Does Mobile Money Adoption and Credit Access Improve Innovation and Performance of Enterprises in Sierra Leone?

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List of abbreviations and acronyms

2SLS	Two-Stage Least Squares
BoSL	Bank of Sierra Leone
GDP	Gross Domestic Product
DFS	Digital Financial Sector
ES	Enterprise Surveys
GSMA	Global System for Mobile Communications Association
IV	Instrumental Variables
MFS	Mobile Financial Services
MSMEs	Micro, Small and Medium Enterprises
OLS	Ordinary Least Squares
PCA	Principal Component Analysis
SMEs	Small and Medium-sized Enterprises
SSA	Sub-Saharan Africa
UNCDF	United Nation Capital Development Fund
WB	World Bank

Abstract

This study sought to unpack the impact of mobile money adoption and credit constraints on product innovation and performance of Micro, Small and Medium-scale Enterprises in Sierra Leone. We used the most recent Sierra Leone Enterprise survey data conducted by the World Bank to monitor enterprises. To achieve the objectives of the study, we used Ordinary Least Square and non-experimental techniques (instrumental variable techniques). This allowed us to account for potential endogeneity problems that may bias parameter estimates if not accounted for. Our findings show that credit constraints significantly limited firms' ability to innovate, and thereby their performance. We also found that the use of mobile money improved innovation. We did not find any statistically significant gender-related variation in the relationship.

Acknowledgements

1. Introduction

The access and utilization of mobile financial services (MFS) is fast gaining ground across the developing world. In sub-Saharan Africa (SSA), it is estimated that there are about 469 million mobile money accounts—significantly higher than South Asia with an estimated 315 million accounts (Global System for Mobile Communications Association [GSMA], 2020). The total value of mobile money transactions in the SSA region was about US$456.3 billion compared to US$125.4 billion in South Asia (GSMA, 2020). Following the lead of the M-PESA service in East Africa, several other countries in the region have adopted similar MFS. In West Africa, Nigeria and Ghana are considered to be leading the way in MFS adoption (Sy et al., 2019). The fast-rising financial technology and innovation sector has shown significant prospects for economic growth and improved wellbeing. For example, it is estimated that since 2015, the financial technology (FinTech) ecosystem has raised about US$320 million and grown by about 60%.[1]

In spite of these progress and prospects, some countries in the sub-region continue to lag behind. This is particularly the case in fragile and post-conflict regions where MFS are substantially underdeveloped. For example, in Sierra Leone, financial markets are underdeveloped with low rates of financial inclusion. Given the countries' turbulent recent history, including civil conflicts and Ebola crises, it is reasonable to expect low levels of domestic resources mobilization which translates to low levels of credit available to the private sector. Micro, Small and Medium Enterprises (MSMEs) are usually the hardest hit in such situations as they face relatively more constraints in accessing credit from the formal sector. While some efforts have been made in recent years to improve financial inclusion and MSME performance in Sierra Leone, it is important to understand how such efforts can reduce credit constraints and improve innovation and performance. In this regard, this study seeks to investigate the linkages between mobile money use, credit constraints, innovation, and performance among MSMEs in Sierra Leone. The study also assessed the gender dimension of these linkages.

MFS adoption and use has been identified to create significant efficiency gains through improved financial inclusion across sectors (Lorenz & Pommet, 2021). The pathways through which these gains can be achieved are several. The use of MFS has the potential to reduce the enforcement cost associated with financial transactions through time saving and transactions can be done instantaneously at anytime and

anywhere. The reduction in transaction costs will potentially release resources for other uses including innovation that could translate into improved productivity (Bångens & Söderberg, 2011; Islam et al., 2018; Kirui & Onyuma, 2015). The use of MFS can also improve trust in MSMEs and have a positive impact on their access to trade credit from their suppliers, which in turn will reduce SMEs credit constraints (Beck et al., 2015). In addition, MFS utilization allows MSMEs to track their financial transactions which could improve business financial management. MSMEs can also use the MFS transaction records to assess and track their returns to capital and improve their micro-savings. Potential creditors can also rely on these transaction records to generate credit score and assess credit risk for SMEs (Njuguna et al., 2016).

