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Abstract

This study connects two important findings in Sub-Saharan Africa. First, digital technologies such as mobile money have become widespread and have increased investment by businesses, especially in East Africa. Second, women-owned business in the region significantly lag their male counterparts in capital investments. Using data for 16 Sub-Saharan African economies, the study connects the two findings by exploring whether mobile money use by women-owned firms increases their investment. The findings indicate that the positive relationship between mobile money use and investment is largely driven by women-owned firms and is statistically insignificant for men-owned firms. Potential channels of these effects are explored. Women-owned firms that use mobile money to transact with suppliers are more likely to invest. Mobile money also seems to facilitate greater provision of customer credit and generally greater demand for more credit by women-owned firms. Such patterns are not observed for men-owned firms.

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Mobile Money and Investment by Women Businesses in Sub-Saharan Africa

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1. Introduction

Digital technologies can provide opportunities for developing economies to leapfrog into the future. They can change the nature of businesses, create better employment opportunities, and potentially transform lives (World Bank, 2019a). Internet upgrades have been found to increase employment into higher skilled occupations in Africa (Hjort and Poulsen, 2019), showing the potentially inclusive nature of such technologies.[3] Mobile money is a digital technology success story that, originally adopted mainly in East Africa, then spread to the rest of the continent and beyond. Mobile money penetration has been well-documented, with studies showing several benefits for individuals and households (Aker and Mbiti, 2010; Suri and Jack, 2016) through reduction of transaction costs (Jack and Suri, 2014), lowering of travel costs (Aker et al. 2013; Bångens and Björn Söderberg 2011), increases in welfare by smoothing unexpected income shocks (Jack and Suri 2014), increasing security (Wright et al. 2014), and facilitating remittances (Munyegera and Matsumoto 2016).

Given the potentially inclusive effects of digital technology, a key question is whether mobile money adoption and diffusion has benefited women, particularly in Africa where gender disparities are still notable. Young women in Africa are less likely to be employed than young men due to challenges in obtaining skills, distorted time allocation, and limited access to capital (World Bank, 2020). Evidence at the household and individual levels indicates that mobile money may have helped women. In Niger, cash transfers through a mobile money system in response to a drought led households to diversify the crops grown, especially for women who in response grew cash crops (Aker et al., 2013). In Kenya, mobile money alleviated poverty, particularly for female-headed households where women moved out of subsistence farming and changed their main occupation to business or retail (Suri and Jack, 2016).

Persistent gender disparities are observed also for women entrepreneurs. Female-owned businesses in Africa tend to have fewer employees, lower value-added, and lower productivity than their male counterparts (World Bank, 2019b). Part of the observed productivity gaps can be attributed to outward orientation (export status and foreign ownership), the ability to protect

[3] See similar findings between internet and female labor force participation in Jordan (Viollaz and Winkler, 2020).

themselves from crime, and also the use of digital technology (Islam et al., 2020). Another significant disparity between female-owned and male-owned businesses is the degree of capital investment. Data from 14 impact evaluations show that the average capital investment by female-owned firms is more than six times lower than the average for male-owned firm in Africa (World Bank, 2019b). A key question to answer is, therefore, whether highly inclusive digital technology, like mobile money, can benefit women enterprises by increasing their investments.

A recent study across four East Africa economies uncovered a positive relationship between mobile money use and investment by firms (Islam et al, 2018). This study revisits this relationship by exploring whether this relationship varies by gender of the business owner, and also extending the sample of study from 4 economies in East Africa to 16 economies across Sub-Saharan Africa. The analysis is based on a unique firm-level data set with a mobile money module that is implemented using a consistent methodology and the same survey instrument for about 4,700 formal firms across 16 countries in Sub-Saharan Africa. The findings are striking. The positive relationship between mobile money use and investment is confirmed; more importantly, the relationship is largely driven by female-owned firms and is statistically insignificant for male-owned firms. The identification strategy employed is unlikely to obviate all concerns of simultaneity bias between mobile money use and investment given the cross-sectional nature of the data. However, the fact that the relationship is uncovered for female-owned but not male-owned firms attenuates some of the concerns of reverse causality. Furthermore, this study provides external validation for experimental evidence that shows mobile money savings leading to greater capital investments by female-owned micro-business in Tanzania (Bastian et al., 2018) and smallholder farmers in Mozambique (Batista and Vincente, 2020).

We explore potential channels that may convey this effect. Female-owned firms that use mobile money to transact with suppliers are more likely to invest. The importance of supplier relationships uncovered by this paper is consistent with the results of Beck et al. (2018) that find that access to trade credit generates demand for using mobile money as a payment method with suppliers. However, we do not find any significant relationship between mobile money use and supplier credit. Only payments to suppliers specifically undertaken through mobile money have a positive effect on investment by female-owned firms. We also find that female-owned firms that use mobile

money are likely to offer more credit to customers and also demand more credit, while male owned-firms do not. One potential explanation is that mobile money builds trust between women-owned businesses and suppliers and customers, providing opportunities to expand and invest. Alternatively, mobile money may provide liquidity to female-owned firms, allowing them to lend to customers. The provision of customer credit is more under the control of businesses than supplier credit, which is ultimately a decision by the supplying firm. Gosavi (2018) uncovered a positive relationship between mobile money and access to credit for a smaller sample of economies in East Africa.

This study builds on the emerging literature exploring mobile money adoption by businesses, and its benefits. This literature has typically focused on a single or a handful of economies, mainly in East Africa. Gosavi (2015) investigates the characteristics of businesses that use mobile money in Kenya, Tanzania, Uganda, and Zambia and explores the relationship between mobile money and access to finance for the same sample (Gosavi, 2018). A precursor to this study, Islam et al, (2018) find a positive relationship between mobile and investment for firms in Kenya, Uganda, and Tanzania. Beck et al (2018) model the relationship between the adoption of mobile money, entrepreneurial growth, and finance, calibrating their model to match firm-level data from Kenya. Bastian et al. (2018) experimentally explore the relationship between mobile money savings and the growth of female-owned micro-businesses in Tanzania and Indonesia. This study is the first to exhaustively explore the relationship between mobile money and investment for formal firms in 16 economies across Sub-Saharan Africa. It also provides important descriptive information for policy makers on adoption rates and the reasons for mobile money use by firms across Sub-Saharan Africa.

This study also relates to the literature on access to finance for women entrepreneurs, a topic of great interest given that financing obstacles hold back firms (Beck et al., 2005 and Ayyagari et al., 2008) and that discrimination in access to finance limits growth of women-led businesses and represents an obstacle for their investing opportunities (World Bank, 2011). The growing body of literature on this topic has focused mainly on gender-based discrimination in credit rationing and discouraged borrowers. Evidence is mixed as to whether female-owned firms are more financially constrained than male-owned firms in Sub-Saharan Africa (Asiedu et al., 2013; Aterido et al.,

2013; Hansen and Rand, 2014a; Hansen and Rand, 2014b). This study, in line with Beck et al. (2018), moves beyond the traditional focus on credit access, showing the importance of improving more broadly access to financial services, including payment services, as tool to stimulate business performance.

To summarize, the study contributes to the literature in the following ways. First, it uses nationally representative firm-level data for 16 economies across Sub-Saharan Africa, making it one of the most exhaustive studies in the region providing new information on mobile money penetration at the firm level. Second, it affirms the finding that mobile money increases investments by firms that was initially found for four economies in the region mostly in East Africa and finds that the relationship between mobile money use and investment by firms in Sub-Saharan Africa is largely driven by female-owned businesses. Finally, it uncovers suggestive evidence that supplier and customer relationships and the demand for credit may be the mechanisms through which mobile money leads female-owned firms to invest but not male-owned firms.

The rest of the study is structured as follows. Section 2 provides the conceptual framework; section 3 provides data details, summary statistics, and mobile money adoption patterns in the region; section 4 details the empirical strategy; section 5 provides the results; section 6 explores several mechanisms; section 7 provides robustness checks and section 8 concludes.

