3 2014 + \beta_4 X_{it} + \gamma_i + \varepsilon_{it} \quad (3)$$

3 Results

3.1 Effects of 2013 and 2018 excise duty at national level

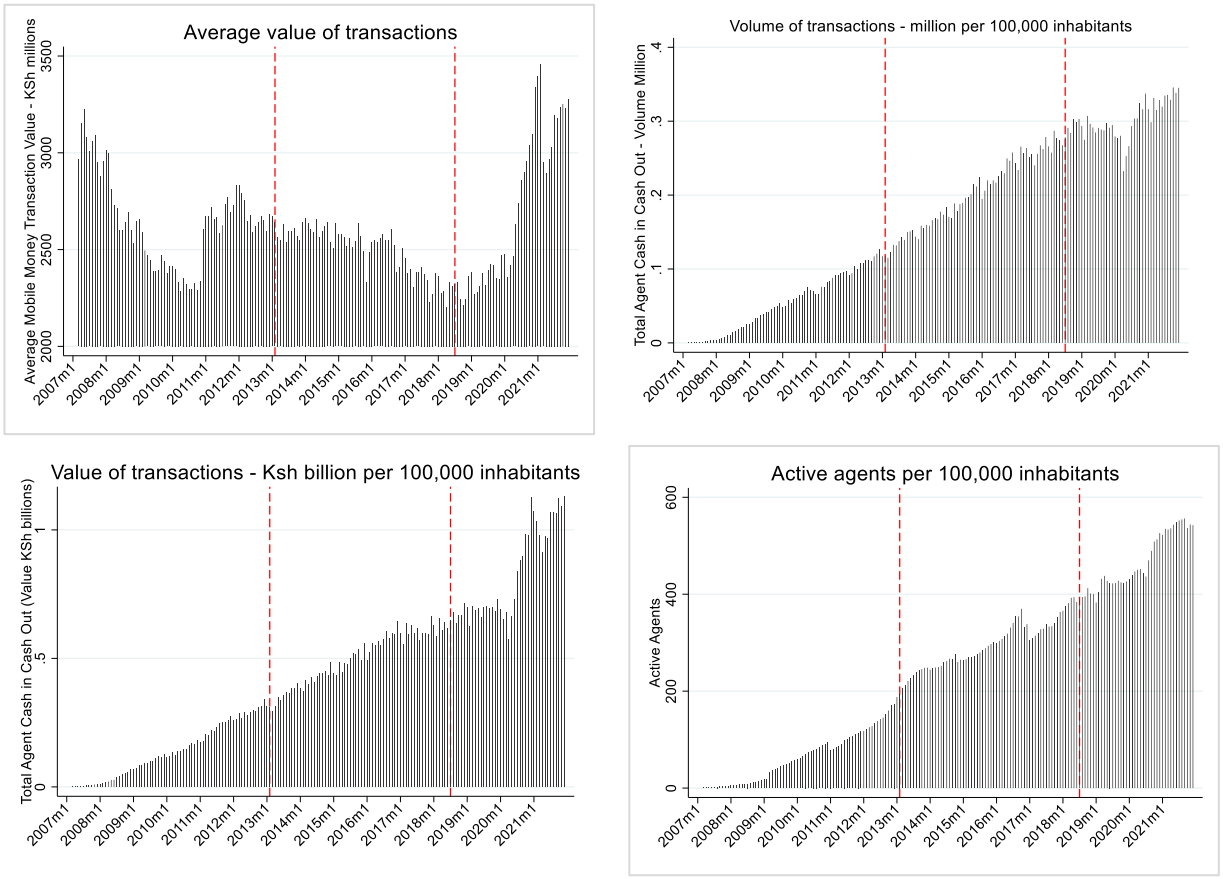
Before proceeding with the model estimation, we first present the trend for the main variables of interest over the period 2007-2021. Evidence from Figure 1 shows that the average value of all transactions shows a sinusoidal trend over the years of interest – an initial decrease from 2007 up to early 2011, a drastic increase in 2011, another decrease until mid-2018, to eventually conclude with a rising trend until late 2021. The three other variables of interest – overall volume and value of transactions and overall number of agents (all expressed per 100,000 people) show an increasing trend over the period of interest. [9] We present the main descriptive statistics of the variables used for this analysis for years 2007, 2014 and 2021 in Table 2.

Results in Table 2 report average monthly values for 2007, 2014 and 2021. As previously observed in Figure 1, the average value of transactions reported was lowest in 2014 (Ksh2,604) and the highest in 2021 (Ksh3,173). By contrast, the overall volume and value of transactions and number of active agents dramatically increased over the years. While in 2007 the volume of monthly transactions was slightly more than 1,000 operations per 100,000 people, the overall monthly value of transactions was around Ksh 4 million per 100,000 people. The number of agents was slightly over 2 agents per 100,000 people. In 2021 the monthly volume of operations per 100,000 people was more than 300,000, the overall monthly value of operations was over Ksh1 billion per 100,000 people, and there were more than 500 agents per 100,000 people. A similar trend can be observed for the number of registered accounts, showing an increase from only half a million accounts in 2007 – the year the service was launched in Kenya – to more than 67 million accounts in 2021.[10] The CIEA shows rising values over the years, and more than doubled between 2007 and 2021. Inflation – measured as the first difference of the natural log of the consumer price index – decreased over the years of interest. The interest rate on 91-day Treasury Bills registered its highest value in 2014, the nominal exchange rate shows a depreciation over the years with respect to the US dollar, the index of financial innovation reported a decrease since 2014, and, on average, 309 monthly deaths due to COVID-19 were registered in 2021.

[9] Nevertheless, the coefficients relative to the trend variable in the regression analysis all report non-statistically significant coefficients. Consequently, we did not include a trend in the ARDL model.

[10] Appendix Figure A2 reports the number of registered accounts over the period 2007-2021.

Figure 1 Value, volume and average value of mobile money transactions, and number of active agents 2007-2021



Source: Authors' calculations based on data from Central Bank of Kenya.

Table 2 Main descriptive statistics for 2007, 2014 and 2021

	2007	**2014**	**2021**
Average transaction value (Ksh)	3037.3	2604.0	3172.7
	(105.3)	(47.6)	(176.9)
Total volume of transactions (million per 100,000 people)	0.001	0.163	0.328
	(0.001)	(0.013)	(0.014)
Total value of transactions (Ksh billion per 100,000 people)	0.004	0.423	1.041
	(0.004)	(0.031)	(0.068)
Number of active agents (per 100,000 people)	2.1	257.9	542.1
	(1.1)	(9.7)	(9.8)
Mobile money registered accounts - million	0.5	25.9	67.4
	(0.5)	(0.4)	(0.7)
CIEA	100.8	171.3	229.8
	(1.5)	(5.2)	(6.0)
Inflation	0.76	0.49	0.46
	(0.80)	(0.45)	(0.25)
Interest on 91-day Treasury Bills	6.94	8.93	6.99
	(0.45)	(0.49)	(0.23)

Nominal exchange rate with US$	66.8	87.9	109.6
	(1.6)	(1.4)	(1.7)
Financial innovation (M2/M1)	1.83	2.06	1.89
	(0.07)	(0.04)	(0.02)
COVID-19 - new deaths	0.0	0.0	309.0
	(0.0)	(0.0)	(235.0)

Source: Authors' calculations based on data from Central Bank of Kenya.

Note: Standard deviation in parentheses. Values refer to monthly average for selected years.

We proceed with the analysis by verifying that the series taken into consideration are not integrated of order 2 – I(2), as this would invalidate the F-statistics of the regression. We hence performed an Augmented Dickey-Fuller (ADF) test and Phillips Peron (PP) test to investigate the order of integration of the selected indicators. Results, showing that there are no variables with an order of integration higher than one – hence possible to use for an ARDL estimation – are presented in Appendix Table A2.

Next, we focus on the decision on the optimal lag order for each variable of the model. We selected the Akaike's information criterion (AIC), Schwarz's Bayesian information criterion (SBIC) and Hannan and Quinn information criterion (HQIC), all with a maximum of six lags, and the decision on the optimal length of the lags was based on the most recurrent value indicated by the criteria. Finally, before proceeding with the analysis, we perform a bounds test for cointegration, to investigate the statistical significance of the long-run equilibrium relationship between the dependent and long-run independent variables. Appendix Tables A3 and A4 in report, respectively, the lags indicated by the three criteria and the final decision implemented for the following analysis, and the F-statistic and lower and upper bounds at 1 per cent confidence interval. The F-statistics of all selected models are above the upper bound, indicating the presence of a long-term relationship between the dependent and independent variables of interest. As the last step, we estimate the short-term and long-term dynamics of the variables of interest. Results are reported in Table 3. Unfortunately, the lack of empirical evidence on the relationship between use of mobile money and macroeconomic policy variables and regulation does not allow us to compare our results with many similar analyses.[11]

[11] Among the few papers that performed a similar analysis, the closest one was performed by Katusiime (2021) in Uganda, where money mobile tax was found to have a negative impact, both in the short and in long term, on average mobile money transactions. In Kenya, Fehling (2019) examines the impact of the introduction of the 2013 mobile money tax, and, using a difference-in-difference approach, found no impact on volume of transactions.

Table 3 Results of ARDL model

	Average transaction value ARDL (1 6 1 1 2 1 4 3 2 2)		Transaction volumes ARDL (6 6 1 1 2 1 4 3 2 2)		Transaction values ARDL (6 6 1 1 2 1 4 3 2 2)		Number of agents ARDL (3 6 1 1 2 1 4 3 2 2)	
	Short-term	**Long-term**	**Short-term**	**Long-term**	**Short-term**	**Long-term**	**Short-term**	**Long-term**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mobile money indicator								
D1			-0.102		-0.172**		-0.006	
			(0.086)		(0.083)		(0.083)	
D2			-0.022		0.047		0.025	
			(0.070)		(0.072)		(0.081)	
D3			-0.047		0.073			
			(0.074)		(0.074)			
D4			-0.032		0.035			
			(0.071)		(0.073)			
D5			0.170***		0.183***			
			(0.063)		(0.061)			
TAX 2013		-0.015		0.032		0.034		0.054***
		(0.012)		(0.019)		(0.021)		(0.020)
D1	0.008		0.013		-0.009		-0.012	
	(0.028)		(0.047)		(0.050)		(0.048)	
TAX 2018		-0.018*		0.008		-0.028		0.005
		(0.009)		(0.016)		(0.019)		(0.019)
D1	0.014		0.017		0.034		0.026	
	(0.028)		(0.047)		(0.051)		(0.049)	
Mobile money registered users		0.041***		0.030		0.172***		0.076
		(0.015)		(0.048)		(0.055)		(0.047)
D1	-0.115*		0.215*		-0.004		0.257**	
	(0.068)		(0.121)		(0.133)		(0.120)	
D2	-0.053		0.106		0.009		0.076	
	(0.061)		(0.118)		(0.127)		(0.107)	
D3	-0.010		-0.096		-0.168		-0.001	
	(0.061)		(0.107)		(0.115)		(0.105)	
D4	0.040		-0.248**		-0.339***		-0.022	
	(0.060)		(0.106)		(0.113)		(0.102)	
D5	0.076		-0.335***		-0.352***		0.048	
	(0.057)		(0.104)		(0.111)		(0.098)	
D6	0.202***		-0.179*		-0.037		-0.072	
	(0.053)		(0.097)		(0.105)		(0.093)	
CIEA		0.004		0.276**		0.289**		-0.272**
		(0.065)		(0.108)		(0.117)		(0.105)
D1	-0.127		1.738***		1.599***		0.198	
	(0.165)		(0.285)		(0.308)		(0.288)	
D2	-0.376**		0.177		0.186		-0.046	
	(0.154)		(0.312)		(0.329)		(0.267)	
Inflation		0.006		-0.002		-0.004		0.004
		(0.005)		(0.008)		(0.008)		(0.008)

D1	-0.001		-0.003		0.004		-0.010	
	(0.004)		(0.007)		(0.007)		(0.007)	
Trade balance		0.002*		0.000		0.001		0.003
		(0.001)		(0.002)		(0.002)		(0.002)
D1	0.001		0.001		0.001		-0.001	
	(0.002)		(0.003)		(0.003)		(0.003)	
D2	-0.003		-0.002		-0.005		-0.005	
	(0.002)		(0.003)		(0.003)		(0.003)	
D3	0.001		0.005		0.004		-0.000	
	(0.002)		(0.003)		(0.003)		(0.003)	
D4	0.001		-0.006**		-0.005		-0.005	
	(0.002)		(0.003)		(0.003)		(0.003)	
Exchange rate		-0.170**		0.155		0.170		0.313***
		(0.070)		(0.129)		(0.128)		(0.111)
D1	0.277**		-0.952***		-0.855***		-0.117	
	(0.135)		(0.243)		(0.249)		(0.231)	
D2	0.176		0.173		0.039		-0.012	
	(0.134)		(0.243)		(0.253)		(0.228)	
D3	0.221*		-0.362		-0.141		-0.021	
	(0.129)		(0.223)		(0.235)		(0.218)	
Financial innovation		0.093*		-0.093		0.045		0.151
		(0.055)		(0.093)		(0.102)		(0.102)
D1	0.080		0.064		0.120		-0.656***	
	(0.116)		(0.190)		(0.205)		(0.207)	
D2	-0.092		-0.063		-0.117		0.121	
	(0.115)		(0.191)		(0.207)		(0.209)	
COVID - new deaths		0.018***		-0.007*		0.004		0.003
		(0.003)		(0.004)		(0.003)		(0.003)
D1	-0.027***		-0.010		-0.033***		-0.006	
	(0.007)		(0.012)		(0.013)		(0.012)	
D2	-0.004		0.012		0.006		-0.005	
	(0.008)		(0.012)		(0.013)		(0.012)	
Error correction term (t-1)	-0.303***		-0.185***		-0.305***		-0.080**	
	(0.054)		(0.044)		(0.055)		(0.031)	
Intercept	2.907***		-2.505***		-3.138***			
	(0.516)		(0.665)		(0.725)			
N	172	172	172	172	172	172	172	172
R-squared	0.371	0.371	0.761	0.761	0.741	0.741	0.647	0.647
Log-likelihood		397.38		316.47		303.19		302.96
Durbin Watson		1.698		2.087		2.096		2.026
F-stat		4.811		7.005		6.073		3.939
F-stat lower bound (1%)		2.701		2.682		2.682		2.394
F-stat upper bound (1%)		4.189		4.198		4.198		3.892
Cameron & Trivedi's decomposition - p-value		0.464		0.464		0.464		0.464

Source: Authors' calculations based on data from Central Bank of Kenya. Standard errors in parentheses – *** p<0.01, ** p<0.05, * p<0.1. Note: The variables D* refer to the variables in difference related to the short-term results. The optimal number of lags obtained using the AIC, SBIC, and the HQIC are reported in Appendix Table A3.