Asiedu et al. (2013) showed that MSMEs are more likely to face credit constraints, and the gap is more important for female owed businesses in SSA. These results are consistent with the findings of Chaudhuri et al. (2020) who find that female-owned small enterprises are more credit constrained and underperform compared to male-owned small enterprises. This gender disparity was also found by Expósito et al. (2021) in favour of women in the likelihood to introduce process innovation in their business. In this regard, our study also explores gender-based heterogeneities that may exist in the impact of MFS adoption, credit access, innovation, and firm performance in Sierra Leone.

2. Overview of financial systems in Sierra Leone

Sierra Leone is a small West African country with about eight million people and gross domestic product (GDP) per capita estimated at about US$510 in 2020. The financial sector of the country is small and underdeveloped. In 2017, the financial sector of Sierra Leone consisted of 14 commercial banks, 17 community banks, five microfinance institutions authorized to collect deposits, and two mobile money operators.[2] Estimates from the World Bank show that private sector credit in Sierra Leone was about 6.3% of GDP in 2018 compared to a SSA average of about 45.5% (World Bank [WB], 2020). This situation is troubling for several reasons, including the fact that 70% of employment is in the private sector, coupled with high (about 60%) youth unemployment (Bank of Sierra Leone [BoSL], 2016).

According to the Global Findex 2017 data of the World Bank[3] , only 20%, 25%, and 15% of Sierra Leone's total population aged above 15 years, male population, and female population own a bank account, respectively. This is well below the average of 42.6% for SSA (WB, 2020) and implies that a significant proportion of the population, and women in particular, are financially excluded. Furthermore, the mobile money penetration rate was very low. Only 11% of the population aged above 15 years own a mobile money account. Also, only 14% of male population and 9% of female population own mobile money account (WB, 2020).

The low financial inclusion pattern is also reflected among MSMEs in the country. The World Bank Enterprises Survey data collected in 2017 for Sierra Leone suggests that, of the 150 firms surveyed, only 48 (32%) use mobile money for their transactions. Also, the majority of these firms only used the mobile money services to receive payment from customers. This situation has compelled the government to roll out relevant interventions to promote financial inclusion in recent years. These include the adoption of a national strategy for financial inclusion (2017–2020) and the provision of support for FinTech innovation. The national strategy has a broad vision "to make financial services available, accessible and affordable to all Sierra Leoneans and enterprises, and support inclusive and resilient private-sector-led growth" (BoSL, 2016).

With the support of the United Nation Capital Development Fund (UNCDF) and the Better Than Cash Alliance in providing technical assistance and investment grants for digital services, there have been some improvements in Sierra Leone's digital financial sector (DFS) between 2017 and 2020. The number of registered DFS

account increased from 4,214,866 in 2017 to 6,235,210 in 2019 before a decrease to 4,718,009 in 2020. This amount is an increase in the financial inclusion rate of about 12% between 2017 and 2020. The DFS account activities rates have also increased from 10% to 47% between 2017 and 2020. Merchant payments that represented 0.2% of transaction values in 2019 have increased to 1.2% in 2020 (BoSL, 2021). This suggests that there is improvement of the use of MFS by enterprises in Sierra Leone. It is also important to note that, despite these efforts, the penetration of financial inclusion through digital financial services like mobile money remains low and fraught with operational challenges. Recent reports by the Bank of Sierra Leone on digital financial services revealed that mobile network operators were only able to activate 12% of their registered customer base in 2016. This figure fell to 6% in 2017 and increased to 8% in 2018.