2. Related Literature and Conceptual Framework

The relationship between transaction costs, access to credit and investment has been well established. In the neoclassical model, the accelerator model, and the Q theory of investment, the optimal level of investment is achieved with zero transaction costs and no budget restrictions; as per the Modigliani-Miller theorem (Modigliani and Miller, 1958), perfect capital markets carry the implication that the firm's financial structure has no role in investment decisions. Subsequent literature has challenged the assumption of perfect capital markets with asymmetric information leading to credit rationing (Stiglitz and Weiss, 1981) and has thus made the availability of capital

the main determinant of investment (Greenwald et al., 1984); and transaction costs may make external sources of finance prohibitively costly, forcing firms to rely on internal funds.

With regards to mobile money, Jack and Suri (2014) model the effect of reducing transaction costs on consumption smoothing risk sharing arrangements among mobile money users. Every transfer of resources across individuals incurs some transaction cost. As transaction costs decline with the mobile money, more exchanges across individuals become feasible, therefore increasing the options for consumption smoothing.

Falling transaction costs increase the number of transactions and expand networks. Similarly, mobile money may alleviate enforcement costs of firms' transactions: time and distance for services rendered can be instantaneous; low-cost and consistent record keeping of transactions can increase trust and nurture better terms and conditions as business transactions are repeated, thereby potentially increasing the volume of operations; and lower outstanding liquidity balances are required for the same level of business activity. With poor infrastructure and under-developed banking sectors, accessing banks in developing economies may involve time consuming travel costs as well as waiting in line time costs. Mobile money use has been found to circumvent such transaction costs especially in Africa (Aker et al., 2013; Jack and Suri, 2014). The reduction of such costs and the ease of money transfer via mobile money improves the liquidity of the firm as cash flows through the firm at a faster rate (Bangens and Soderberg, 2011). The consequent freed up resources can be used to potentially increase investment levels. There is an established literature that has identified the positive effect of improved cash flows on investment (Kadapakkam et al., 1998). Islam et al (2018) have empirically shown a link between mobile money use and investments by firms in East Africa.

The effects of mobile money on investment may differ by personal characteristics such as the gender of the business owner. This is because mobile money may be helpful to circumvent discrimination in access to capital. Taste-based discrimination (Becker, 1957) and statistical discrimination (Phelps, 1972; Arrow, 1973) may both affect financial markets (Aterido et al., 2013). Based on Becker's taste-based discrimination theory, a male dominated financial system may imply higher barriers to accessing financial services for women than men. While, based on the Arrow and Phelps statistical discrimination theory, where discrimination is based on rational

optimizing behavior and limited information, information asymmetry problems could have greater effect among female-owned firms due to lack of credit history or limited access to collateral.

The magnitude of such effects will depend on how the key theoretical channels between mobile money and investment may be affected by gender. Mobile money use may improve supplier and customer relationships and increase demand for credit. Beck et al. (2018), using a dynamic general equilibrium model with heterogeneous entrepreneurs, imperfect credit markets, and the risk of theft, find a positive relationship between supplier credit and mobile money use. Empirically the literature has documented the role of trade credit, via reputation effects, in increasing access to external sources of financing such as bank financing (Alphonse et al., 2006; Buckart and Ellingsen, 2004). Women entrepreneurs may have difficulty accessing suppliers and customers or breaking into networks dominated by men due to women-specific barriers in mobility or access to resources. If mobile money provides women greater access to supplier and customer networks, then this could lead to more opportunities to expand and invest. In other words, mobile money would provide women access to networks that men already have access to. Thus, the use of mobile money may lead to increased investment for female-owned businesses but not necessarily for male-owned businesses.

There is considerable debate whether female-owned businesses face more barriers in accessing finance than male-owned business. Asiedu et al. (2013) find that female-owned firms in Sub-Saharan Africa have difficulty accessing finance, while Hansen and Rand (2014a) do not find gender-specific differences in access to finance. The empirical link between access to finance and investment has been well established (Rajan and Zingales, 1998; Levine et al., 2000; Demirguc-Kunt and Maksimovic, 1998; Cull and Xu, 2005). If we assume that access to finance is harder for women entrepreneurs than male entrepreneurs, then mobile money may provide female-owned businesses access to financing that was already available to male entrepreneurs. Therefore, through the financing channel we can expect mobile money to have a positive effect on investment by female-owned businesses but not male-owned businesses. Similarly, the collection of transaction, savings, and financial operations data from digital financial service platforms may generate credit scores and evaluate and price credit risk. This can help to overcome the so-called collateral technology hurdle, which has hindered the development of credit markets in Africa (Ndung'u, Morales, and Ndirangu. 2016). Mobile money can provide female-owned firms a way to develop

records and thereby access financing that male-owned businesses may already access. This study aims to empirically test the key hypothesis of whether the relationship between mobile money use and investment varies by the gender of the business owner.

3. Data and Summary Statistics

The main data source used in this paper consists of cross-sectional firm-level surveys for 16 economies across Sub-Saharan Africa conducted by the World Bank's Enterprise Surveys (ES). Table A2 presents the list of economies. Most of the surveys were conducted between 2015 and 2017 apart from four economies (Ghana, Tanzania, Uganda, and Zambia) for which data were collected in 2012. The ES collect information on a representative sample of formal (registered) private firms with at least five employees operating in manufacturing or services sectors. The ES data are fully comparable across countries and are collected via face-to-face interviews with business owners or top managers by using a global methodology.[4] The data have been widely used by several studies to explore the private sector in developing economies (Paunov, 2016; Besley and Mueller, 2018; Chauvet and Ehrhar, 2018; Hjort and Poulsen, 2019; Falciola et al., 2020).

The ES global methodology includes a consistent definition of the universe of inference, a standardized survey instrument, a uniform methodology of implementation, and a standard sampling methodology. The selection of firms in each country is done by stratified random sampling with three levels of stratification: sector of activity, firm size, and location within the country. Sampling weights are used to correct for unequal probability of selection as well as for ineligibility and non-response.[5] Supervisors and enumerators attend formal training sessions to ensure the best practices are deployed. Several quality control checks are implemented to guarantee the quality of the data throughout the data collection process. Consistency checks are employed for 10 percent and 50 percent batches of the data during the survey so as to allow quick callbacks to respondents to be undertaken when necessary to verify information.

Several aspects of the business environment are measured by the ES: infrastructure, regulations, taxes, finance, corruption, crime, informality, and competition. In addition, firms' characteristics

[4] ES data are collected using Computer Assisted Personal Interviewing (CAPI) software.
[5] More information on the Enterprise Surveys global methodology as well as on the sample design and weights computation for the 16 economies is available on the website http://www.enterprisesurveys.org.

and firms' outcomes are also covered, including firms' age, legal status, international markets' engagement, workforce composition, gender, innovation, and performance. The gender section includes information on whether the firm has a female owner. The 16 ES conducted in Sub-Saharan Africa included a section on mobile money adoption and use. To the extent of our knowledge this is the most extensive firm-level data on mobile money adoption in Sub-Saharan Africa. Summary statistics for the sample are provided in table 1.

3.1 Mobile Money Adoption

Table 1 shows that 27 percent of firms in the sample have adopted mobile money. About 15 percent of firms used mobile money to receive payments from customers, which is the most common use of mobile money by firms in the sample. This is followed by paying utility bills (10 percent), paying suppliers (8 percent) and finally paying employees (4 percent). Table A1 provides the breakdown by whether or not the firm has at least one woman among the owners (female-owned firms). About 29 percent of female-owned firms and 26 percent of fully male-owned firms use mobile money for financial transactions. The difference is not statistically significant. With regards the use of mobile money, 76 percent of female-owned firms use mobile money to receive payments from customers in contrast to 60 percent of fully male-owned firms. The difference is statistically significant at the 5 percent level. The other uses of mobile money do not show any statistically significant difference between female and male-owned firms.

There is considerable heterogeneity in the adoption of mobile money by firms across economies. Kenya (2017) had the highest penetration with 77 percent of firms using mobile money (Table A2). This is followed by Zimbabwe in 2015 (68 percent) and Uganda in 2012 (54 percent). At the other end, Guinea (6.7 percent) in 2015, and Ghana (4.2 percent) and Zambia (3.7 percent) in 2012 have the lowest rates of mobile money penetration. The time differences in the surveys could explain some of the penetration rates given that penetration may be higher for more recent years due to technological or regulatory advancements. This is empirically accounted for in the estimations.