We first focus on the short-run determinants of the independent variables for our main dependent variables of interest. It is first interesting to note that the tax on mobile money in both 2013 and 2018 had no short-term impact on the variables of interest. A possible and reasonable explanation can be found in the nature of the tax on financial transactions, and on the different rates applied to different types of financial transactions. When the tax was introduced in 2013 a flat rate of 10 per cent was applied to all types of financial transactions (banks, agencies, financial service providers and mobile money providers). In 2018 different rates were assigned to different transactions, with mobile money having the lowest rate (12 per cent vs. 20 per cent for other providers). It is reasonable to believe that, if any adverse impact of the tax on mobile money was present, it would be more likely to be associated with introduction of the tax in 2013 rather than in 2018, when mobile money providers experienced the lowest rate among digital financial services. In addition, our results can find additional support if we plausibly assume a low degree of substitution between cash and mobile money transactions at least in the short term, due to the nature of those transactions – for example, remittances. Finally, results obtained with the use of the continuous tax variable, presented in Appendix Table A5, confirm the absence of any relationship between the tax and mobile money indicators in the short term.

Moving the focus to the other main independent regressor, the number of registered mobile money users – we instead observe an initial negative relationship with average transaction value. This turns positive at higher lags. The opposite can be observed between registered users and total transaction volumes. We also observe a negative relationship between registered users and transaction values in correspondence of higher lags, and a positive relationship at lower lags, with the total number of agents.[12] Finally, the negative and significant coefficients relative to the error correction term (ECT_{t-1}) indicate the presence of a long-term relationship. With reference to the specific variables of interest for this paper, the coefficients relative to the error correction terms indicate that any shock in the previous period is adjusted in the long term at an approximate speed of 30 per cent for the average transaction value and overall transaction values, 18.5 per cent for transaction volumes, and 8 per cent for the total number of agents.

When it comes to long-term determinants, our results show a weakly significant and negative relationship between average transaction value and the revised tax in 2018, and a strongly significant and positive relationship between the 2013 tax and number of agents. We do not find any other statistically significant relationship between either of the taxes and overall volumes and values of transaction. Results relative to the long-run relationship between the tax on mobile money and selected mobile money indicators are generally confirmed by the results obtained with the use of the continuous tax variables presented in Appendix Table A5. The only exception relates to the shift of the weak significance from the relationship between the tax and average transaction value, to the one between tax and overall volume. Focusing on other independent variables, the number of registered mobile money users is

[12] The CIEA has a negative relationship with average transaction value, a strong and positive relationship with total transaction values and volumes. Inflation and interest rate on 91-day Treasury Bills do not show any significant relationship with any of the variables of interest, except for a very low and negative coefficient relative to interest rate on 91-day Treasury Bills and overall volumes of transaction. The exchange rate reports a positive correlation with average transaction value, and a negative one with overall transaction volumes and values. Higher financial innovation is negatively associated with the number of agents, while an increase in the number of COVID-19 deaths has a negative impact on average transaction value and on overall transaction values.

positively associated with average and overall transaction values, but not with overall volumes nor number of agents.[13]

Summarising the short-term findings, we find that the duty on money transfers fees had no short-term impact on our selected mobile money indicators. In addition, for the number of registered mobile money users we find mixed evidence with average transaction values and overall volumes, a negative relationship with overall values, and a positive one with total number of agents. Moving to the long-term results, we find that the 2013 excise duty is strongly and positively associated with total number of agents, while the tax in 2018 is negatively associated with average transaction value, although this relationship is weak. Finally, an increase in the number of registered users has a positive impact on average and overall transaction values.

Hence, our findings at the macroeconomic level do not show a strong significant impact of the excise duty applied in 2013 and modified in 2018. However, macroeconomic data aggregates all types of transactions and users, and does not allow us to include heterogeneity between users and uses. For instance, users can change their behaviour depending on the use (sending, receiving or saving) or even purpose for sending (personal or professional). Consequently, the rest of the study uses survey data at the individual and household levels to analyse changes in mobile money usage after application of the tax.

3.2 Patterns of usage before introduction of the duty at microeconomic level

Before evaluating the effects of mobile money excise duty at the microeconomic level, we turn to survey data and explore patterns of usage among Kenyan households at baseline, in 2010. Thanks to this detailed data, we can highlight important dynamics that can play a role in better understanding overall impact of the duty. At the time of the 2010 survey round, as many as 69 per cent of households had at least one member registered with M-PESA. We run a simple OLS regression framework quantifying the correlates of M-PESA registration and presenting some initial evidence on the difference between households with and without registered individuals. The OLS coefficients, and corresponding confidence intervals and level of significance, are plotted in Figure 2.

This initial exercise shows that households with higher monthly expenditure are significantly more likely to use M-PESA. The fact that household size is negatively related to usage, and strongly significantly so, may indicate that wealthier households – smaller in size and with higher expenditure – are more likely to use M-PESA. The number of mobile phones in the household is another strong covarying factor, again corroborating the hypothesis that wealthier households – with higher access to phone devices – are better placed to use M-PESA.[14] Lastly, having an older and male head of household negatively covaries with using M-PESA. Age can be seen as a barrier to adoption, while, surprisingly, female-headed households are more likely to use M-PESA – probably because they need to receive remittances and other transfers in a timely and safe fashion, as described below.

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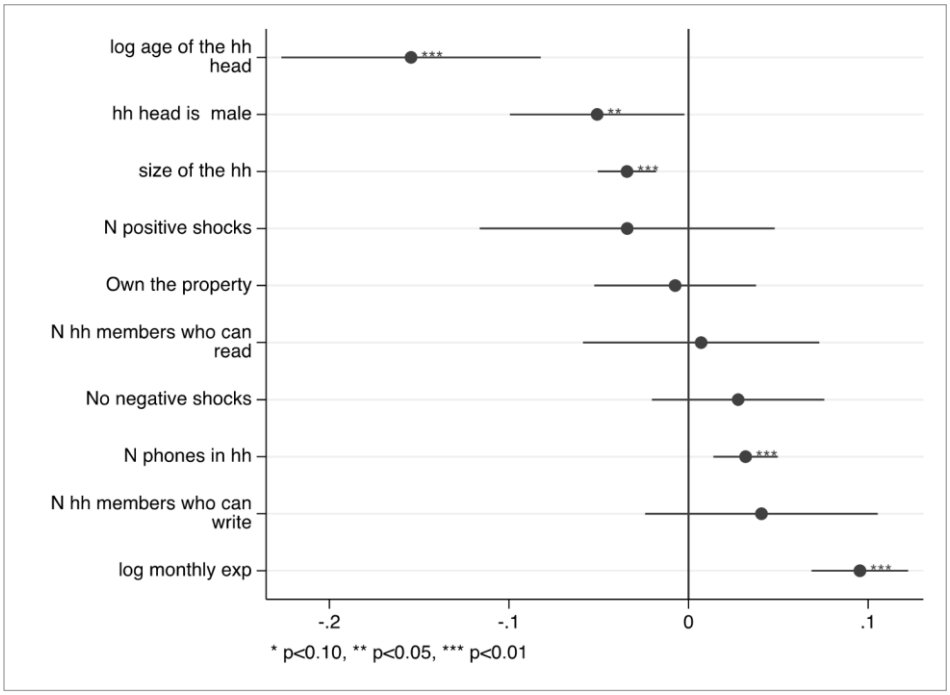
[13] The CIEA reports a positive relationship with overall volumes and values and a negative long-run relationship with number of agents. Inflation and interest rate on 91-day Treasury Bills do not show any significant long-term relationship with any variables of interest, except for a very low and negative coefficient relative to interest rate on 91-day Treasury Bills and average transaction value. The exchange rate is negatively associated with average transaction value and positively associated with number of agents. Finally, an increase in financial innovation and COVID-19 related deaths is positively associated with average transaction value; the number of COVID-19 related deaths is negatively associated with overall volume of transactions.

[14] The top household quintile in the expenditure distribution own on average 2.9 mobile phones, as opposed to 1.7 in the remaining quintiles – a difference statistically significant at 1% level.

Figure 2 Correlates of M-PESA adoption – OLS coefficients

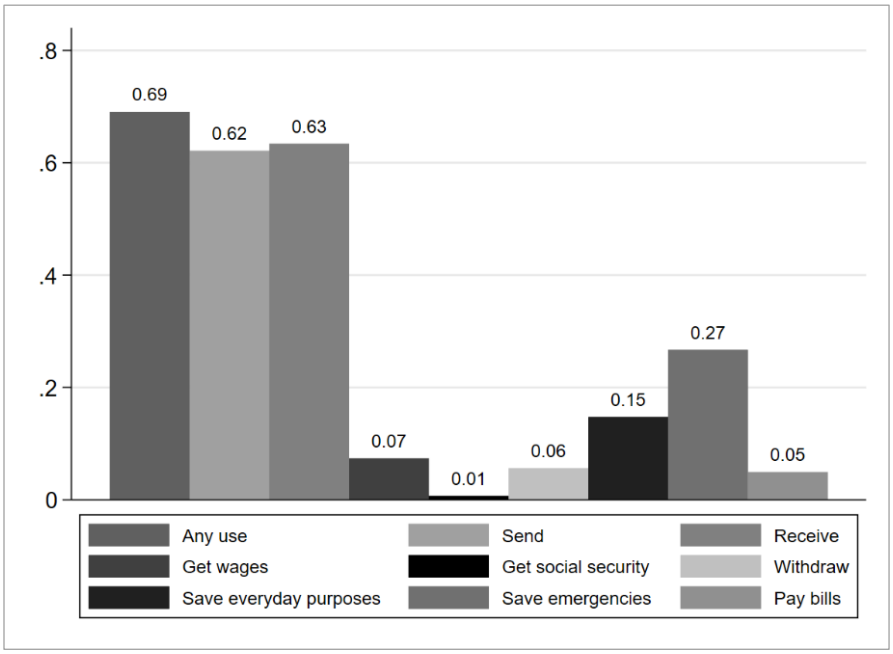


Source: Authors' calculations based on round 3 (2010) of survey data.

0

As a second piece of evidence, Figure 3 outlines the likelihood of using M-PESA for different specific uses. Again, 69 per cent overall report using M-PESA for any reason. Figure 3 indicates that users perform a variety of tasks with mobile money. Not surprisingly, almost all of them use mobile money for sending and receiving money. The most common other use is saving for emergencies (50 per cent), followed by saving for everyday purposes (47 per cent). Withdrawing (37 per cent), getting wages (36 per cent) and paying bills (35 per cent) are also relatively common.