3. Literature review

The basic objective of every firm is to optimize profits, through increased productivity, subject to input constraints—including innovative activities to improve productivity. This implies that the production function of the firm depends on inputs such as capital, labour, and land. In the context of our study, capital inputs are directly reflected in the firm's ability to access finance and/or adopt MFS. This implies that a firm that is constrained in capital, all things being equal, will produce fewer outputs and be less innovative compared to a firm that does not face such constraints. We, therefore, hypothesize that enhancing financial inclusion will help to address the problem of credit constraint, and hence improve firm innovation and productivity. As noted by De Mel et al. (2009), addressing credit constraints helps to significantly increase returns to capital for SMEs. One channel that has proven effective for promoting financial inclusion is the use of mobile money. Mobile money uptake has the potential to reduce information asymmetries that can influence optimal decision-making. In addition, the use of mobile money reduces transaction cost to the firm, hence, reducing overall production costs.

Against this backdrop, we propose a theory of change that highlights the potential pathways through which mobile money, as a means of enhancing financial inclusion for firms, can affect firm innovation and performance (see Figure 1). The model shows that access and utilization of mobile money services promote financial inclusion through the provision of crucial financial products that were otherwise difficult to access. These financial products include means for easy payment to suppliers and receiving payments, savings, insurance, and credit. The immediate benefits from these financial products include easy access to and reduction in cost of financial transactions, improved access to credit and improved efficiency in business transactions, as well as improved access to financial information. Firms that benefit from these products have the advantage of raising additional finance that could be used for business expansion and product innovation by investing in additional inputs such as capital and labour, as well as research and development. For example, Lorenz and Pommet (2021) noted that mobile money access and utilization frees up time that firms could use to develop innovative ideas. That is, mobile money allows financial transactions that would have required physical travels and extra time to perform. In the medium to long term, these expansions will translate to increased productivity/outputs and, ultimately, business growth. It is important to note that

these pathways depend on several assumptions including the existence of an effective mobile money system that does not impose substantial transaction cost in the form of fees and charges. Also, the gains from innovation can be optimized if firms are able to overcome the sunk and operational cost of innovation. For example, if innovations are better-leveraged, additional revenues could be raised that will offset the sunk and operational cost of innovation.

The literature also points to the importance of credit for the performance of female-owned enterprises. In a study of firms across Europe, Latin America, and sub-Saharan Africa, Bardasi et al. (2011) found that, despite women having relatively smaller enterprises, little difference existed between male- and female-owned enterprises in terms of performance. Gichuki et al. (2014) notes that access to credit is one of the factors that influence the performance of women led SMEs. However, women usually face challenges in accessing credit (Asiedu et al., 2013; Aterido et al., 2013). The impact of mobile money in enhancing inclusion, and thus improving firm performance, may therefore be greater for female-owned enterprises (De Mel et al., 2009).

Figure 1: Theory of change
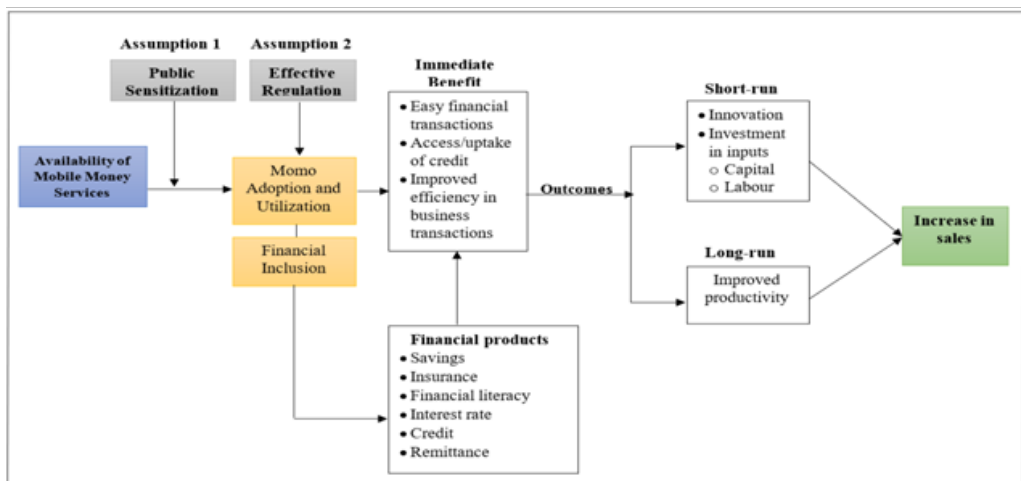
Source: Authors' own construction.