In table 2 we regress mobile money use on a number of firm-level variables, accounting for location (within country) and sector fixed effects. We explore these correlations by female-owned

versus male-owned firms as well. Firms that have a checking or savings account, faced more bribe solicitations and experienced losses due to crime are more likely to adopt mobile money. These correlations are in line with previous findings in the literature. The association between mobile money use and access to banking services has been documented in the literature on mobile money use at the individual level by Pulver et al. (2009) for Kenya and Ndiwalana, Morawczynki, and Popov (2010) for Uganda. Crime and request for bribes are more likely to occur in settings where transactions involve exchange of money and are unlikely to be recorded. Thus, mobile money use may increase with the risk of crime (Vaughn, 2007) and with the exposure to bribes, acting as a deterrent to both (Krolikowski, 2014; Blumenstock et al., 2015). Firms that were not registered when started operations (i.e. that have started informally) are also more likely to adopt mobile money. There are two possible interpretations for this. One, it may be that firms that started informally have characteristics that make them more similar to informal firms and, therefore, more likely to adopt mobile money as it allows for flexibility that fits with the informal sector (Loayza, 2018). Second, it may be that informal firms that successfully formalize are more likely to adopt mobile money. The causation could run in the other direction – mobile money helps informal firms to formalize – but given the data limitations we cannot discern the likely interpretation. Moreover, firms with lower levels of labor productivity are also more likely to adopt mobile money. This is in line with mobile money being used by firms that operate at a smaller scale as it may be the case for less productive firms. Finally, there is no statistically significant correlation between gender of the owner and mobile money adoption, i.e. women-owned firms are as likely as men-owned firms to use mobile money for business-related financial transactions. This is in line with results at the individual level that show no gender effect for mobile money adopters (Munyergera and Matsumoto, 2016).

When looking at the two sub-samples of women and men-owned firms separately, differences in the correlates for mobile money adoption emerge. The correlation between having started informally and mobile money adoption is largely driven by female-owned firms, with no statistically significant correlation for male-owned firms. On the other hand, the correlations between bribery, crime, and productivity with mobile money adoption are largely driven by male-owned businesses. Finally, when exploring the proportion of sales sold on credit, a positive correlation with mobile money adoption is found for female-owned firms but not male-owned firms. This may imply that the use of mobile money and the building of relationships with

customers are positively correlated for female-owned firms to build. Note that we find no statistically significant results between the proportion of working capital financed by supplier credit and mobile money use for the whole sample as well as for female or male-owned firms sub-samples. Results for the regression that include the proportion of sales sold on credit are presented separately (table 2, columns 4-6) as the data are unavailable for Kenya, and thus implying considerable changes in the sample composition.[6]

The ES also collects responses from respondents on why they have chosen to adopt or avoid mobile money.[7] The findings by gender of the owner are presented in table A1. Most female-owned firms cite satisfying customer requests (31 percent of mobile-money adopting firms), followed by reduction of time spent in financial transactions (25 percent) and reduction of costs of financial transactions (19 percent). Most male-owned firms cite reduction in time spent in financial transactions (42 percent), followed by satisfy customer request (25 percent) and then reduction of costs of financial transactions (17 percent). The differences in reasons provided by female versus male-owned firms are not statistically significant with the exception of reduction of time spent in financial transactions (25 percent female owned firms vs. 42 percent male-owned firms).

For firms that do not adopt mobile money, the lack of use by customers or suppliers are the most cited reasons, regardless of gender of owner (table A1).[8] Fewer female-owned firms cited high fees than male-owned firms for not adopting mobile money (7 percent vs. 23 percent). Fewer female-owned firms cited "not easy to use" as a reason for not adopting mobile money than male-owned firms (10 percent vs. 18 percent). Both differences are statistically significant at the 1 percent level. The indication may be that women firm-owners are more experienced with mobile money than male-owned firms and thus ease of use is not a barrier to adoption. It also may be that female-owned firms engage in smaller transactions and thus do not see high fees as a barrier to adopting mobile money as male-owned firms. It is also worth noting that 20 percent of female-owned firms and 25 percent of male-owned firms that did not adopt mobile money cite "don't know enough" as the reason why. This may imply there is scope for awareness campaigns to improve mobile money adoption.

[6] The survey question on proportion of sales sold on credit has been removed from recent rounds of the Enterprise Surveys and thus the Kenya 2019 survey does not have this information.
[7] Note that this excludes Zimbabwe.
[8] Note that Kenya is excluded as the exact survey question was not included in the questionnaire.

4. Empirical Strategy

We estimate the equation (1) below for female-owned and male-owned firms separately to explore the heterogenous relationship between mobile money use and investment.

$$Invest_i = \beta_0 + \beta_1 MobileMoney_i + \beta_2 Size_i + \beta_3 Manager_i + \beta_4 LabProd_i + \beta_5 Age_i + \beta_6 Multi + \beta_7 Exprt_i + \beta_8 Frgn_i + \beta_9 Train_i + \beta_{10} Power_i + \beta_{11} Elctgn_i + \beta_{12} Loan_i + \beta_{13} Bank_i + \beta_{14} Itrnt_i + \delta_1 D_s + \delta_2 D_l + \epsilon_i \quad (1)$$

where $Invest$ is a measure of investment by firm i. $MobileMoney$ is a set of variables that capture mobile money use. To account for as many confounding factors as possible several firm-level controls are employed. These include firm size ($Size$); manager experience ($Manager$); labor productivity ($LabProd$); firm age (Age); part of a multi-establishment firm ($Multi$); export orientation ($Exprt$); foreign ownership ($Frgn$); offered formal training ($Train$); experienced power outages ($Power$); used electric generators ($Elctgn$); had a loan or line of credit ($Loan$); has a bank account ($Bank$); use of their own website ($Itrnt$). The estimation includes sector two-digit (ISIC) sector (D_s) and within country location (D_l) fixed effects. ϵ_i is the standard error term with the usual desirable properties. Weights and the stratification design of the survey are utilized for all the estimates in this study. Given that the survey was stratified, by design, the standard errors are clustered by firm size, sector, and location.

Investment is captured by two variables. The first is a binary variable that takes a value of 1 if the firm purchased any fixed assets such as machinery, vehicles, equipment, land, or buildings were purchased (new or used) in the previous fiscal year. The second variable is the amount of expenditure on the fixed assets (in logs).

The main explanatory variables capture the use of mobile money ($MobileMoney$). This includes a binary variable that takes on a value of 1 if a firm has used mobile money for any transaction, and 0 if it has not. Four additional binary variables are used to capture four types of purpose of mobile money use – payment of employees, payments to suppliers, payments of utility bills, and receipt of payments from customers.

There is a concern of endogeneity given the possibility of simultaneity between mobile money use and investment - it may be that firms that invest are more likely to use mobile money. While this is difficult to obviate, given that we estimate equation (1) separately for female-owned and male-

owned, reverse causality is only a concern if the effect of investment on mobile money adoption is not the same for both female-owned and male-owned firms. If the simultaneity between mobile money and investment is the same for both female-owned and male-owned firms, then this is less of a concern if we find a positive effect of mobile money on investment for female-owned firms but not for male-owned firms. Our strategy is to account for as many firm-level factors as possible to limit the issue of omitted variable bias. These are described in detail below.

Larger firms may have different investment needs than smaller firms and thus firm size can influence investment (Cull and Xu, 2005). Larger firms may also have more access to resources and networks to carry out investments than small firms. The same argument can be employed for productive firms, and multi-establishment firms as opposed to single-establishment firms. Thus, we account for firm size ($Size$), whether the firm is part of an establishment ($Multi$), and labor productivity ($LabProd$) in equation (1). We also we account for firm age (Age) given technology upgrades are likely to be influenced by the age of the firm (Cull and Xu, 2005). Several studies have uncovered relationships between a firm's performance and its age and size (Biesebroeck 2005; Bigsten and Gebreyeesus 2007; Haltiwanger et al. 2013). We also account for power infrastructure quality and ownership of generators that are important for firm performance (Cole et al., 2018).