Figure 3 Likelihood of using mobile money for different uses

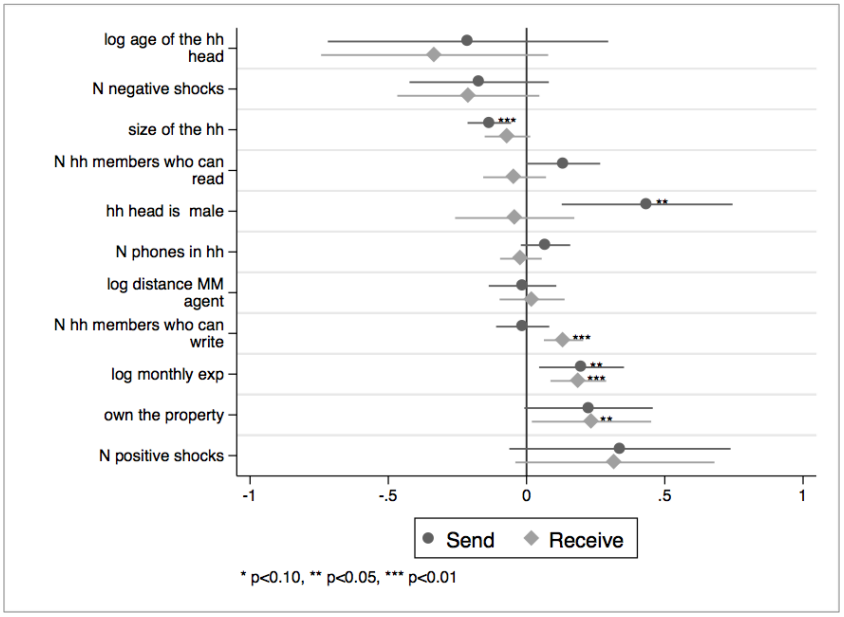


Source: Authors' calculations based on round 3 (2010) of survey data, N=1600.

Appendix Table A6 further explores the correlates of using M-PESA, reproducing the OLS coefficients from Figure 2, for each use.[15] While overall the key factors at play remain important, at least three considerations are important. First, the gender dimension in the household matters most for receiving money (col. 2), since female-headed households might be more reliant on remittances and transfers of money from other individuals supporting them. Second, the level of education in the household, proxied by the number of members who can read and write, is a key correlate of using M-PESA for getting wages and savings for everyday purposes. This indicates that more educated households are more likely to have formal jobs, whose payment channels are more digital and transparent. At the same time, they are more likely to use mobile money to keep adequate savings for everyday uses. Lastly, the number of negative shocks experienced by the household naturally covaries with using M-PESA for saving for emergencies, and, at least marginally, for saving for everyday uses.

A last piece of evidence relates to usage frequency and amounts. Appendix Figure A3 maps frequency for each use. It shows that a large proportion of households regularly perform different activities through mobile money – usually every month, or, for a few, every week. Likewise, around one-sixth to one-third of the sample use mobile money rarely, less than once a year – this being especially true for withdrawing money, which seems to be a rare event. Appendix Table A7 provides further evidence on the correlates of frequent usage for the four main use cases,[16] defined as using mobile money at least every month. In line with previous results, wealthier households with higher expenditure are more likely to be frequent users. In contrast, larger households and those with older heads are less likely to frequently use mobile money, while male-headed households use mobile money more frequently for saving. In the next section, we discriminate between frequent and infrequent users when capturing impact of the duty.

Figure 4 Correlates of log amounts – OLS coefficients



Source: Authors' calculations based on round 3 (2010) of survey data. The outcome is log amount sent or received through mobile money.

[15] For simplicity we remove the use of getting social security, as it is less common in the sample.

[16] For simplicity we omit results on frequency of paying bills with mobile money. This use is characterised by a more standard timing pattern, as bills are usually paid every month (50% of the sample) or every six months (23%), and do not directly depend on households' preference for usage.

The median amounts sent and received per time are very similar, around KSh1,980 (US$25) and naturally correlated (Appendix Figure A4). Once transformed in logs, we map the key factors correlated with amounts in Figure 4. Similar patterns to Figure 2 are observed. Household higher expenditure capacity and smaller size are key correlates of amounts, while male-headed households are more likely to send larger amounts. Interestingly, more educated households receive larger amounts as well. We will explore these dynamics in the next section on impact.

3.3 Immediate effects of 2013 excise duty at microeconomic level

In this section, we assess the immediate effects of the 2013 excise duty on fees using survey data. To do this, a fixed effects estimation approach is applied to the panel of four survey rounds – 2008, 2009, 2010 and 2014. The fourth round of survey run in 2011 is not available for public use. This approach allows us to estimate changes in mobile money usage across time, taking 2010 as the reference year, and controlling for all time-invariant household characteristics (see section 2.2). In other words, we try to see if mobile money usage changed in 2014 (period after the tax), compared to 2010 and before (periods before the tax). We include heterogeneity according to uses, frequency of use, average amount transacted, and purpose for using. Hence, four main groups of outcomes are presented in this section.

First, we analyse changes in mobile money service adoption with a variable equal to 1 if the respondent used a given service, and 0 if not. Then we consider mobile money usage frequency per use. The latter is based on the usage frequency variable and equals to 1 if the individual uses mobile money daily, weekly or monthly, and 0 if the individual uses mobile money every three months, six months or less. We also consider the average amount sent and received by individuals per transaction. Finally, we make regressions with four outcomes depending on whether individuals send/receive money to/from household or work.
Table 4 presents the fixed effects estimates on changes in mobile money adoption in 2008, 2009 and 2014, compared to 2010. Our findings align with those at the macroeconomic level – the excise duty implemented on mobile money transfer fees does not seem to hinder adoption of mobile money one year after introduction of the levy. If anything, we document an increase in mobile money adoption in 2014, with respect to 2010, with significant and positive coefficients for all uses. This shows that, despite the levy, people continued to adopt mobile money services. It is also relevant to notice that the coefficient size of paying bills (0.19), saving for everyday purposes (0.17) and emergencies (0.09) are much larger than other coefficients – 0.04 and 0.03, respectively for sending and receiving. This means that the increasing trend of mobile money services does not have the same intensity for all uses, and that the increase has been less important for transactions directly affected by the levy – sending and receiving. Indeed, the tax is applied on money transfers and does not affect other uses, such as savings and paying bills.

It is also true that the way the question on mobile money services usage is framed could generate confusion around the reference period. Respondents were asked: ‘What have you used the M-PESA service to do?’, without specifying the time period to refer usage to. In part to address this limitation, we now consider frequency of usage as an outcome to better analyse behavioural changes after the tax. Figure 5 illustrates the changes in mobile money services usage frequency for four uses – sending, receiving, saving for everyday purposes, and saving for emergencies.[17] This variable equals to 1 if the respondent is a frequent user, and 0 if not.

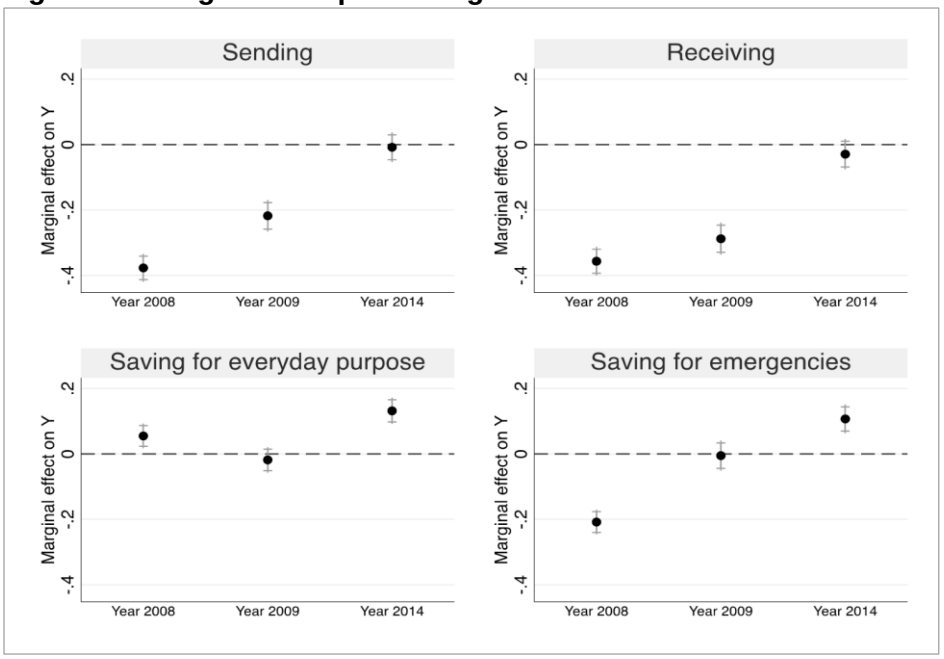
[17] Paying bills is not included, since bills are normally paid at regular intervals (usually per month) for most users.

Table 4 Changes in adopting mobile money services – 2010 as baseline

Use cases	Sending	Receiving	Saving for everyday purpose	Saving for emergencies	Paying bills
2008	-0.52***	-0.49***	0.03	-0.26***	-0.14***
	0.02	0.02	0.02	0.02	0.01
2009	-0.00	-0.03*	0.02	0.04	-0.02
	0.02	0.02	0.02	0.03	0.02
2014	0.04***	0.03**	0.17***	0.09***	0.19***
	0.02	0.01	0.02	0.02	0.02
Baseline Y	0.89	0.91	0.21	0.38	0.16
R-squared	0.426	0.388	0.056	0.149	0.214
Observations	5209	5209	5209	5209	5209

Source: Authors' calculations based on survey data. Question: What have you used the M-PESA service to do?

Figure 5 Changes in frequent usage over time – 2010 as baseline

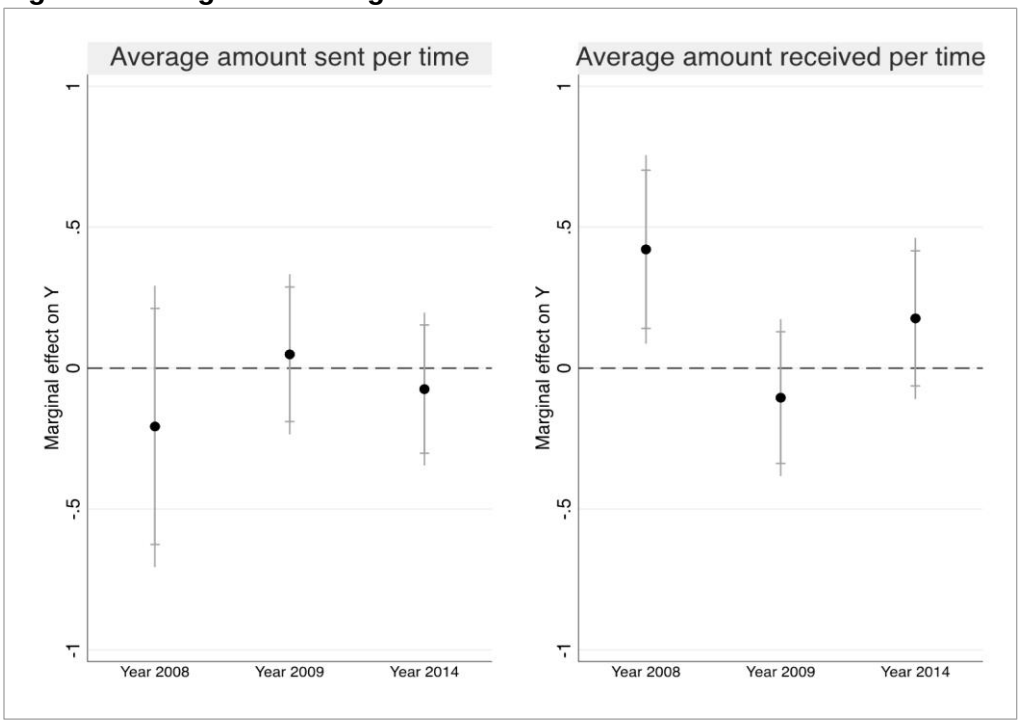


Source: Authors' calculations based on survey data. Questions: What is the frequency of use of this service?

Results differ according to the considered use. For saving for everyday purposes and for emergencies, we find a positive and significant coefficient for 2014 compared to 2010. This means that the probability of using these services frequently increased after implementation of tax compared to the period before the tax. However, the coefficients for sending and receiving are negative and non-significant. In other words, while mobile money users used saving services more often in 2014 compared to 2010, they did not change how often they used those services (sending and receiving) directly affected by the levy. We also note that the probability of using mobile money transfer services (sending and receiving) frequently increased before implementation of the tax. Indeed, this probability was significantly more important in 2010 compared to 2009 and 2008, with negative and significant coefficients (Appendix Table A8). However, one year after implementation of the duty this rising pattern is no longer observed. This shows that even if the duty did not decrease mobile money usage, it seems to have prevented more intensive use of dutiable services.

As a third set of results, we consider the fact that users change their transaction amounts to adapt to the duty. Since the tax is applied on fees, and fees relatively decrease with the transaction amount, sending higher amounts can help people pay less tax. Hence, we produce fixed effects estimations with the total average amount sent and received per time. Figure 6 presents the changes in average amount sent and received before and after the duty.[18] We find that amounts sent and received did not significantly change in 2014 compared to 2010. In other words, users did not reduce the average amount sent and received in response to introduction of the levy.