Previous empirical studies on the impact of mobile money have also confirmed parts of these pathways. However, these studies are largely in countries that face better peace and stability as well as non-fragile. In Ghana, Oteng-Peprah et al. (2020) provided evidence to show that mobile money played an important role in the performance of smallholder farmers. The authors estimated a positive impact between 33.8% and 56% on the output of these smallholder farmers. There has also been some evidence from East Africa that confirms the positive impact of mobile money. Using data from Kenya, Uganda, and Tanzania, Lorenz and Pommet (2021) showed that mobile money utilization has the potential to mitigate challenges of credit constraints faced by enterprises in the sub-region. Their findings also implied that, while credit constraints

hindered innovation among enterprises, this negative impact could be reduced with the utilization of mobile money. Other studies that have highlighted the positive impact of mobile money in East Africa include Mdoe and Kinyanjui (2018) who found an impact of about six percentage points on access to finance; Gosavi (2018) with evidence of significant impact on credit access as well as Okello et al. (2018) who found a significant impact on financial inclusion in Uganda. The impact from East Africa is expected as it was the pioneering region of mobile financial services in SSA.

For studies that have investigated the impact of mobile money uptake in fragile countries, the focus was only on parts of the pathways described in Figure 1. For example, Batista and Vicente (2020) showed that, in Mozambique, owning a mobile money account increased mobile savings, especially where these mobile money accounts attracted some interest. The study also found that mobile money accounts encouraged investment among agricultural entrepreneurs. This evidence highlights the fact that mobile money could improve returns to credit and investment. In terms of innovation, the empirical literature confirms that access to finance improves firm innovation, even though this depends on specific characteristics of the firm. Ayyagari et al. (2011) show that external finance significantly drives innovation, while Fombang and Adjasi (2018) found that overdraft finance encourages firm innovation.

There are also a group of studies that have highlighted the indirect benefits of adopting mobile money services. These benefits include positive net transaction costs (Alinaghi, 2019; Jack & Suri, 2014; Mbiti & Weil, 2013) and reduction in information asymmetries (Alinaghi, 2019). These studies confirm some of the important pathways through which mobile money could improve the growth of firms. They unanimously show that, by reducing net transaction costs and helping to bridge information gaps, mobile money services aid in improving financial inclusion.

4. Methodology

The objective of our research is to assess the impact of mobile money use and credit constraints on enterprises' ability to innovate and firm performance. To achieve this objective, we estimate various econometric models at different stages. We provide details of the different stages below.

The innovation equation

To achieve the first objective of the study, we specify two equations which assess the impact of mobile money use and credit constraint on firms' ability to innovate.

$$Innov_i = \beta_0 + \beta_1 MoMo_i + \beta_2 X + e_i \tag{1}$$

$$Innov_i = \beta_0 + \beta_1 credit_i + \beta_2 X + e_i \tag{2}$$

Where: $Innov_i$ is an index that measures a firm's process innovation. To compute the process innovation index, we relied on Principal Component Analysis (PCA). This technique allows us to extract from a set of innovation-related variables in the data set. The process involves an orthogonal linear combination of variables that most accurately represent common information about firm-level process innovation. According to the World Bank Enterprise Surveys (2019)[4], process innovation involves the use of new production techniques or methods of service delivery, introduction of new software for production, or the introduction of internet-based service delivery options. Therefore, we included in the calculation of firms' ability to introduce a process innovation variables such as website (capturing whether or not the firm has a functional website), email (whether the firm uses email), and financial audit (whether the firm's financial statements were certified by an external auditor).

$MoMo_i$ and $credit_i$ are dummy variables that capture mobile money utilization and credit access constraints faced by firms, respectively. In both variables, a value of 1 represents firms that use mobile money and face credit constraints. X is a collection of control variables including the sex of the firm's manager, firm age, firm size, whether

or not the firm is an exporter, whether or not the firm has foreign ownership, and whether the firm is registered or not. We have described the measurement of the variables in further detail in Table 1.