Manager characteristics may be positively related to investment (McMillan and Woodruff, 2002). Optimistic and more experienced managers may be more likely to invest, and thus manager experience ($Manager$) is captured in the empirical specification. Also following the literature, we capture whether firms offer formal training ($Train$) given that it improves human capital capacity and thus raises productivity and investments (Kinda et al, 2015). We also include variables such as exporter status ($Exprt$) and foreign ownership ($Frgn$) given that outward orientation of the firm is correlated with innovation and productivity, and therefore, with potentially higher level of investment (Seker, 2012; Lopez 2005; Bernard et al. 2007; Dimelis and Louri, 2002; Guadalupe et al., 2012). Finally, the gender of the manager of the firm may affect the productivity of the firm and the propensity to invest due to a variety of factors (Schubert et al. 1999).

Access to finance influences the investment decisions of firms. Access to finance has also been found to improve firm productivity (Gatti and Love, 2008; Rajan and Zingales, 1998). This is

captured by whether or not a firm has a loan or line of credit ($Loan$) and bank account ($Bank$). We proxy for internet connection by including a dummy variable equal to one if the firm has its own website and 0 if it does not ($Itrnt$) following Clarke et al., 2015. This is to address the concern that firms' use of mobile money may be correlated with the level of internet use or digital connectivity of the firm, and therefore any finding of a positive correlation between mobile money use and investment may reflect a broader tendency for the firm to use digital technologies.

Firms in certain sectors may be more inclined to adopt mobile money than other sectors. Furthermore, certain sectors are more likely to have more female entrepreneurs than others (Amin and Islam, 2014). The type of activity a firm undertakes may also dictate what sorts of supplier the firm engages with and the type of relationship they have given that some sectors may be monopolized with just one supplier. We account for such factors using sector fixed effects at the 2-digit ISIC level.

There are several country-level confounding factors that may influence the level of firm investment. The state of the banking system including the depth of the financial systems are country-level factors that would have to be accounted for to obtain clean estimates of the effect of mobile money adoption on investment. Countries may pursue policies that affect the use of banking systems and thereby affect a firm's investment decisions. Furthermore, financial systems may vary between regions within a country. Thus, we include location (within country) fixed effects to account for time invariant region-specific or country-specific omitted variables.

5. Estimation Results

Table 3 provides the base estimation results. Column 1 presents the results for the binary outcome of whether a firm has invested for the whole sample. Columns 2 and 3 repeat the same estimations for subsamples of female-owned firms and male-owned firms respectively. Column 1 confirms the positive and statistically significant relationship between mobile money use and the likelihood of investing in fixed assets as found by Islam et al., (2018) for a smaller set of four economies. Use of mobile money leads to an 9.1 percent increase in the likelihood of investing in fixed assets, statistically significant at the 1 percent level. However, the most striking finding is that mobile money is positively and statistically related with investment for female-owned firms (Table 2,

column 2) but there is no statistically significant relationship for male-owned firms.[9] Use of mobile money by female-owned firms leads to a 19.8 percent increase in the likelihood of investment. Thus, the overall relationship between mobile money use and investment is driven by female-owned firms. The same patterns are observed for the amount invested.[10] Column 4 in table 2 shows that mobile money use is positively correlated with the amount invested for the whole sample. However, columns 5 and 6 show that that this relationship is only statistically significant for the female-owned firms subsample but not the male-owned firms subsample. Thus, the relationship between mobile money use and both the likelihood and the amount invested is largely driven by female-owned firms.

Other factors are also correlated with the purchase of fixed assets. For the whole sample, access to finance, as proxied by having a loan or line of credit or having a bank or checking account is positively correlated with the likelihood of investment and also the amount invested. However, this finding is only statistically significant for male-owned firms but not for female-owned firms. This may indicate that traditional formal banking services are not accessible by women. Larger firms, firms that have their own website, and firms that own electric generators that buffer against power outages are both more likely to invest and also to invest higher amounts, regardless of whether the business is owned by men or women. Finally, there is a positive and statistically significant correlation between formal training and amount invested for female-owned firms but not for male-owned firms.

6. Mechanisms

The findings thus far have confirmed the finding from Islam et al., (2018) that mobile money is positively correlated with investment. Furthermore, we have shown that this result is largely driven

[9] Note that the female-owned sample is almost half the size of the male-owned sample, and thus the smaller sample size for female-owned firms biases the results towards finding no significant effects for the female-owned firm sample.

[10] The estimations for the amount invested were also obtained using a Tobit model, censoring the dependent variable at zero, given the high proportion of firms not investing. The main finding stands—mobile money usage is positively correlated with investment for female-owned firms but not male-owned firms. Tobit estimation results are not reported but available from the authors upon request.

by female-owned firms. The question that follows is why mobile money is more likely to lead to investment for female-owned firms but not male-owned firms. To unpack possible explanations, we first correlate investment with different uses of mobile money separately for female-owned and male-owned firms (table 4). We explore four uses of mobile money – to pay suppliers, to pay employees, to pay utility bills, and to receive payments from customers. Columns 2 and 4 show that female-owned firms that use mobile money to pay suppliers are more likely to invest or increase investment, statistically significant at the 5% level. None of the other uses of mobile money is statistically significantly related to investment. For male-owned firms, none of the mobile money use variables is statistically significantly related to investment. The implication is that mobile money might provide female-owned firms an avenue to build relationships with suppliers, potentially increasing access to trade credit that leads to more investment. Male-owned firms may have already established these networks and thus mobile money does little to improve their networks. This result may also suggest that mobile money allows for the possibility of financing through trade credit, helping female-owned firms to overcome the negative effects of statistical discrimination due to asymmetry of information. The significance of mobile money in influencing trade credit has also been uncovered by Beck et al (2018).

However, as reported in columns 3 and 4 of table 5, we do not find any statistically significant relationship between mobile money use and the proportion of working capital financed by supplier credit for either female-owned or male-owned firms, although the relationship is positive for the former and negative for the latter.[11] There are a couple of reasons we can propose but not necessarily verify in explaining these findings. It could mean that although mobile money use does not expand trade credit overall, the relationships created with suppliers provide opportunities for women-owned businesses that lead to greater opportunities to invest. Alternatively, it could be that overall trade credit does not expand, but trade credit obtained specifically through mobile money does, and with this comes certainty and stability that incentivizes women-owned businesses to invest. We do not have data on whether trade credit was obtained through mobile money or traditional means to verify these plausible mechanisms.

[11] We get statistically insignificant results if we instead use proportion of investment financed by supplier credit (note that this variable is only available for firms that invested), and also a combined measure of supplier credit financing for both working capital and investment.

We then explore if mobile money use is correlated with the proportion of sales sold on credit for female-owned firms and male-owned firms, which may proxy for relationships with customers. Results are presented in columns 1 and 2 of table 5 respectively. Mobile money use is positively correlated with the proportion of sales sold on credit for female-owned firms, statistically significant at the 5% level. Mobile money use is negatively related to the proportion of sales sold on credit for male-owned firms, although the relationship is statistically insignificant. These findings are unlikely to be driven by the sector of activity given they are accounted for by sector fixed effects. This suggests that mobile money provides female-owned firms with opportunities to build relationships with customers which can then increase the customer base and possibilities for expansion and investment. Alternatively, it may also mean that mobile money injects more liquidity into female-owned firms and thus they are able to lend more credit to customers and also invest.

We also explore whether mobile money use is correlated with the desire for more credit. Firms that "want a loan" are those that applied for a loan (whether they obtained one or not) or would have applied for a loan if there were better terms and conditions. Conversely firms that did not want a loan are those that did not apply for a loan because they had sufficient capital or did not need one. Columns 5 and 6 of table 5 provide the results for female-owned and male-owned firms respectively. Mobile money use is positively correlated with the desire for loans for female-owned firms, statistically significant at the 1% level. For male-owned firms the coefficient for mobile money is negative but statistically insignificant. Even though the variable we use does not capture the actual access to credit, the fact female-owned firms that use mobile money are more likely to demand credit may be an indication of higher confidence. Thus, mobile money use may reduce the discouragement effect that often holds female-owned firms back.

In summary, our empirical results suggest that mobile money use by female-owned firms may lead to greater investment through a number of plausible channels. First, mobile money use leads to better relationships with suppliers and customers that may provide opportunities for expansion, which in turn increases investment. Furthermore, the positive association between mobile money and customer credit may imply that mobile money provides women-owned businesses with more liquidity and thus they are able to provide credit, and also invest. Second, the use of mobile money by women-owned businesses leads to a desire for more credit that allows for investments.