Figure 6 Changes in average amount sent and received over time – 2010 as baseline

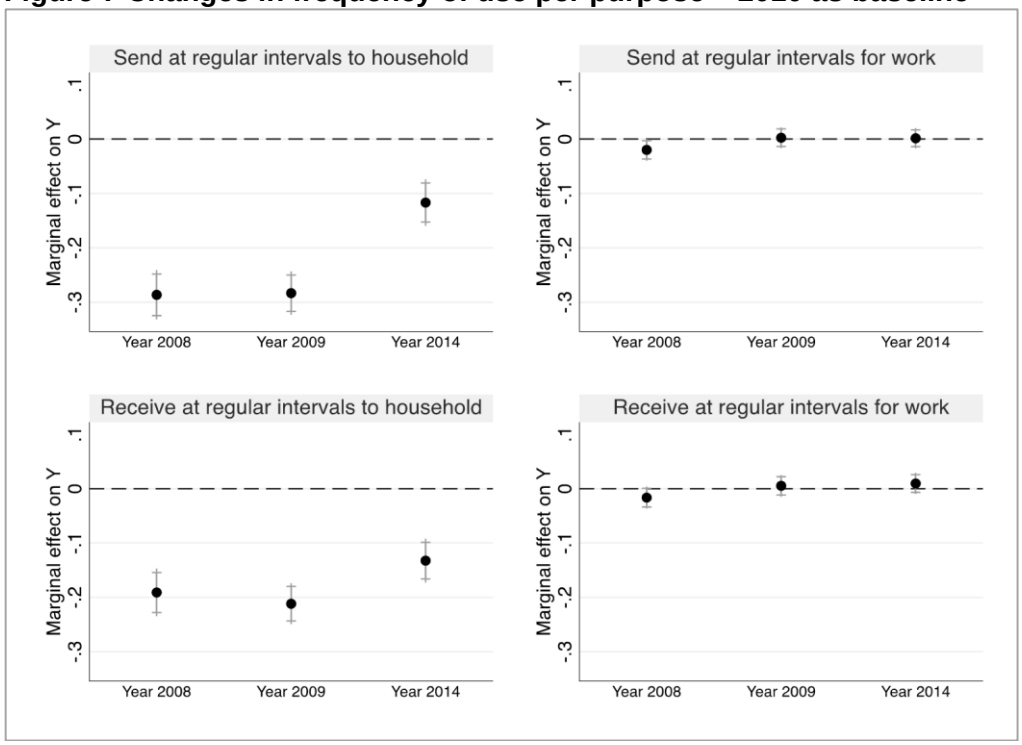


Source: Authors' calculations based on survey data – Question: What is the average amount sent (received) at a time?

As a fourth set of results, while the duty seems to not affect sending and receiving overall (Table 4 and Figure 5), these patterns could mask heterogeneity, especially when considering the specific purpose or recipient of sending and receiving transactions. To test for this, in Figure 7 we look closely at frequency of transactions to and from households – including the spouse and any other household member – as well as transactions for work purpose when they involve employees or employers. We find no significant change in usage frequency in 2014 compared to 2010 for work-related transactions. However, we find a significant and negative impact in sending and receiving frequency in 2014 compared to 2010 when the sender/receiver is a household member. This implies that households could have found other ways to send and receive money after implementation of the duty, such as reverting to cash. Sending and receiving habits remained the same for work, probably as more formal work-related transactions are more difficult to substitute with other means, such as cash.

[18] This information has not been collected for other uses.

Figure 7 Changes in frequency of use per purpose – 2010 as baseline



Source: Authors' calculations based on survey data – Question: Do you ever make/receive the following transfers of money at regular intervals?

Finally, as the descriptive analysis on main characteristics of mobile money users shows, many factors can determine mobile money usage. Hence, we reproduce fixed effects regressions by splitting the sample according to these variables – age, gender, household size, number of people that can write, number of people that can read, monthly expenditure and number of mobile phones in the household. Coefficient results are presented in Table 5, and suggest some heterogeneity in impacts that is worth discussing.

While for the whole sample mobile money usage significantly increased for all uses in 2014 compared to 2010, we find that – contrary to richer households – poorer households, with monthly expenses below median, sending and receiving with mobile money did not increase significantly after the duty. Muted impacts are found for larger households as well, again for those transactions, such as sending and receiving, affected by the duty.

Concerning the frequency of usage, when we consider only larger households, we find a negative and significant effect of the duty on the probability of receiving money frequently after introduction of the duty . This finding, coupled with the above, may indicate that larger households might face budget constraints that the duty made more salient, limiting usage. Larger households are also more likely to send smaller amounts. These households also show a more pronounced reduction in the regularity of transacting within the household, compared to smaller households.

In sum, the evidence seems to indicate that the duty might have had some concerning repercussions on equity. As shown descriptively, larger and poorer households are less likely to be financially included at baseline before the duty. These categories are also those for whom impacts are more muted, if not negative, after the duty was introduced. This suggests that financial inclusion could have become more challenging for worse-off households as a result of the duty.

Table 5 Heterogeneity according to users' main characteristics

Sample	Send	Receive	Save	Save for emerg-encies	Pay bills	Frequent user for sending	Frequent user for receiving	Frequent user for saving	Frequent user for saving for emerg-encies	Amount sent per time	Amount received per time	Send to household at regular intervals	Receive from household at regular intervals
Whole sample	**0.04*** **	**0.03** **	**0.17*** **	**0.09*** **	**0.19*** **	-0.01	-0.03	**0.13*** **	**0.11*** **	-0.07	0.18	**-0.12*** **	**-0.13*** **
Household head is a male	**0.03** **	**0.04** **	**0.14*** **	**0.08*** **	**0.19*** **	-0.01	-0.04	**0.10*** **	**0.09*** **	0.03	0.11	**-0.10*** **	**-0.10*** **
Household head is a female	**0.08** **	**0.07** **	**0.27*** **	**0.13** **	**0.18*** **	-0.01	0.07	**0.23*** **	**0.13** **	0.18	0.00	**-0.12** **	**-0.28*** **
Small household	**0.06** **	0.04	**0.10*** **	0.05	**0.21*** **	-0.00	-0.04	**0.09*** **	**0.08** **	0.10	0.43	**-0.08** **	**-0.11*** **
Large household	0.02	0.01	**0.22*** **	**0.11*** **	**0.19*** **	-0.04	**-0.08** **	**0.16*** **	**0.11*** **	**-0.33** **	**0.36** **	**-0.15*** **	**-0.13*** **
Monthly expenses below median	0.02	-0.01	**0.16*** **	**0.10** **	**0.04** **	-0.05	-0.00	**0.14*** **	**0.11** **	0.11	**0.72** **	**-0.08** **	**-0.10** **
Monthly expenses above median	**0.05*** **	**0.05*** **	**0.17*** **	**0.08** **	**0.26*** **	0.02	-0.02	**0.13*** **	**0.09*** **	-0.02	0.25	**-0.11*** **	**-0.11*** **
No. mobile phones below median	**0.04** **	0.03	**0.17*** **	**0.15*** **	**0.14*** **	-0.04	-0.02	**0.15*** **	**0.16*** **	0.09	**0.37** **	**-0.11*** **	**-0.14*** **
No. mobile phones above median	**0.07** **	**0.07** **	**0.22*** **	0.08	**0.26*** **	0.05	-0.02	**0.18*** **	**0.11** **	-0.43	0.00	**-0.11** **	-0.08
No. members can write below median	**0.06** **	0.04	**0.13*** **	**0.09** **	**0.17*** **	0.02	-0.02	**0.11*** **	**0.11*** **	0.26	0.43	**-0.09** **	**-0.10*** **
No. members can write above median	0.01	0.00	**0.19*** **	**0.10*** **	**0.22*** **	-0.02	-0.04	**0.14*** **	**0.11*** **	-0.24	0.21	**-0.12*** **	**-0.13*** **
No. members can read below median	**0.05** **	0.04	**0.13*** **	**0.09** **	**0.17*** **	0.02	-0.01	**0.11*** **	**0.11*** **	0.40	0.42	**-0.08** **	**-0.10*** **
No. members can read above median	0.02	0.01	**0.19*** **	**0.10*** **	**0.20*** **	-0.02	-0.03	**0.14*** **	**0.10*** **	-0.25	0.20	**-0.13*** **	**-0.12*** **
Age below median	0.02	**0.07** **	**0.16*** **	**0.11*** **	**0.20*** **	-0.00	0.00	**0.13*** **	**0.13*** **	0.12	0.35	**-0.11*** **	**-0.09** **
Age above median	**0.05** **	0.03	**0.18*** **	**0.09*** **	**0.19*** **	-0.02	-0.04	**0.14*** **	**0.11*** **	0.07	0.20	**-0.14*** **	**-0.17*** **

Source: Authors' calculations based on survey data.

4 Discussion and conclusion

In this study we assess the effect of the excise duty implemented in Kenya in 2013, and modified in 2018, on the use of mobile money. The analysis is done at the macro and micro level. At the macro level, we use data from the Central Bank of Kenya on mobile money transaction values, volumes and agents. To include differences in uses and other factors, we run a micro analysis with survey data on mobile money usage in 2008, 2009, 2010 and 2014. With this data, we also analyse patterns of mobile money usage before implementation of the levy and explore heterogeneity in impacts.

At the macro level, we find that neither the 2013 excise duty on money transfers nor the change in 2018 had any short-term impact on the main indicators of interest – average transaction value, volume and value of transactions, and number of agents. In the long term, we observe similar findings, apart from a positive and strong impact of the tax in 2013 on the number of agents, and a negative and weak negative impact of the tax in 2018 on the average value of transactions.

At the micro level, results show that the 2013 excise duty did not severely decrease mobile money usage. If anything, we note that usage has been more important for non-affected transactions – saving and paying bills, while the rising trend of mobile money usage has been slowed by introduction of the tax for affected transactions – sending and receiving. Further, we find the probability of a respondent sending or receiving regularly for household purposes decreased after introduction of the tax. Finally, heterogeneity analysis hints at concerning repercussions on equity. Larger and poorer households, who already had difficulty in being financially included before the tax, show worse outcomes after its introduction.

As mentioned in the introduction, the effect of an excise duty on mobile money can be linked to policy design, country/users' specificities, and the level of development of the targeted sector and business environment (licence, regulation, etc.). In this case, the non-significant effect of the tax on aggregated mobile money transaction values and volumes at the macroeconomic level could be explained by many considerations. Kenya has one of the most developed mobile money markets in Africa; the rate applied to bank transfers is higher than the one applied to mobile money; the excise duty coincides with an extension of mobile money services, with the possibility of users paying some of their bills with a mobile money account; the nature of early mobile money adopters, who are wealthier than non-adopters and might cope better with the price increase; and the decrease in money transfer fees in 2014, which could smooth the price increase caused by the duty.

First, mobile money was adopted in Kenya in 2007. There was fast development and adoption of these services over the years. This implies that mobile money users might have embedded these services into their everyday life, making them less responsive to a price increase. Mobile money services made it easier to make financial transactions, and have been demonstrated to be less expensive than traditional means – which may also be insecure and have high transport costs. This could explain why mobile money users did not stop using mobile money after implementation of the tax. Relatedly, we find that the rate increases in 2018 (from 10 to 12 per cent) did not curb use of mobile money.

Second, and beyond the robust development of the mobile money market in Kenya, policy design can also explain our findings. Bank transfers have been taxed at 20 per cent since 2018, while mobile money transfers have been taxed at 12 per cent. This could lead people to prefer to use mobile money rather than bank services, since the levy is less important, and

this could explain the non-significant effect of the 2018 policy change. Further, bank services are used more by those who are wealthier. Consequently, this justification is more relevant for wealthier users of mobile money. However, the descriptive analysis shows that mobile money users are on average wealthier than non-users, which allows substitution between these two services. Nevertheless, we emphasise that mobile money operators and banks can have different business models, which can decrease the level of substitutability.

In addition, the introduction of the tax coincides with an important innovation by mobile money operators – the possibility of paying a wider range of bills (water, rent, electricity and shopping) via a mobile money account. Hence, as highlighted by Herbling (2013), the benefit of using mobile money could have remained more important than its cost, despite the price increase, leading people to keep using mobile money for other purposes. This could explain why the excise duty did not significantly affect aggregated transaction volumes and values.

We should also mention that descriptive analysis of the 2010 round shows that early adopters of mobile money were wealthier than non-adopters. The price factor may not be an important determinant of mobile money adoption for them, and they would continue using mobile money services regardless of the price increase caused by the duty.

Finally, the price paid by consumers for mobile money services includes the fees charged by operators. When a duty is based on fees, operators can mitigate its effect by decreasing the fees applied to affected transactions – this is not possible when the duty targets transaction values. In 2014 Safaricom – the first operator in Kenya – decreased the fees for person-to-person transactions on lower transaction values (US$17 or below).[19] This intervention on fees could also explain why we do not see a negative impact on usage after the duty, and could deserve future research – to be carefully disentangled from the effect of the duty.