7. Robustness – Additional Controls

We try to limit the omitted variable bias problem by accounting for additional control variables, with the limitation that the inclusion of additional controls comes at a cost of smaller sample size due to low response rates. As a robustness check, we account for several elements of the business environment that are known to impact firm productivity and thus possibly investment. These include measures of corruption and business regulations (see Aterido et al, 2011; Commander and Svejnar, 2011). Corruption is measured by the percent of public transactions made by a firm where a gift or informal payment was requested. Regulations are captured by the time spent by senior management in dealing with regulations.

Firms that started informally are likely to share similar characteristics as informal firms. These include lower levels of productivity with managers that have low education (La Porta and Shleifer, 2014). On the other hand, firms that started informally have already formalized by the time of the surveys. This may be indicative of high growth firms. Thus, we account for whether or not a firm started informally given that it is correlated with mobile money adoption and may also be correlated with investment. A study by Islam et al. (2020) found that differential access to internet and outward orientation of the firm by the gender of the manager of the firm contributed to a productivity gap between firms that do and do not have a female top manager. Thus, we additionally account for whether or not the top manager in the firm is female.

We also include a wider range of variables beyond internet connectivity that capture technological capacity of the firm. These include whether they spent money on research and development and whether they have ISO certification. Furthermore, to take a more comprehensive account of firm productivity beyond looking at labor productivity, we include the real annual sales growth of the firm, typically estimates as a growth rate between the fiscal year and three years before. The limitation is that sales three years previous are based on recall data.

The findings are presented in table 6. The main results stand. The relationship between mobile money use and investment is largely driven by female-owned firms. The magnitude of the coefficient is larger than the base estimates in table 3. None of the additional covariates have a statistically significant relationship with investment except for bribery. Bribery is positively correlated with investment for male-owned firms but not female-owned firms. Surprisingly male-owned firms that face more adverse business environments such as bribery are also more likely to

invest in fixed assets. This might imply that firms that invest are greater targets for bribe payments. The data at hand do not allow us to say for certain what may be driving the relationship between bribery and male-owned firms.

An additional robustness check is whether our results change if we explore firms with 100 percent female ownership as opposed to the current definition where a woman-owned business is one that has at least one female owner. Our hesitancy to explore fully female-owned businesses is due to the fact that there is a precipitous drop in the sample as not as many firms are fully female-owned. However, as shown in table 7, the results stand for fully female-owned firms as well. The coefficient of mobile money adoption is positive and statistically at the 5% level for both whether or not the firm invested and the magnitude of investment. As reported previously, the relationship is not statistically significant for male-owned firms. Thus, our main finding that mobile money adoption by women-owned businesses leads to greater investment survives the battery of robustness checks we employ.

8. Conclusions

The benefits of mobile money can be inclusive, reaching segments of the population that may be typically excluded from networks that provide financial access. This study builds on the literature by confirming the positive relationship between mobile money use and investment for 16 economies in Sub-Saharan Africa. Moreover, the study shows that this relationship is largely driven by female-owned businesses, that is, the relationship between mobile money and investment is statistically significant for female-owned businesses but not male-owned businesses. The evidence suggests that the channels leading women-owned businesses to invest due to mobile money include access to suppliers, credit to customers, which may proxy for liquidity, and an increase in the demand for credit.

The finding that mobile money helps women-owned businesses is a major contribution to the literature, as studies on the effect of mobile money use have typically focused on female-headed households or micro entrepreneurs but not formal firms. This is however just one aspect of the story. There are still numerous dimensions that are ripe for research. Several questions remain

unanswered regarding how the productivity and profitability of female-owned businesses may be affected by mobile money use.

Furthermore, the inclusive nature of mobile money may provide inferences for digital technologies in general. Other technologies may or may not be as inclusive in terms of gender as mobile money, and such effects could be explored in a similar vein. More importantly, the inclusive nature of mobile money could provide synergies with other technologies, and thereby mobile money could provide opportunities for wider effects than those uncovered in this study. We hope this study encourages further research on the interactions between gender and technology both in developed and developing economies.

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Table 1: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Mobile Money Used for Financial Transaction (Y/N)	4,746	0.27	0.44	0.00	1.00
Mobile money to pay supplier Y/N (0 if not adopted)	4,425	0.08	0.27	0.00	1.00
Mobile money to pay employee Y/N (0 if not adopted)	4,425	0.04	0.19	0.00	1.00
Mobile money to pay utility bills Y/N (0 if not adopted)	4,425	0.10	0.30	0.00	1.00
Mobile money to receive payments from customers Y/N (0 if not adopted)	4,425	0.15	0.36	0.00	1.00
Firm Purchased Fixed Assets Y/N	4,746	0.41	0.49	0.00	1.00
Log of purchase of fixed assets (amount in USD)	4,746	3.76	4.95	0.00	24.10
Firm has a Female Owner Y/N	4,746	0.29	0.46	0.00	1.00
Log of size	4,746	2.62	1.03	0.00	7.44
Top manager experience in sector (years)	4,746	16.09	9.86	1.00	60.00
Labor Productivity (deflated, USD)	4,746	8.77	1.80	2.21	15.84
Log of age of firm	4,746	2.50	0.77	0.00	4.82
Firm is part of a larger firm Y/N	4,746	0.22	0.42	0.00	1.00
Proportion of working capital financed by supplier credit (%)	4,603	9.08	19.60	0.00	100.00
Direct exports 10% or more of sales Y/N	4,746	0.08	0.26	0.00	1.00
Foreign ownership Y/N	4,746	0.14	0.35	0.00	1.00
Firm offers formal training Y/N	4,746	0.28	0.45	0.00	1.00
Firm experienced power outage Y/N	4,746	0.81	0.39	0.00	1.00
Firm owns or shares an electric generator	4,746	0.56	0.50	0.00	1.00
Establishment has a line of credit or loan Y/N	4,746	0.19	0.39	0.00	1.00
Establishment has checking or savings account Y/N	4,746	0.84	0.37	0.00	1.00
Website Y/N	4,746	0.24	0.43	0.00	1.00
Firm wants a loan Y/N	4,653	0.65	0.48	0.00	1.00
Proportion of sales sold on credit (%)	3,654	20.35	26.73	0.00	100.00
Female top manager Y/N	4,745	0.17	0.38	0.00	1.00
Firm Not Registered when Started Operations Y/N	4,722	0.18	0.39	0.00	1.00
Senior management time spent in dealing with requirements of government regulations (%)	4,116	10.46	18.18	0.00	100.00
ISO Certification Ownership Y/N	4,599	0.08	0.28	0.00	1.00
Establishment Spent on R&D over the last FY Y/N	4,722	0.15	0.35	0.00	1.00
Real annual sales growth (%)	4,145	5.74	28.71	-99.79	99.83
Bribery depth (% of public transactions where a gift or informal payment was requested)	3,957	19.39	35.66	0.00	100.00

Table 2: Types of Firms that use Mobile Money

Model	Linear Probability Model					
Dependent Variable	Mobile Money Used for Financial Transaction (Y/N)					
	All	Female-owned Firms	Male-owned Firms	All	Female-owned Firms	Male-owned Firms
	(1)	(2)	(3)	(4)	(5)	(6)
Firm has a Female Owner Y/N	-0.031			-0.041		
	(0.027)			(0.029)		
Proportion of sales sold on credit (%)				-0.0001	0.001**	-0.001
				(0.000)	(0.001)	(0.001)
Log of size	-0.017	-0.033	-0.007	-0.017	-0.047*	-0.005
	(0.013)	(0.025)	(0.018)	(0.014)	(0.027)	(0.018)
Top manager experience in sector (years)	-0.002	-0.003	-0.003	-0.003**	-0.003	-0.004**
	(0.001)	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)
Labor Productivity (deflated, USD)	-0.019**	-0.013	-0.024**	-0.020**	-0.015	-0.023**
	(0.009)	(0.023)	(0.011)	(0.010)	(0.024)	(0.011)
Log of age of firm	-0.026	-0.033	-0.019	-0.024	-0.049	-0.012
	(0.019)	(0.038)	(0.024)	(0.020)	(0.039)	(0.025)
Firm is part of a larger firm Y/N	0.018	0.007	0.018	0.023	0.042	0.010
	(0.034)	(0.065)	(0.044)	(0.036)	(0.069)	(0.045)
Proportion of working capital financed by supplier credit (%)	0.0004	0.002	-0.0003	0.0002	0.001	-0.0002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Direct exports 10% or more of sales Y/N	0.027	0.047	0.009	0.033	0.035	0.019
	(0.044)	(0.062)	(0.063)	(0.049)	(0.064)	(0.068)
Foreign ownership Y/N	-0.026	-0.031	-0.024	-0.037	-0.077	-0.025
	(0.034)	(0.071)	(0.043)	(0.035)	(0.071)	(0.044)
Firm offers formal training Y/N	0.019	0.020	0.012	0.018	-0.007	0.021
	(0.026)	(0.047)	(0.035)	(0.028)	(0.052)	(0.036)
Firm experienced power outage Y/N	0.001	-0.051	0.035	-0.017	-0.045	0.009
	(0.039)	(0.103)	(0.044)	(0.043)	(0.112)	(0.045)
Firm owns or shares an electric generator	0.003	0.001	0.005	0.007	-0.014	0.015
	(0.026)	(0.050)	(0.034)	(0.028)	(0.058)	(0.036)
Firm Not Registered when Started Operations Y/N	0.080**	0.128*	0.053	0.091**	0.122*	0.068
	(0.039)	(0.071)	(0.047)	(0.040)	(0.073)	(0.047)
Bribery depth (% of public transactions where a gift or informal payment was req	0.001*	0.001	0.001*	0.001**	0.0004	0.001**
	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
Firm experienced losses due to crime Y/N	0.063**	0.040	0.081*	0.065*	0.062	0.078*
	(0.031)	(0.049)	(0.043)	(0.034)	(0.054)	(0.045)
Establishment has a line of credit or loan Y/N	-0.010	0.020	-0.023	-0.015	0.006	-0.030

	(0.029)	(0.053)	(0.040)	(0.032)	(0.060)	(0.042)
Establishment has checking or savings account Y/N	0.097**	0.121*	0.102*	0.103**	0.119*	0.116**
	(0.041)	(0.069)	(0.055)	(0.042)	(0.071)	(0.056)
Website Y/N	0.016	0.001	0.026	0.044	0.069	0.035
	(0.032)	(0.057)	(0.043)	(0.034)	(0.054)	(0.047)
Constant	0.271*	0.289	0.270	0.337**	0.387	0.276
	(0.138)	(0.324)	(0.196)	(0.147)	(0.349)	(0.207)
Sector (ISIC 2 Digit) Fixed Effects	YES	YES	YES	YES	YES	YES
Location (within country) Fixed Effects	YES	YES	YES	YES	YES	YES
Number of observations	3,823	1,299	2,524	2,935	902	2,033
R2	0.353	0.503	0.324	0.289	0.419	0.288

note: *** p<0.01, ** p<0.05, * p<0.1. Proportion of Credit excludes Kenya, as the survey did not include the question

Table 3: Mobile Money Use and Investment

Model	Linear Probability Model			OLS		
Dependent Variable	Firm Purchased Fixed Assets Y/N			Log of purchase of fixed assets (amount in USD)		
	All	Female-owned Firms	Male-owned Firms	All	Female-owned Firms	Male-owned Firms
	(1)	(2)	(3)	(4)	(5)	(6)
Mobile money for any financial transactions Y/N	0.091***	0.198***	0.065	0.777**	1.512***	0.621
	(0.035)	(0.066)	(0.044)	(0.316)	(0.581)	(0.406)
Firm has a Female Owner Y/N	0.043			0.301		
	(0.032)			(0.298)		
Log of size	0.052***	0.063**	0.061***	0.787***	1.006***	0.822***
	(0.018)	(0.029)	(0.021)	(0.175)	(0.283)	(0.217)
Top manager experience in sector (years)	0.002	-0.001	0.005**	0.013	-0.013	0.034
	(0.002)	(0.003)	(0.002)	(0.017)	(0.027)	(0.021)
Labor Productivity (deflated, USD)	0.015*	0.017	0.014	0.278***	0.354*	0.249**
	(0.009)	(0.019)	(0.011)	(0.089)	(0.185)	(0.109)
Log of age of firm	-0.031	-0.055	-0.032	-0.192	-0.584	-0.149
	(0.023)	(0.039)	(0.028)	(0.211)	(0.366)	(0.251)
Firm is part of a larger firm Y/N	-0.003	-0.008	0.002	0.167	-0.013	0.330
	(0.037)	(0.066)	(0.049)	(0.361)	(0.634)	(0.483)
Direct exports 10% or more of sales Y/N	0.024	0.146	-0.022	0.462	1.854	0.005
	(0.064)	(0.116)	(0.070)	(0.637)	(1.173)	(0.703)
Foreign ownership Y/N	-0.017	0.033	-0.060	-0.232	0.102	-0.534
	(0.045)	(0.088)	(0.055)	(0.438)	(0.848)	(0.540)
Firm offers formal training Y/N	0.070**	0.086	0.046	0.768**	0.987*	0.543
	(0.035)	(0.057)	(0.045)	(0.340)	(0.544)	(0.437)
Firm experienced power outage Y/N	-0.000	0.049	-0.011	-0.047	0.341	-0.155
	(0.039)	(0.085)	(0.047)	(0.340)	(0.788)	(0.406)
Firm owns or shares an electric generator	0.091***	0.126*	0.079*	0.935***	1.191*	0.867**
	(0.035)	(0.065)	(0.043)	(0.312)	(0.627)	(0.368)
Establishment has a line of credit or loan Y/N	0.089**	0.064	0.087*	1.153***	0.653	1.219**
	(0.038)	(0.067)	(0.049)	(0.396)	(0.655)	(0.512)
Establishment has checking or savings account Y/N	0.081*	-0.032	0.112**	0.802**	-0.005	1.007**
	(0.045)	(0.094)	(0.053)	(0.383)	(0.849)	(0.446)
Website Y/N	0.144***	0.206***	0.113**	1.089***	1.692***	0.755
	(0.042)	(0.064)	(0.052)	(0.397)	(0.616)	(0.492)
Constant	0.065	-0.022	0.124	-1.726	-2.867	-0.981
	(0.178)	(0.288)	(0.233)	(1.622)	(2.504)	(2.142)

Sector (ISIC 2 Digit) Fixed Effects	YES	YES	YES	YES	YES	YES
Location (within country) Fixed Effects	YES	YES	YES	YES	YES	YES
Number of observations	4,746	1,559	3,187	4,754	1,561	3,193
R2	0.186	0.319	0.187	0.222	0.327	0.228

note: *** p<0.01, ** p<0.05, * p<0.1

Table 4: Mobile Money Purpose and Investment

Model	Linear Probability Model		OLS	
Dependent Variable	Firm Purchased Fixed Assets Y/N		Log of purchase of fixed assets (amount in USD)	
	Female-owned Firms	Male-owned Firms	Female-owned Firms	Male-owned Firms
	(1)	(2)	(3)	(4)
Mobile money to pay supplier Y/N (0 if not adopted)	0.207**	0.072	1.733**	0.234
	(0.096)	(0.073)	(0.847)	(0.627)
Mobile money to pay employee Y/N (0 if not adopted)	0.035	-0.013	0.868	0.142
	(0.119)	(0.111)	(1.024)	(1.031)
Mobile money to pay utility bills Y/N (0 if not adopted)	0.140	0.026	0.757	0.737
	(0.087)	(0.068)	(0.787)	(0.620)
Mobile money to receive payments from customers Y/N (0 if not adopted)	0.125	0.073	0.779	0.582
	(0.079)	(0.060)	(0.795)	(0.516)
Log of size	0.077**	0.063***	1.085***	0.846***
	(0.030)	(0.022)	(0.302)	(0.226)
Top manager experience in sector (years)	-0.001	0.005**	-0.014	0.034
	(0.003)	(0.003)	(0.030)	(0.023)
Labor Productivity (deflated, USD)	0.007	0.013	0.245	0.229**
	(0.020)	(0.011)	(0.194)	(0.110)
Log of age of firm	-0.064*	-0.031	-0.681*	-0.101
	(0.037)	(0.030)	(0.366)	(0.269)
Firm is part of a larger firm Y/N	0.035	0.009	0.383	0.382
	(0.070)	(0.051)	(0.704)	(0.501)
Direct exports 10% or more of sales Y/N	0.148	-0.026	1.935	-0.047
	(0.116)	(0.070)	(1.185)	(0.714)
Foreign ownership Y/N	0.043	-0.065	0.201	-0.590
	(0.090)	(0.057)	(0.888)	(0.562)
Firm offers formal training Y/N	0.096	0.043	1.115*	0.517
	(0.060)	(0.045)	(0.584)	(0.442)
Firm experienced power outage Y/N	0.056	-0.013	0.416	-0.185
	(0.089)	(0.049)	(0.849)	(0.418)
Firm owns or shares an electric generator	0.129*	0.081*	1.219*	0.922**
	(0.068)	(0.044)	(0.681)	(0.376)
Establishment has a line of credit or loan Y/N	0.059	0.083*	0.735	1.190**
	(0.066)	(0.050)	(0.655)	(0.519)