The more nuanced evidence from the microeconomic analysis also provides interesting insights. It shows that, even if the effect is non-significant at the macroeconomic level on aggregated values, people seem to have changed their behaviour after the duty depending on the use or purpose. After implementation of the duty, a greater increase in mobile money adoption has been observed in non-affected transactions – savings and paying bills, while the increase has been less substantial for sending and receiving. Further, the probability of using mobile money frequently for sending and receiving increased in 2010 compared to 2008 and 2009. However, we did not observe an increase in 2014 compared to 2010, while the probability of frequent usage increased for uses not affected by the tax. Finally, the probability of using mobile money regularly to send or receive money from a household member actually decreased after implementation of the tax. This could be explained by the fact that people in the same household can easily find another way of exchanging money – for example, storing the money until they meet in person, rather than sending it by mobile money and facing higher fees. Even if the 2013 excise duty did not reduce use of mobile money compared to previous years, it seems to have prevented a faster and more widespread adoption of affected services.

This study shows that the effect of a mobile money tax depends on many factors, and must be analysed at several levels. Among the factors that can determine mobile money taxation, the tax design and implementation schedule play an important role. A similar study on Uganda using the same methodology and macroeconomic data (Katusiime 2021) finds a negative effect of the tax on mobile money implemented in 2018 on mobile money transaction values and volume. In Kenya these indicators have not been significantly

[19] For more information, see: https://www.cgap.org/blog/price-sensitivity-and-new-m-pesa-tariffs.

impacted by the excise duty on fees. These differences could be explained by differences in policy reforms. In Kenya the tax is only applied on fees, while Uganda combines a tax on fees and values;[20] in Kenya mobile money is taxed less than bank transfers. However, this difference could also come from the increased use of non-affected transactions observed in Kenya after introduction of the duty.

Hence, the Kenya case gives interesting insights on the appropriate design and implementation of a mobile money tax. An important policy insight could be that ex-ante widespread adoption, innovation and improvement of mobile money services can prevent specific taxation from decreasing adoption of these services. In addition, applying a lower rate to mobile money transfers than other financial services could give an advantage to mobile money and prevent its decline, even when taxed. However, even if poorer populations could be helped by this measure, you could ask if similar financial services should not be taxed in the same way to avoid market distortion. It would then be relevant to compare the overall tax burden of these two sectors and assess the effect of the rate difference on the banking sector. Further, the Kenyan case is special, making it worth exploring other contexts and types of mobile money tax design.

This study has some limitations that should be highlighted, especially with gaps in data. At the macro level it would be interesting to have data by transaction type, to observe whether there has been an heterogenous impact of the tax. In other words, it would be interesting to see at the macro level if affected transactions (transfers and withdrawals) have been differently impacted by the duty. For the same reason, it would also be useful to have more granular information on the type of transaction – cash-in and cash-out, and on the type of provider – banks and other mobile money providers. This type of data is usually held by mobile network operators and other financial institutions, but accessing this confidential information proves to be difficult. Likewise, at the micro level, the fact that the survey data we analysed was not framed specifically to answer questions around the impact of mobile money taxation means that our analysis is only partial, and probably does not capture the full complexity of mobile money usage patterns and preferences, especially when it comes to users' attitudes and perceptions.

Much more work is needed to understand the full impact of mobile money taxation. Given the rise in new taxes and fees on digital financial services, especially in Africa, we hope that there can be easier access to mobile money transaction data for research purposes, and more targeted survey data collection to better answer questions around impact. Since the excise duty also targeted other types of money transfers, notably bank transfers, it could also be interesting to explore how it impacted other affected industries. Taxation policies on electronic transactions recently served as an incentive to increase formalisation – in Ghana, the e-levy tax design includes a possibility for registered merchants to make transactions exempted from the levy. It could be relevant to assess the effectiveness of this policy. We leave this to future research.

[20] Uganda has two excise duties on money transfers - one targeting withdrawal fees (15%), and another on withdrawal values (0.5%). These two taxes were first applied on transfers and withdrawals, and then limited to withdrawals.

Appendix

Appendix 1 Composite Indicator of Economic Activity – CIEA

For the purpose of this analysis, we derived the monthly Composite Indicator of Economic Activity (CIEA), following the work of Ndirangu et al. (2014), to overcome the absence of official monthly information on GDP. The indicator, derived using the Conference Board Technique, is obtained using information on real sector, external sector and financial sector, as indicated in Table A1.

Table A1 List of indicators for derivation of CIEA

Financial sector	Real sector	Service sector	External sector
Money supply - M3	Production cement	Electricity generation	Total export
Credit to private sector	Production tea	Tourism	Total import
NSE share price index	Export horticulture		
Real exchange rate with U$			

Source: Authors' elaboration.

All indicators are obtained from the National Bureau of Statistics of Kenya, except information on credit to private sector (Central Bank of Kenya) and real exchange rate with US$ (US Department of Agriculture). Information on production statistics are expressed in real terms while indicators reported using nominal values have been deflated using the Consumer Price Index. Information on tourism refer to the natural logarithm of total arrivals at Jomo Kenyatta International Airport and Moi International Airport.

The CIEA has been derived using the following approach. First, we calculated the symmetric monthly percentage change of all selected indicators, using the formula presented in Equation 4:

$$\Delta x_{it} = 200 * \frac{x_{it} - x_{it-1}}{x_{it} + x_{it-1}} \tag{4}$$

Second, we calculated the weights to adjust each indicator based on its volatility, by first taking the inverse of the standard deviation (σ_i) of each indicator and then sum them all together, as presented in Equation 5:

$$T = \sum_{i}^{n} \frac{1}{\sigma_i} \tag{5}$$

Weights (w_i) are then calculated by dividing the inverse of the standard deviation of each indicator over the sum of all inverse standard deviation, as presented in Equation 6, and finally used to adjust the monthly changes of each indicator based on its volatility as reported in Equation 7:

$$w_i = \frac{\frac{1}{\sigma_i}}{T} \tag{6}$$

$$\Delta X_i = w_i * \Delta x_{it} \tag{7}$$

The CIEA is then obtained by adding up all adjusted monthly changes of the indicators as reported in Equation 8:

$$CIEA_t = \sum_{i=1}^{n} \Delta X_i \quad (8)$$

Finally, the CIEA is converted into an index with first year equal to 100 and calculating the monthly symmetric percentage change as indicated in the following Equations 9, 10 and 11:

$$Index_1 = 100 \quad (9)$$

$$Index_2 = \frac{Index_1 * (200 + \Delta X_{2)}}{(200 - \Delta X_{2)}} \quad (10)$$

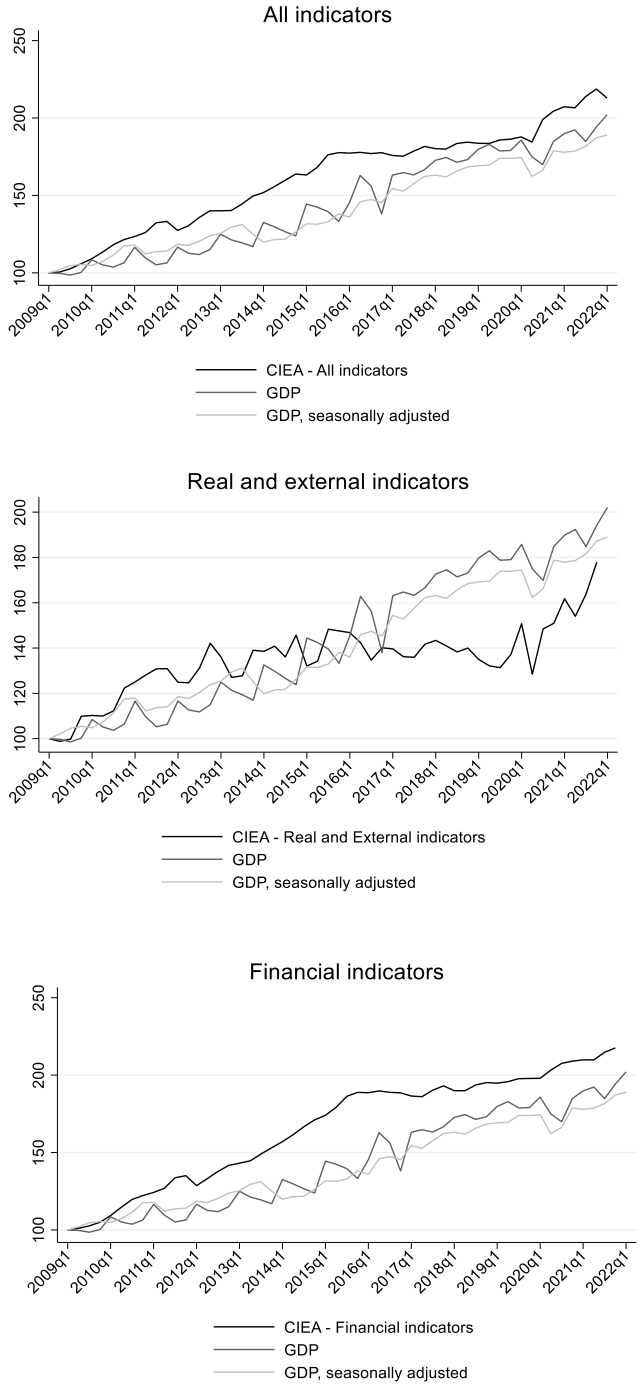
$$Index_3 = \frac{Index_2 * (200 + \Delta X_{3)}}{(200 - \Delta X_{3)}} \quad (11)$$

; …

To measure the quality of the indicator, we then converted the CIEA into quarterly series and compared the trend with the one of the quarterly GDP (at constant prices), converted itself into an index. Figure A1 shows the comparison of the trend of the quarterly GDP, of the quarterly GDP seasonally adjusted and of the CIEA with all indicators, with real and external sector indicators and with financial indicators only.[21]

[21] Note: as we could not retrieve reliable information on GDP at current prices for 2007 and 2008, this exercise considers 2009q1 as starting year. We do however have all information to derive the CIEA since 2007m3 for the analysis on impact of the tax on mobile money transactions.

Figure A1 Comparison trends quarterly CIEA and GDP

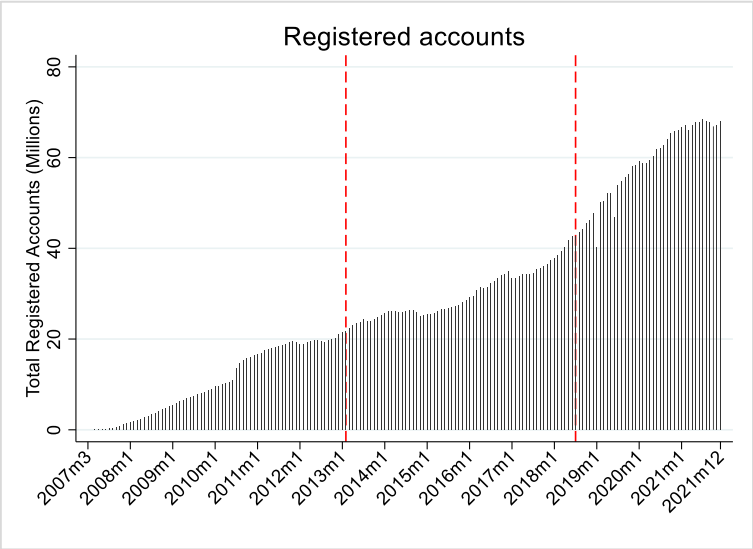


Source: Authors' calculations.

Evidence in Figure A1 shows that the derived CIEA using all indicators is a useful tool to replace missing information on monthly GDP. For this reason, our analysis uses this index to account for Kenya's economic activity at monthly level.

Appendix 2 Additional information for the macroeconomic analysis

Figure A2 Registered mobile money accounts 2007-2021



Source: Authors' calculations based on data from the Central Bank of Kenya.

Table A2 Unit root tests

	Augmented Dicky-Fuller - ADF		Phillips Peron - PP		I()
	Levels	**First difference**	**Levels**	**First difference**	
MM - Average transaction value (t-1)	-1.74	-12.546	-1.587	-12.617	I(1)
MM - Transaction volumes (t-1)	-17.007		-13.234		I(0)
MM - Transaction values (t-1)	-14.936		-11.819		I(0)
MM - Number of gents (t-1)	-12.910		-11.881		I(0)
TAX[22]	-1.057	-13.296	-1.052	-13.297	I(1)
MMR	-21.008		-12.592		I(0)
CIEA	-0.959	-18.838	-0.996	-18.389	I(1)
INFL	-7.849		-7.903		I(0)
TB	-3.1	-12.117	-3.38	-12.081	I(1)
ER	-1.072	-9.765	-1.184	-9.592	I(1)
FI	-2.408	-16.643	-2.226	-16.57	I(1)
COVID - new deaths	-0.578	-9.531	-1.04	-9.46	I(1)
Critical value (1%)	-3.484		-3.484		

Source: Authors' calculations based on data from Central Bank of Kenya.

[22] Only for the continuous tax variable – results presented in the Appendix.

Table A3 Decision on optimal lags length

	Akaike's information criterion (AIC)	Schwarz's Bayesian information criterion (SBIC)	Hannan and Quinn information criterion (HQIC)	Optimal lags
	Lags	Lags	Lags	Lags
MM - Average transaction value	3	1	1	1
MM - Transaction volumes	6	6	6	6
MM - Transaction values	6	6	6	6
MM - Number of agents	3	1	3	3
TAX[22]	1	1	1	1
MMR	6	6	6	6
CIEA	6	2	2	2
INFL	3	3	1	3
TB	4	4	4	4
ER	4	3	3	3
FI	2	2	2	2
COVID - new deaths	2	2	2	2

Source: Authors' calculations based on data from Central Bank of Kenya.

Table A4 Bounds cointegration test

	Average transaction value	Transaction volumes	Transaction values	Number of agents
F-Stat	4.811	7.005	6.073	3.939
F-Stat lower bound (1%)	2.701	2.682	2.682	2.394
F-Stat upper bound (1%)	4.189	4.198	4.198	3.892

Source: Authors' calculations based on data from Central Bank of Kenya.

Table A5 Results ARDL model with continuous tax variable

	Average transaction value ARDL (1 6 1 2 1 4 3 2 2)		Transaction volumes ARDL (6 6 1 2 1 4 3 2 2)		Transaction values ARDL (6 6 1 2 1 4 3 2 2)		Number of agents ARDL (3 6 1 2 1 4 3 2 2)	
	Short-term	**Long-term**	**Short-term**	**Long-term**	**Short-term**	**Long-term**	**Short-term**	**Long-term**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
MM								
D1			-0.101		-0.214***		-0.012	
			(0.082)		(0.080)		(0.082)	
D2			-0.022		0.017		0.022	
			(0.068)		(0.070)		(0.080)	
D3			-0.048		0.045			
			(0.072)		(0.072)			
D4			-0.030		0.018			
			(0.070)		(0.072)			
D5			0.170***		0.165***			
			(0.062)		(0.060)			
TAX		-0.002		0.003*		0.002		0.005***
		(0.001)		(0.002)		(0.002)		(0.002)
D1	0.001		0.002		-0.000		-0.001	
	(0.003)		(0.005)		(0.005)		(0.005)	
MMR		0.029**		0.033		0.104***		0.067**
		(0.013)		(0.037)		(0.039)		(0.033)
D1	-0.120*		0.212*		0.032		0.257**	
	(0.068)		(0.119)		(0.131)		(0.119)	
D2	-0.061		0.106		0.044		0.076	
	(0.061)		(0.116)		(0.126)		(0.107)	
D3	-0.022		-0.096		-0.149		-0.001	
	(0.060)		(0.106)		(0.115)		(0.105)	
D4	0.024		-0.248**		-0.327***		-0.024	
	(0.059)		(0.105)		(0.114)		(0.102)	
D5	0.059		-0.335***		-0.346***		0.043	
	(0.056)		(0.103)		(0.112)		(0.096)	
D6	0.195***		-0.179*		-0.024		-0.076	
	(0.053)		(0.096)		(0.105)		(0.091)	
CIEA		0.028		0.275***		0.318***		-0.270**
		(0.064)		(0.104)		(0.117)		(0.104)
D1	-0.123		1.742***		1.673***		0.201	
	(0.165)		(0.282)		(0.306)		(0.286)	
D2	-0.363**		0.176		0.248		-0.045	
	(0.154)		(0.308)		(0.329)		(0.265)	
INFL		0.006		-0.002		-0.000		0.004
		(0.005)		(0.008)		(0.008)		(0.007)

D1	-0.001		-0.002		0.002		-0.010	
	(0.004)		(0.007)		(0.007)		(0.007)	
TB		0.002*		0.000		0.001		0.003*
		(0.001)		(0.002)		(0.002)		(0.002)
D1	0.002		0.001		0.002		-0.001	
	(0.002)		(0.003)		(0.003)		(0.003)	
D2	-0.002		-0.002		-0.004		-0.005	
	(0.002)		(0.003)		(0.003)		(0.003)	
D3	0.001		0.005*		0.004		-0.000	
	(0.002)		(0.003)		(0.003)		(0.003)	
D4	0.001		-0.006**		-0.005		-0.005	
	(0.002)		(0.003)		(0.003)		(0.003)	
ER		-0.160**		0.158		0.123		0.312***
		(0.070)		(0.124)		(0.126)		(0.111)
D1	0.254*		-0.955***		-0.856***		-0.115	
	(0.135)		(0.242)		(0.250)		(0.228)	
D2	0.161		0.173		0.060		-0.007	
	(0.134)		(0.241)		(0.254)		(0.226)	
D3	0.200		-0.364		-0.134		-0.015	
	(0.129)		(0.222)		(0.236)		(0.214)	
FI		0.112**		-0.097		0.038		0.142
		(0.053)		(0.092)		(0.102)		(0.099)
D1	0.057		0.069		0.098		-0.652***	
	(0.115)		(0.187)		(0.206)		(0.205)	
D2	-0.112		-0.059		-0.125		0.121	
	(0.114)		(0.189)		(0.208)		(0.207)	
COVID - new deaths		0.016***		-0.007*		0.002		0.002
		(0.003)		(0.004)		(0.003)		(0.003)
D1	-0.026***		-0.010		-0.030**		-0.006	
	(0.007)		(0.011)		(0.013)		(0.012)	
D2	-0.003		0.011		0.010		-0.005	
	(0.008)		(0.012)		(0.013)		(0.012)	
ECT (t-1)	-0.293***		-0.187***		-0.251***		-0.075***	
	(0.054)		(0.038)		(0.046)		(0.024)	
Intercept	2.693***		-2.520***		-2.795***			
	(0.499)		(0.648)		(0.700)			
N	172	172	172	172	172	172	172	172
R-squared	0.360	0.360	0.761	0.761	0.735	0.735	0.646	0.646
Log-likelihood		395.83		316.40		301.12		302.73
Durbin Watson		1.699		2.081		2.075		2.022
F-Stat		5.056		7.886		6.334		4.400

F-Stat lower bound (1%)		2.825		2.806		2.806		2.479
F-Stat upper bound (1%)		4.308		4.318		4.318		3.976
Cameron & Trivedi's decomposition - p-value		0.464		0.464		0.464		0.464
Source: (…) – Standard errors in parentheses - *** p<0.01, ** p<0.05, * p<0.1								

Source: Authors' calculations based on data from Central Bank of Kenya.

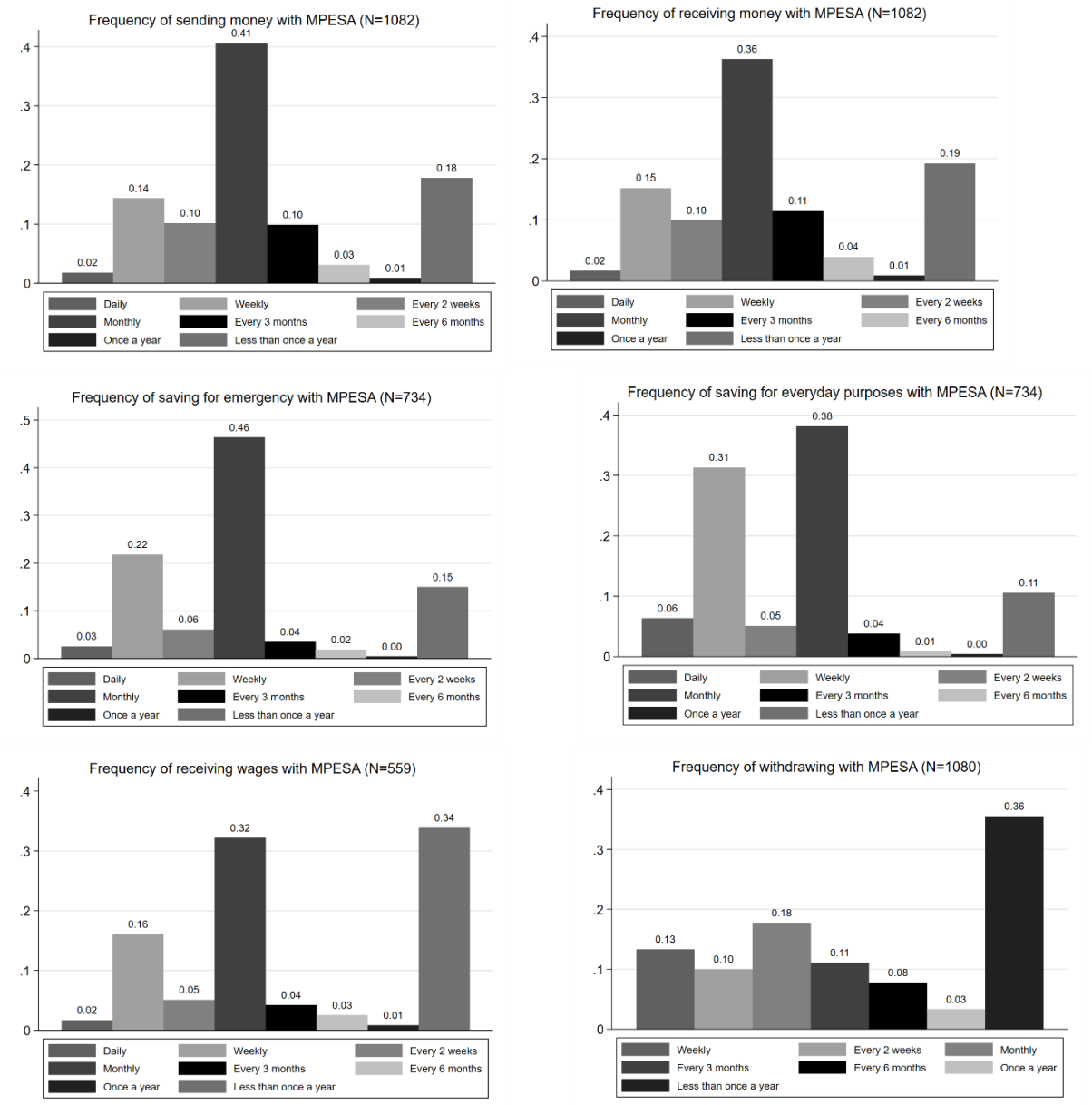
Appendix 3 Additional information for microeconomic analysis

Table A6 Determinants of using M-PESA for different purposes

Use cases	Send	Receive	Receive wages	Withdraw	Save every day	Save emergency	Pay bills
size of hh	-0.03***	-0.03***	-0.03***	-0.03***	-0.04***	-0.04***	-0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
log age of hh head	-0.18***	-0.18***	-0.09**	-0.12***	-0.13***	-0.14***	-0.14***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
hh head is male	-0.05*	-0.05**	-0.01	0.00	-0.02	0.00	-0.02
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
N hh members who can read	0.01	0.01	-0.01	0.01	0.01	0.02	0.03
	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
N hh members who can write	0.04	0.04	0.05***	0.02	0.04**	0.02	0.00
	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
log monthly exp	0.10***	0.10***	0.08***	0.10***	0.08***	0.08***	0.08***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
N phones in hh	0.02	0.02*	0.04***	0.05***	0.05***	0.05***	0.07***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Own the property	-0.00	0.01	-0.03	-0.01	-0.04	-0.04	-0.04*
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)
N positive shocks	-0.03	-0.03	-0.00	0.04	-0.02	-0.01	0.06
	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
No negative shocks	0.03	0.03	0.04	0.04	0.06*	0.07**	0.05
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Mean of Y	0.68	0.68	0.36	0.37	0.47	0.50	0.35
R-sq.	0.284	0.283	0.136	0.162	0.178	0.189	0.181
N	1600	1600	1600	1600	1600	1600	1600

Source: Authors' calculations based on round 3 (2010) of survey data.

Figure A3 Frequency of usage by use



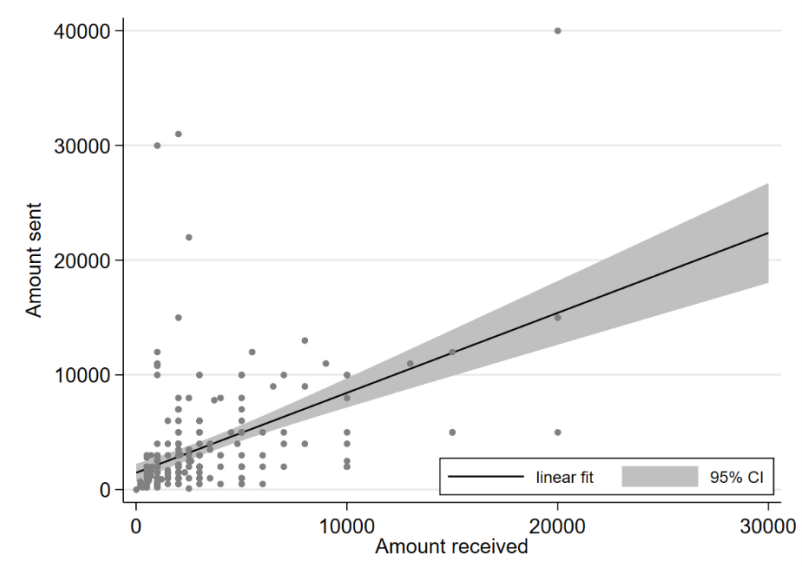
Source: Authors' calculations based on round 3 (2010) of survey data.