Establishment has checking or savings account Y/N	-0.057	0.112**	-0.172	0.986**
	(0.098)	(0.053)	(0.895)	(0.444)
Website Y/N	0.183***	0.118**	1.462**	0.812
	(0.069)	(0.056)	(0.662)	(0.520)
Constant	0.090	0.127	-1.663	-0.890
	(0.290)	(0.236)	(2.550)	(2.172)
Sector (ISIC 2 Digit) Fixed Effects	YES	YES	YES	YES
Location (within country) Fixed Effects	YES	YES	YES	YES
Number of observations	1,410	3,015	1,412	3,021
R2	0.347	0.190	0.343	0.233

note: *** p<0.01, ** p<0.05, * p<0.1. Excludes Zimbabwe as the survey instrument did not include questions on purpose of mobile money

Table 5: Potential Channels of Effects

Model	OLS				Linear Probability Model	
Dependent Variable	Proportion of sales sold on credit (%)		Proportion of working capital financed by supplier credit (%)		Firm wants a loan Y/N	
	Female-owned Firms	Male-owned Firms	Female-owned Firms	Male-owned Firms	Female-owned Firms	Male-owned Firms
	(1)	(2)	(3)	(4)	(5)	(6)
Mobile money for any financial transactions Y/N	7.271**	-0.943	3.342	-0.227	0.177***	0.007
	(3.234)	(2.168)	(2.748)	(1.681)	(0.067)	(0.048)
Log of size	2.511	2.386*	2.400	0.446	-0.033	-0.051***
	(1.774)	(1.336)	(1.631)	(0.874)	(0.027)	(0.019)
Top manager experience in sector (years)	0.121	-0.029	-0.055	-0.097	0.004	0.001
	(0.167)	(0.125)	(0.185)	(0.097)	(0.003)	(0.002)
Labor Productivity (deflated, USD)	0.980	0.303	0.756	-0.104	-0.039**	-0.007
	(0.929)	(0.667)	(0.779)	(0.835)	(0.017)	(0.012)
Log of age of firm	2.698	0.394	0.217	0.705	-0.019	0.042
	(1.952)	(1.495)	(2.014)	(1.089)	(0.043)	(0.028)
Firm is part of a larger firm Y/N	-1.172	-3.097	-1.974	-1.061	0.054	-0.070
	(3.406)	(2.308)	(2.607)	(1.884)	(0.063)	(0.049)
Direct exports 10% or more of sales Y/N	6.481	-0.142	-4.973	-0.818	-0.002	0.011
	(5.342)	(3.542)	(5.198)	(2.060)	(0.085)	(0.081)
Foreign ownership Y/N	1.043	3.010	-1.479	3.075	0.090	-0.068
	(4.676)	(2.994)	(3.400)	(2.187)	(0.068)	(0.053)
Firm offers formal training Y/N	3.915	3.443	3.129	1.441	-0.053	0.014
	(3.639)	(2.670)	(4.001)	(1.676)	(0.058)	(0.041)
Firm experienced power outage Y/N	-1.940	-0.311	-0.650	4.334***	0.158**	-0.002
	(3.792)	(2.214)	(3.514)	(1.679)	(0.077)	(0.049)
Firm owns or shares an electric generator	2.275	3.663*	2.189	-1.547	-0.026	-0.022
	(3.682)	(2.106)	(2.648)	(1.640)	(0.054)	(0.042)
Establishment has a line of credit or loan Y/N	8.548*	10.805***	2.651	3.602*	0.193***	0.179***
	(4.419)	(3.056)	(3.026)	(1.895)	(0.069)	(0.043)
Establishment has checking or savings account Y/N	-4.656	1.201	2.517	-2.943	-0.033	0.029
	(3.194)	(2.710)	(4.254)	(2.296)	(0.075)	(0.057)
Website Y/N	0.954	7.797**	-5.158*	-3.144*	-0.034	0.021
	(4.141)	(3.182)	(2.702)	(1.811)	(0.062)	(0.046)
Constant	-19.265	-2.453	-12.195	0.026	0.917***	0.769***
	(12.735)	(11.908)	(9.367)	(8.342)	(0.278)	(0.164)
Sector (ISIC 2 Digit) Fixed Effects	YES	YES	YES	YES	YES	YES

Location (within country) Fixed Effects	YES	YES	YES	YES	YES	YES
Number of observations	1,094	2,567	1,520	3,091	1,531	3,128
R2	0.329	0.230	0.198	0.095	0.295	0.155

note: *** p<0.01, ** p<0.05, * p<0.1. Proportion of Sales Sold on Credit excludes Kenya, as the survey did not include the question. A firm that "wants a loan" is one that applied or would have applied if there were better terms and conditions.

Table 6: Robustness – Additional Controls

Model	Linear Probability Model		OLS	
Dependent Variable	Firm Purchased Fixed Assets Y/N		Log of purchase of fixed assets (amount in USD)	
	Female-owned Firms	Male-owned Firms	Female-owned Firms	Male-owned Firms
	(1)	(2)	(3)	(4)
Mobile money for any financial transactions Y/N	0.211**	0.082	1.917**	0.736
	(0.094)	(0.056)	(0.933)	(0.545)
Female top manager Y/N	0.009	-0.073	-0.016	-0.580
	(0.066)	(0.108)	(0.638)	(1.002)
Firm Not Registered when Started Operations Y/N	0.105	-0.019	0.919	-0.438
	(0.077)	(0.063)	(0.714)	(0.546)
Senior management time spent in dealing with requirements of government regulations (%)	-0.0001	0.002	0.004	0.016
	(0.002)	(0.001)	(0.018)	(0.012)
ISO Certification Ownership Y/N	-0.057	0.079	-0.021	0.693
	(0.113)	(0.081)	(1.163)	(0.886)
Establishment Spent on R&D over the last FY	-0.020	0.104	-0.165	0.992
	(0.078)	(0.065)	(0.829)	(0.614)
Real annual sales growth (%)	0.001	0.001	0.009	0.013
	(0.001)	(0.001)	(0.012)	(0.008)
Bribery depth (% of public transactions where a gift or informal payment was requested)	0.001	0.001*	0.016	0.011*
	(0.001)	(0.001)	(0.010)	(0.006)
Log of size	0.075**	0.033	1.140***	0.589**
	(0.032)	(0.026)	(0.325)	(0.275)
Top manager experience in sector (years)	-0.004	0.005*	-0.023	0.045
	(0.003)	(0.003)	(0.031)	(0.029)
Labor Productivity (deflated, USD)	0.006	0.009	0.240	0.239
	(0.025)	(0.015)	(0.258)	(0.150)
Log of age of firm	-0.014	-0.040	-0.272	-0.110
	(0.050)	(0.041)	(0.501)	(0.381)
Firm is part of a larger firm Y/N	0.011	0.053	0.060	0.767
	(0.078)	(0.057)	(0.799)	(0.590)
Direct exports 10% or more of sales Y/N	0.109	0.008	1.486	0.303
	(0.136)	(0.091)	(1.426)	(0.899)
Foreign ownership Y/N	-0.027	-0.077	-0.092	-0.856
	(0.102)	(0.061)	(0.967)	(0.615)
Firm offers formal training Y/N	0.059	-0.029	0.561	-0.028
	(0.073)	(0.057)	(0.678)	(0.552)