Table A7 Determinants of being a frequent M-PESA user

	Frequent send	Frequent receive	Frequent save every day	Frequent save emergency
Size of hh	-0.05***	-0.02	-0.02***	-0.03**
	(0.01)	(0.01)	(0.01)	(0.01)
log age of hh head	-0.14**	-0.03	-0.02	-0.15***
	(0.06)	(0.06)	(0.04)	(0.05)
hh head is male	0.06	0.01	0.09***	0.07*
	(0.04)	(0.04)	(0.03)	(0.03)
N hh members who can read	0.04	0.00	0.03	0.02
	(0.04)	(0.04)	(0.03)	(0.03)
N hh members who can write	0.02	0.02	0.00	0.00
	(0.03)	(0.04)	(0.03)	(0.03)
log monthly exp	0.09***	0.09***	0.03***	0.05***
	(0.02)	(0.02)	(0.01)	(0.01)
N phones in hh	-0.02	-0.02	0.01	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)
Own the property	0.02	0.08**	-0.04	-0.03
	(0.03)	(0.03)	(0.03)	(0.03)
N positive shocks	0.01	0.03	0.00	-0.01
	(0.06)	(0.06)	(0.05)	(0.06)
No negative shocks	0.04	0.00	0.05	0.06
	(0.03)	(0.04)	(0.03)	(0.04)
Log distance MM agent	-0.03*	-0.02	-0.01	-0.02
	(0.02)	(0.02)	(0.01)	(0.02)
Mean of Y	0.60	0.58	0.18	0.30
R-sq.	0.086	0.061	0.046	0.057
N	1109	1109	1083	1087

Source: Authors' calculations based on round 3 (2010) of survey data.

Figure A4 Average amount sent and average amount received, Scatterplot



Source: Authors' calculations based on round 3 (2010) of survey data. Amounts in Ksh.

Table A8 Changes in mobile money frequent usage over time – 2010 as baseline

Use cases	Sending	Receiving	Saving for everyday purposes	Saving for emergencies
2008	-0.38***	-0.36***	0.06***	-0.21***
	0.02	0.02	0.02	0.02
2009	-0.22***	-0.29***	-0.02	-0.01
	0.02	0.03	0.02	0.02
2014	-0.01	-0.03	0.13***	0.11***
	0.02	0.02	0.02	0.02
Baseline Y	0.60	0.57	0.17	0.29
R-sq.	0.199	0.169	0.053	0.129
Observations	5212	5212	5212	5212

Source: Authors' calculations based on survey data. Standard errors in parentheses * p<0.10, ** p<0.05, *** p<0.01

Table A9 Changes in average amount over time – 2010 as baseline

Use cases	Average amount sent per time	Average amount received per time
2008	-0.21	0.42**
	0.25	0.17
2009	0.05	-0.10
	0.14	0.14
2014	-0.07	0.18
	0.14	0.15
Baseline Y	7.54	7.57
R-sq.	0.053	0.071
Observations	1085	938

Source: Authors' calculations based on survey data. Standard errors in parentheses * p<0.10, ** p<0.05, *** p<0.01.

Table A10 Changes in transfer services usage frequency over time – 2010 as baseline

Purposes/use cases	Send at regular intervals to household	Send at regular intervals for work	Receive at regular intervals from household	Receive at regular intervals from work
2008	-0.31***	-0.02**	-0.20***	-0.02*
	0.03	0.01	0.02	0.01
2009	-0.26***	0.01	-0.20***	0.00
	0.02	0.01	0.02	0.01
2014	-0.12***	-0.00	-0.13***	0.01
	0.02	0.01	0.02	0.01
Baseline Y	0.44	0.04	0.38	0.04
R-sq.	0.121	0.009	0.060	0.004
Observations	4691	4691	4691	4691

Source: Authors' calculations based on survey data. Standard errors in parentheses * p<0.10, ** p<0.05, *** p<0.01.

Table A11 Changes in all outcomes if head of household is male

	Send	Receive	Save	Save for emerg-encies	Pay bills	Frequent user for sending	Frequent user for receiving	Frequent user for saving	Frequent user for saving for emerg-encies	Amount send per time	Amount received per time	Sent to household at regular intervals	Receive from household at regular intervals
2008	-0.52***	-0.51***	0.03	-0.27***	-0.15***	-0.38***	-0.38***	0.05**	-0.22***	-0.18	0.40**	-0.32***	-0.21***
	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.26	0.19	0.03	0.03
2009	-0.02	-0.03	0.02	0.03	-0.03*	-0.23***	-0.30***	-0.02	-0.02	-0.01	-0.14	-0.28***	-0.20***
	0.02	0.02	0.03	0.03	0.02	0.03	0.03	0.02	0.03	0.16	0.16	0.03	0.02
2014	**0.03***	**0.04****	**0.14*****	**0.08*****	**0.19*****	-0.01	-0.04	**0.10*****	**0.09*****	0.03	0.11	**-0.10*****	**-0.10*****
	0.02	0.02	0.03	0.03	0.02	0.03	0.03	0.02	0.03	0.15	0.16	0.03	0.02
Baseline Y	0.89	0.91	0.21	0.38	0.16	0.60	0.57	0.17	0.29	7.54	7.57	0.44	0.38
R-sq.	0.431	0.405	0.051	0.149	0.215	0.215	0.185	0.050	0.126	0.042	0.068	0.139	0.066
Observations	4141	4141	4141	4141	4141	4144	4144	4144	4144	934	794	3718	3718

Table A12 Changes in all outcomes if head of household is female

	Send	Receive	Save	Save for emerg-encies	Pay bills	Frequent user for sending	Frequent user for receiving	Frequent user for saving	Frequent user for saving for emerg-encies	Amount send per time	Amount received per time	Sent to household at regular intervals	Receive from household at regular intervals
2008	-0.45***	-0.39***	0.08	-0.17***	-0.09**	-0.32***	-0.29***	0.11**	-0.15***	-1.41**	-6.54***	-0.23***	-0.18***
	0.05	0.05	0.05	0.05	0.04	0.05	0.06	0.05	0.05	0.59	0.00	0.07	0.07
2009	0.09**	0.02	0.03	0.09	0.04	-0.14**	-0.20***	0.02	0.03	1.83**	8.63***	-0.17***	-0.27***
	0.04	0.04	0.05	0.06	0.04	0.06	0.06	0.05	0.06	0.70	0.00	0.06	0.06
2014	**0.08****	**0.07***	**0.27*****	**0.13***	**0.18*****	-0.01	0.07	**0.23*****	**0.13****	0.18	0.00	**-0.12****	**-0.28*****
	0.04	0.04	0.05	0.07	0.05	0.07	0.07	0.05	0.06	0.43	.	0.06	0.06
Baseline Y	0.89	0.91	0.21	0.38	0.16	0.60	0.57	0.17	0.29	7.54	7.57	0.44	0.38
R-sq.	0.428	0.319	0.096	0.128	0.170	0.152	0.139	0.091	0.107	0.729	1.000	0.070	0.103
Observations	1065	1065	1065	1065	1065	1065	1065	1065	1065	151	144	969	969

Table A13 Changes in all outcomes if respondent is in a small household – household size less than or equal to the median

	Send	Receive	Save	Save for emerg-encies	Pay bills	Frequent user for sending	Frequent user for receiving	Frequent user for saving	Frequent user for saving for emerg-encies	Amount send per time	Amount received per time	Sent to household at regular intervals	Receive from household at regular intervals
2008	-0.50***	-0.48***	0.03	-0.28***	-0.16***	-0.38***	-0.36***	0.07**	-0.24***	-0.40	1.26***	-0.26***	-0.20***
	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.30	0.23	0.04	0.04
2009	-0.00	-0.05*	-0.00	-0.02	-0.01	-0.19***	-0.30***	-0.02	-0.05	-0.09	0.02	-0.24***	-0.18***
	0.02	0.03	0.03	0.04	0.03	0.04	0.04	0.03	0.03	0.21	0.16	0.03	0.03
2014	**0.06****	0.04	**0.10*****	0.05	**0.21*****	-0.00	-0.04	**0.09*****	**0.08****	0.10	0.43	**-0.08****	**-0.11*****
	0.02	0.03	0.04	0.04	0.03	0.04	0.04	0.03	0.04	0.26	0.37	0.04	0.04
Baseline Y	0.89	0.91	0.21	0.38	0.16	0.60	0.57	0.17	0.29	7.54	7.57	0.44	0.38
R-sq.	0.442	0.367	0.027	0.138	0.224	0.188	0.155	0.040	0.128	0.150	0.423	0.108	0.053
Observations	2805	2805	2805	2805	2805	2808	2808	2808	2808	511	451	2457	2457

Table A14 Changes in all outcomes if the respondent is in a large household – household size more than the median

	Send	Receive	Save	Save for emerg-encies	Pay bills	Frequent user for sending	Frequent user for receiving	Frequent user for saving	Frequent user for saving for emerg-encies	Amount send per time	Amount received per time	Sent to household at regular intervals	Receive from household at regular intervals
2008	-0.54***	-0.52***	0.03	-0.24***	-0.11***	-0.37***	-0.35***	0.04	-0.17***	0.19	0.10	-0.34***	-0.18***
	0.03	0.03	0.03	0.03	0.02	0.03	0.04	0.03	0.03	0.43	0.25	0.04	0.04
2009	-0.02	-0.02	0.03	0.08*	-0.02	-0.26***	-0.30***	-0.02	0.05	0.27	-0.02	-0.30***	-0.22***
	0.03	0.02	0.03	0.04	0.03	0.04	0.04	0.03	0.04	0.22	0.21	0.04	0.03
2014	0.02	0.01	**0.22*****	**0.11*****	**0.19*****	-0.04	**-0.08****	**0.16*****	**0.11*****	**-0.33***	**0.36***	**-0.15*****	**-0.13*****
	0.03	0.02	0.03	0.04	0.03	0.04	0.04	0.03	0.03	0.19	0.18	0.04	0.03
Baseline Y	0.89	0.91	0.21	0.38	0.16	0.60	0.57	0.17	0.29	7.54	7.57	0.44	0.38
R-sq.	0.425	0.422	0.091	0.160	0.209	0.204	0.166	0.079	0.121	0.108	0.095	0.137	0.068
Observations	2404	2404	2404	2404	2404	2404	2404	2404	2404	574	487	2234	2234

Table A15 Changes in all outcomes if monthly expenses less than the median

	Send	Receive	Save	Save for emerg-encies	Pay bills	Frequent user for sending	Frequent user for receiving	Frequent user for saving	Frequent user for saving for emerg-encies	Amount send per time	Amount received per time	Sent to household at regular intervals	Receive from household at regular intervals
2008	-0.66***	-0.59***	-0.07*	-0.28***	-0.07***	-0.39***	-0.32***	-0.01	-0.19***	-0.49	-0.24	-0.23***	-0.16***
	0.04	0.04	0.04	0.04	0.02	0.04	0.05	0.03	0.03	0.32	0.33	0.05	0.05
2009	-0.03	-0.06*	-0.02	0.03	-0.01	-0.27***	-0.23***	-0.02	0.01	0.47**	0.21	-0.23***	-0.26***
	0.04	0.04	0.04	0.05	0.02	0.05	0.05	0.03	0.04	0.22	0.23	0.04	0.04
2014	0.02	-0.01	**0.16*** **	**0.10** **	**0.04***	-0.05	-0.00	**0.14*** **	**0.11** **	0.11	**0.72***	**-0.08***	-0.10**
	0.04	0.04	0.04	0.05	0.02	0.05	0.05	0.04	0.04	0.60	0.40	0.05	0.05
Baseline Y	0.89	0.91	0.21	0.38	0.16	0.60	0.57	0.17	0.29	7.54	7.57	0.44	0.38
R-sq.	0.506	0.458	0.089	0.180	0.092	0.189	0.135	0.076	0.145	0.646	0.161	0.107	0.098
Observations	1884	1884	1884	1884	1884	1885	1885	1885	1885	242	255	1682	1682

Table A16 Changes in all outcomes if monthly expenses higher than the median

	Send	Receive	Save	Save for emerg-encies	Pay bills	Frequent user for sending	Frequent user for receiving	Frequent user for saving	Frequent user for saving for emerg-encies	Amount send per time	Amount received per time	Sent to household at regular intervals	Receive from household at regular intervals
2008	-0.41***	-0.41***	0.09***	-0.26***	-0.21***	-0.36***	-0.37***	0.10***	-0.22***	-0.22	0.25	-0.31***	-0.20***
	0.02	0.02	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.38	0.20	0.03	0.03
2009	0.02	0.00	0.04	0.06	-0.02	-0.19***	-0.31***	0.00	-0.01	0.03	-0.24	-0.26***	-0.15***
	0.02	0.02	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.19	0.19	0.03	0.03
2014	**0.05*** **	**0.05*** **	**0.17*** **	**0.08** **	**0.26*** **	0.02	-0.02	**0.13*** **	**0.09*** **	-0.02	0.25	**-0.11*** **	**-0.11*** **
	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.16	0.17	0.03	0.03
Baseline Y	0.89	0.91	0.21	0.38	0.16	0.60	0.57	0.17	0.29	7.54	7.57	0.44	0.38
R-sq.	0.334	0.327	0.037	0.112	0.296	0.178	0.166	0.036	0.096	0.058	0.101	0.116	0.056
Observations	3325	3325	3325	3325	3325	3327	3327	3327	3327	843	683	3009	3009