Firm experienced power outage Y/N	0.007	-0.047	-0.099	-0.703
	(0.102)	(0.064)	(0.989)	(0.565)
Firm owns or shares an electric generator	0.080	0.128**	0.910	1.286***
	(0.087)	(0.053)	(0.901)	(0.440)
Establishment has a line of credit or loan Y/N	0.066	0.055	1.068	0.815
	(0.093)	(0.058)	(0.919)	(0.603)
Establishment has checking or savings account Y/N	0.018	0.071	0.409	0.775
	(0.126)	(0.074)	(1.208)	(0.619)
Website Y/N	0.181***	0.134**	1.312**	1.130*
	(0.067)	(0.066)	(0.648)	(0.618)
Constant	0.076	0.364	-2.166	0.543
	(0.361)	(0.301)	(3.617)	(2.914)
Sector (ISIC 2 Digit) Fixed Effects	YES	YES	YES	YES
Location (within country) Fixed Effects	YES	YES	YES	YES
Number of observations	1,002	1,992	1,003	1,993
R2	0.396	0.231	0.370	0.277

note: *** p<0.01, ** p<0.05, * p<0.1

Table 7: Robustness – Fully female-owned firms

Model	Linear Probability Model		OLS	
Dependent Variable	Firm Purchased Fixed Assets Y/N		Log of purchase of fixed assets (amount in USD)	
	Fully Female-owned Firms (100%)	Fully Male-owned Firms (100%)	Fully Female-owned Firms (100%)	Fully Male-owned Firms (100%)
	(1)	(2)	(3)	(4)
Mobile money for any financial transactions Y/N	0.291**	0.065	2.632**	0.622
	(0.117)	(0.044)	(1.103)	(0.406)
Log of size	0.200***	0.061***	1.648***	0.823***
	(0.056)	(0.021)	(0.454)	(0.217)
Top manager experience in sector (years)	-0.007	0.005**	-0.103*	0.033
	(0.006)	(0.002)	(0.054)	(0.021)
Labor Productivity (deflated, USD)	0.040	0.014	0.547*	0.249**
	(0.036)	(0.011)	(0.315)	(0.109)
Log of age of firm	-0.065	-0.032	-0.445	-0.146
	(0.055)	(0.028)	(0.551)	(0.251)
Firm is part of a larger firm Y/N	-0.168	0.002	-0.786	0.332
	(0.132)	(0.049)	(1.186)	(0.483)
Direct exports 10% or more of sales Y/N	0.294	-0.022	3.080	0.007
	(0.228)	(0.070)	(2.105)	(0.703)
Foreign ownership Y/N	0.053	-0.060	-0.607	-0.531
	(0.214)	(0.055)	(1.991)	(0.540)
Firm offers formal training Y/N	0.044	0.046	0.638	0.542
	(0.095)	(0.045)	(0.911)	(0.437)
Firm experienced power outage Y/N	-0.053	-0.011	-0.096	-0.158
	(0.141)	(0.047)	(1.056)	(0.406)
Firm owns or shares an electric generator	0.229**	0.079*	2.116**	0.871**
	(0.106)	(0.043)	(0.938)	(0.368)
Establishment has a line of credit or loan Y/N	0.054	0.087*	0.773	1.210**
	(0.194)	(0.049)	(1.713)	(0.511)
Establishment has checking or savings account Y/N	-0.174	0.112**	-1.458	1.005**
	(0.158)	(0.053)	(1.269)	(0.446)
Website Y/N	0.172	0.113**	1.298	0.752
	(0.124)	(0.052)	(1.094)	(0.492)
Constant	-0.164	0.124	-3.365	-0.981
	(0.448)	(0.233)	(3.859)	(2.142)
Sector (ISIC 2 Digit) Fixed Effects	YES	YES	YES	YES
Location (within country) Fixed Effects	YES	YES	YES	YES
Number of observations	490	3,190	490	3,196

R2	0.464	0.187	0.479	0.227

note: *** p<0.01, ** p<0.05, * p<0.1

Table A1: Mobile Money Adoption by Gender

	Female-owned Firms	Male-owned Firms	
Mobile Money Adoption (% of firms)			
Mobile money for any financial transactions (%)	29.00	26.00	
Mobile Money Use (% of adopting firms)			
Mobile money to pay employee (%)	18.00	16.00	
Mobile money to pay supplier (%)	39.00	31.00	
Mobile money to pay utility bills (%)	50.00	43.00	
Mobile money to receive payments from customers (%)	76.00	60.00	***
Reasons for Adopting Mobile Money (% of adopting firms)			
Reduce costs of financial transactions (%)	19.00	17.00	
Reduce time spent in financial transactions (%)	25.00	42.00	**
Reduce the risks in financial transactions (%)	16.00	10.00	
Satisfy suppliers request (%)	8.00	4.00	
Satisfy costumers request (%)	31.00	25.00	
Align with competitors use (%)	2.00	2.00	
Reasons for Not Adopting Mobile Money (% of non-adopting firms)			
Don't know enough (%)	20.00	25.00	
Fees too high (%)	7.00	23.00	***
Payments too large (%)	30.00	32.00	
Not easy to use (%)	10.00	18.00	***
Customers don't use (%)	37.00	37.00	
Suppliers don't use (%)	37.00	37.00	

note: *** p<0.01, ** p<0.05, * p<0.1. All countries in sample have information on mobile money adoption. Zimbabwe excluded for other statistics as information not included in survey. Kenya does not have information on reasons for not adopting mobile money

Table A2: Mobile Money Adoption by Country

			Reasons for Adopting Mobile Money (adopting firms)						Reasons for Not Adopting Mobile Money (non-adopting firms)					
Country	**year**	**Mobile money for any financial transactions (%)**	**Reduce costs of financial transactions (%)**	**Reduce time spent in financial transactions (%)**	**Reduce the risks in financial transactions (%)**	**Satisfy suppliers request (%)**	**Satisfy costumers request (%)**	**Align with competitors use (%)**	**Don't know enough (%)**	**Fees too high (%)**	**Payments too large (%)**	**Not easy to use (%)**	**Customers don't use (%)**	**Suppliers don't use (%)**
Benin	2015	6.03	3.63	10.76	10.11	7.34	53.30	14.86	14.95	4.41	27.70	3.94	38.76	41.08
Cameroon	2015	14.30	24.22	48.23	16.54	0.72	8.37	1.92	16.36	6.73	4.87	6.92	21.57	21.40
Chad	2017	16.28	14.74	34.58	11.11	0.00	30.66	8.91	41.57	38.45	37.53	45.28	47.78	48.66
Côte d'Ivoire	2015	30.71	7.07	23.32	15.86	11.49	42.26	0.00	6.09	5.46	33.76	4.68	27.50	28.92
Ghana	2012	4.20	20.37	36.06	9.34	13.46	20.76	0.00	28.61	11.55	33.47	12.46	53.83	51.36
Guinea	2015	6.71	4.93	0.00	21.96	18.28	54.83	0.00	40.54	24.53	52.39	0.54	12.24	34.64
Kenya	2017	77.38	10.01	21.38	19.22	6.60	40.58	2.22						
Liberia	2016	33.06	32.69	36.14	10.56	0.51	19.90	0.20	12.73	1.97	38.01	9.44	22.32	23.08
Mali	2015	8.81	15.57	30.22	0.00	0.00	54.21	0.00	20.12	48.61	38.12	18.69	29.33	35.50
Niger	2016	14.68	36.07	37.51	0.00	0.00	6.07	20.35	52.54	10.78	37.59	29.10	38.01	31.61
Sierra Leone	2016	23.88	17.40	54.66	17.93	2.08	7.93	0.00	32.19	29.44	41.26	21.44	56.33	48.23
Tanzania	2012	46.17	26.00	51.25	5.37	3.56	12.21	1.60	7.98	7.98	16.78	8.35	21.64	17.35
Togo	2015	10.53	14.45	65.29	3.42	7.94	8.90	0.00	20.65	11.10	29.91	13.45	32.20	34.38
Uganda	2012	54.23	21.65	38.09	8.13	10.74	18.95	2.44	2.16	12.23	17.69	6.20	17.49	20.05
Zambia	2012	3.69	38.11	42.89	2.43	2.82	13.74	0.00	32.16	14.38	39.58	13.45	52.70	51.16
Zimbabwe	2015	68.29												