Table A17 Changes in all outcomes if number of mobile phones in household is less than the median

	Send	Receive	Save	Save for emerg-encies	Pay bills	Frequent user for sending	Frequent user for receiving	Frequent user for saving	Frequent user for saving for emerg-encies	Amount send per time	Amount received per time	Sent to household at regular intervals	Receive from household at regular intervals
2008	-0.55***	-0.50***	0.03	-0.27***	-0.11***	-0.39***	-0.34***	0.06***	-0.21***	-0.34	0.27	-0.29***	-0.20***
	0.02	0.02	0.02	0.03	0.02	0.03	0.03	0.02	0.02	0.25	0.20	0.03	0.03
2009	-0.02	-0.04**	0.02	0.03	-0.01	-0.23***	-0.26***	-0.01	-0.01	0.18	-0.06	-0.26***	-0.22***
	0.02	0.02	0.03	0.03	0.02	0.03	0.03	0.02	0.03	0.19	0.15	0.03	0.03
2014	**0.04***	0.03	**0.17*****	**0.15*****	**0.14*****	-0.04	-0.02	**0.15*****	**0.16*****	0.09	**0.37***	**-0.11*****	**-0.14*****
	0.02	0.02	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.21	0.21	0.03	0.03
Baseline Y	0.89	0.91	0.21	0.38	0.16	0.60	0.57	0.17	0.29	7.54	7.57	0.44	0.38
R-sq.	0.468	0.421	0.068	0.193	0.170	0.214	0.154	0.064	0.164	0.069	0.132	0.129	0.064
Observations	3871	3871	3871	3871	3871	3872	3872	3872	3872	715	645	3436	3436

A18 Changes in all outcomes if number of mobile phones in household is more than the median

	Send	Receive	Save	Save for emerg-encies	Pay bills	Frequent user for sending	Frequent user for receiving	Frequent user for saving	Frequent user for saving for emerg-encies	Amount send per time	Amount received per time	Sent to household at regular intervals	Receive from household at regular intervals
2008	-0.38***	-0.39***	0.12**	-0.18***	-0.27***	-0.35***	-0.37***	0.11*	-0.16***	0.43	0.86*	-0.30***	-0.21***
	0.05	0.05	0.06	0.07	0.05	0.06	0.06	0.06	0.06	0.62	0.50	0.07	0.06
2009	0.06*	0.05	0.10	0.09	-0.08	-0.15**	-0.25***	0.05	0.03	-0.36	0.66	-0.18***	-0.13**
	0.03	0.04	0.06	0.07	0.06	0.07	0.07	0.06	0.06	0.34	0.45	0.07	0.06
2014	**0.07***	**0.07****	**0.22*****	0.08	**0.26*****	0.05	-0.02	**0.18*****	**0.11***	-0.43	0.00	**-0.11***	-0.08
	0.04	0.03	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.35	0.26	0.06	0.05
Baseline Y	0.89	0.91	0.21	0.38	0.16	0.60	0.57	0.17	0.29	7.54	7.57	0.44	0.38
R-sq.	0.326	0.323	0.073	0.081	0.305	0.179	0.159	0.069	0.075	0.204	0.361	0.142	0.080
Observations	1338	1338	1338	1338	1338	1340	1340	1340	1340	370	293	1255	1255

Table A19 Changes in all outcomes if the number members who can write is less than the median

	Send	Receive	Save	Save for emerg-encies	Pay bills	Frequent user for sending	Frequent user for receiving	Frequent user for saving	Frequent user for saving for emerg-encies	Amount send per time	Amount received per time	Sent to household at regular intervals	Receive from household at regular intervals
2008	-0.50***	-0.50***	0.04	-0.28***	-0.14***	-0.35***	-0.34***	0.07**	-0.24***	-0.70**	0.78***	-0.25***	-0.21***
	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.29	0.24	0.04	0.04
2009	-0.01	-0.05**	0.01	-0.01	-0.00	-0.19***	-0.28***	-0.02	-0.05	-0.35*	-0.15	-0.22***	-0.18***
	0.02	0.02	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.19	0.18	0.03	0.03
2014	**0.06****	0.04	**0.13*****	**0.09****	**0.17*****	0.02	-0.02	**0.11*****	**0.11*****	0.26	0.43	**-0.09****	**-0.10*****
	0.03	0.03	0.04	0.04	0.03	0.04	0.04	0.03	0.04	0.26	0.34	0.04	0.04
Baseline Y	0.89	0.91	0.21	0.38	0.16	0.60	0.57	0.17	0.29	7.54	7.57	0.44	0.38
R-sq.	0.438	0.387	0.037	0.149	0.177	0.190	0.160	0.043	0.144	0.198	0.324	0.107	0.060
Observations	2999	2999	2999	2999	2999	3002	3002	3002	3002	531	485	2658	2658

Table A20 Changes in all outcomes if the number members who can write is more than the median

	Send	Receive	Save	Save for emerg-encies	Pay bills	Frequent user for sending	Frequent user for receiving	Frequent user for saving	Frequent user for saving for emerg-encies	Amount send per time	Amount received per time	Sent to household at regular intervals	Receive from household at regular intervals
2008	-0.53***	-0.51***	0.03	-0.27***	-0.14***	-0.40***	-0.37***	0.05	-0.19***	-0.44	0.28	-0.34***	-0.16***
	0.03	0.03	0.04	0.04	0.03	0.04	0.04	0.03	0.03	0.35	0.27	0.05	0.04
2009	-0.01	-0.01	-0.00	0.06	-0.03	-0.25***	-0.30***	-0.05	0.03	0.18	-0.09	-0.28***	-0.22***
	0.03	0.02	0.04	0.04	0.03	0.04	0.05	0.03	0.04	0.23	0.26	0.04	0.04
2014	0.01	0.00	**0.19*****	**0.10*****	**0.22*****	-0.02	-0.04	**0.14*****	**0.11*****	-0.24	0.21	**-0.12*****	**-0.13*****
	0.02	0.02	0.04	0.04	0.03	0.04	0.04	0.03	0.04	0.19	0.19	0.04	0.03
Baseline Y	0.89	0.91	0.21	0.38	0.16	0.60	0.57	0.17	0.29	7.54	7.57	0.44	0.38
R-sq.	0.421	0.406	0.079	0.165	0.249	0.194	0.159	0.076	0.117	0.091	0.082	0.121	0.064
Observations	2210	2210	2210	2210	2210	2210	2210	2210	2210	554	453	2033	2033

Table A21 Changes in all outcomes if the number members who can read is less than the median

	Send	Receive	Save	Save for emerg-encies	Pay bills	Frequent user for sending	Frequent user for receiving	Frequent user for saving	Frequent user for saving for emergencies	Amount send per time	Amount received per time	Sent to household at regular intervals	Receive from household at regular intervals
2009	-0.50***	-0.49***	0.04	-0.27***	-0.14***	-0.35***	-0.34***	0.07**	-0.23***	-0.68**	0.71***	-0.25***	-0.21***
	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.30	0.23	0.04	0.04
2009	-0.00	-0.04*	0.01	-0.00	0.00	-0.18***	-0.27***	-0.01	-0.05	-0.32	-0.17	-0.21***	-0.17***
	0.02	0.03	0.03	0.04	0.03	0.04	0.04	0.03	0.03	0.23	0.19	0.03	0.03
2014	**0.05****	0.04	**0.13*****	**0.09****	**0.17*****	0.02	-0.01	**0.11*****	**0.11*****	0.40	0.42	**-0.08****	**-0.10*****
	0.03	0.03	0.04	0.04	0.03	0.04	0.04	0.03	0.04	0.27	0.36	0.04	0.04
Baseline Y	0.89	0.91	0.21	0.38	0.16	0.60	0.57	0.17	0.29	7.54	7.57	0.44	0.38
R-sq.	0.437	0.380	0.035	0.144	0.173	0.184	0.149	0.039	0.137	0.196	0.346	0.106	0.060
Observations	2931	2931	2931	2931	2931	2934	2934	2934	2934	506	469	2585	2585

Table A22 Changes in all outcomes if the number members who can read is more than the median

	Send	Receive	Save	Save for emerg-encies	Pay bills	Frequent user for sending	Frequent user for receiving	Frequent user for saving	Frequent user for saving for emerg-encies	Amount send per time	Amount received per time	Sent to household at regular intervals	Receive from household at regular intervals
2008	-0.53***	-0.51***	0.03	-0.27***	-0.14***	-0.39***	-0.36***	0.04	-0.19***	-0.45	0.32	-0.34***	-0.16***
	0.03	0.03	0.03	0.04	0.03	0.04	0.04	0.03	0.03	0.35	0.27	0.05	0.04
2009	-0.00	-0.01	0.00	0.06	-0.03	-0.25***	-0.29***	-0.05	0.03	0.13	0.05	-0.28***	-0.21***
	0.03	0.02	0.04	0.04	0.03	0.04	0.04	0.03	0.04	0.22	0.25	0.04	0.04
2014	0.02	0.01	0.19***	0.10***	0.20***	-0.02	-0.03	0.14***	0.10***	-0.25	0.20	-0.13***	-0.12***
	0.02	0.02	0.04	0.04	0.03	0.04	0.04	0.03	0.04	0.18	0.18	0.04	0.03
Baseline Y	0.89	0.91	0.21	0.38	0.16	0.60	0.57	0.17	0.29	7.54	7.57	0.44	0.38
R-sq.	0.422	0.402	0.087	0.163	0.242	0.191	0.163	0.084	0.113	0.097	0.064	0.121	0.066
Observations	2278	2278	2278	2278	2278	2278	2278	2278	2278	579	469	2106	2106

Table 23 Changes in all outcomes if head of household's age is less than median

	Send	Receive	Save	Save for emerg-encies	Pay bills	Frequent user for sending	Frequent user for receiving	Frequent user for saving	Frequent user for saving for emerg-encies	Amount send per time	Amount received per time	Sent to household at regular intervals	Receive from household at regular intervals
2008	-0.49***	-0.51***	0.06**	-0.26***	-0.14***	-0.35***	-0.34***	0.07**	-0.20***	-0.12	0.49**	-0.26***	-0.16***
	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.37	0.24	0.04	0.04
2009	0.01	-0.03	0.04	0.05	0.00	-0.20***	-0.27***	-0.01	-0.00	-0.10	-0.19	-0.25***	-0.17***
	0.02	0.02	0.03	0.04	0.03	0.03	0.04	0.03	0.03	0.21	0.17	0.03	0.03
2014	0.02	**0.07****	**0.16*****	**0.11*****	**0.20*****	-0.00	0.00	**0.13*****	**0.13*****	0.12	0.35	**-0.11*****	**-0.09****
	0.03	0.03	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.21	0.29	0.04	0.04
Baseline Y	0.89	0.91	0.21	0.38	0.16	0.60	0.57	0.17	0.29	7.54	7.57	0.44	0.38
R-sq.	0.425	0.422	0.043	0.157	0.230	0.183	0.159	0.044	0.137	0.128	0.192	0.110	0.043
Observations	2717	2717	2717	2717	2717	2718	2718	2718	2718	526	464	2369	2369

Table A24 Changes in all outcomes if head of household's age is more than median

	Send	Receive	Save	Save for emerg-encies	Pay bills	Frequent user for sending	Frequent user for receiving	Frequent user for saving	Frequent user for saving for emerg-encies	Amount send per time	Amount received per time	Sent to household at regular intervals	Receive from household at regular intervals
2008	-0.52***	-0.47***	0.03	-0.23***	-0.14***	-0.39***	-0.37***	0.06**	-0.18***	-0.28	0.30	-0.34***	-0.23***
	0.03	0.03	0.03	0.03	0.02	0.03	0.04	0.03	0.03	0.42	0.27	0.04	0.04
2009	-0.00	-0.02	0.03	0.08**	-0.04	-0.22***	-0.28***	-0.01	0.03	0.11	0.11	-0.28***	-0.23***
	0.03	0.02	0.03	0.04	0.03	0.04	0.04	0.03	0.04	0.26	0.25	0.03	0.03
2014	**0.05****	0.03	**0.18*****	**0.09*****	**0.19*****	-0.02	-0.04	**0.14*****	**0.11*****	0.07	0.20	**-0.14*****	**-0.17*****
	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.03	0.03	0.29	0.22	0.03	0.03
Baseline Y	0.89	0.91	0.21	0.38	0.16	0.60	0.57	0.17	0.29	7.54	7.57	0.44	0.38
R-sq.	0.416	0.362	0.074	0.134	0.192	0.194	0.170	0.071	0.110	0.029	0.087	0.135	0.077
Observations	2492	2492	2492	2492	2492	2494	2494	2494	2494	559	474	2322	2322

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