The productivity equation

To achieve the second objective of our study, we estimate the impact of credit constraint on firms' performance. Equation 3 shows the credit constraint and firm performance econometric specification.

$$y_i = \beta_1 credit_i + \beta_2 X + e_i \tag{3}$$

Where: y_i stands for enterprise performance measured by sales per employee of the enterprise. $credit_i$, capture credit access constraint variables, and X is a vector of control variables described in Table 1.

In addition to these estimations, and in line with our theory of change, we also explored interactive effects across the variables of interest. These include an interaction between mobile money use and credit constraint to understand whether the level of impact differs for firms that both use mobile money and without credit constraint. To understand the gender dimensions of the results, we also interacted mobile money use and credit constraint with sex of firm owner.

Issues of endogeneity

Various studies have highlighted the crucial need to address issues of endogeneity in the relationship between access to credit constraints and firm performance. Fowowe (2017) indicates that the use of self-reported data in the Enterprise Surveys means that answers to the credit obstacle question might reflect idiosyncratic levels of pessimism among firm managers. Such unobserved factors might bias our estimates. It is also possible that while access to credit helps improve firm performance, better-performing firms are more likely to be able to access credit. In the presence of such endogeneities, the resultant estimates may be biased and lead to false conclusions.

We instrument for credit constraint using a variable that captures whether or not the firm's financial statements were audited by an external auditor. Firm's whose statements are certified by an auditor may be more likely to access formal credit. This may be due to two related reasons. First, firms with audited financial statements are more likely to apply for credit since they may be in the position to present the requisite documentation. Also, presenting audited financial statements is likely to signal credibility to the bank or financial institution, thus contributing to the decision to lend to the firm. To account for the endogeneity issues, we estimate Equation 2 and Equation 3 using the two-stage least squares (2SLS).

Data

This study draws on World Bank's Enterprise Surveys (ES) data collected in 2017 on a representative sample of 152 enterprises in the manufacturing and services sectors of the private sector in Sierra Leone. It represents a unique and most comprehensive data set available on different enterprises in the country and is therefore well-fitted with the objectives of this study. The questionnaire contains information on different socioeconomic characteristics of the business manager and the business itself. Specifically, information on the business manager is sex and experience. Information on the enterprise includes the date of creation, location, access to electricity, the number of employees, number of worked hours, registration status, capacity-building of the business employees, sales, profits, publicity, and sales practices. Information on financial practices is also collected. This includes access to credit and the adoption of mobile money.

5. Results

Descriptive statistics

Table 1 presents summary statistics using data from the World Bank Enterprise Survey conducted in 2017. These statistics show that, 52% of the surveyed enterprises reported access to finance as a major or very severe obstacle for their business expansion. Also, there are only about 32% of MSMEs that have adopted and used mobile money for their transactions, mostly to receive payment from their customers or to pay their suppliers and employees.

The average sales per year are estimated at US$64,510 and the average sales per employee at US$2,177. Moreover, some enterprises (about 19%) had innovated or showed signs of innovation by introducing a new process. Only 18% of the surveyed enterprises' managers are women, and the average number of years of experience among the managers is about 13.5 years. Most of the enterprises are working in the informal sector, and very few of them own a website (about 18%) and/or email (about 18%).

Table 1: Summary statistics

Variable	N	Mean	SD
Firm performance's variables			
Sales in US$ (*The enterprise sales in the last fiscal year*)	150	64510.986	153672.12
Sales per employee	150	2177.211	4182.032
Access to credits variables			
Credit constraint (= *1 if the enterprise access to finance was a major obstacle or very severe obstacle to their operations, and 0 otherwise*)	150	0.520	0.501
Treatment variables			
Mobile Money (= *1 if the enterprise has adopted mobile money, and 0 otherwise*)	150	0.320	0.468

Table 1 Continued

Variable	N	Mean	SD
Innovation variables:			
New process (= *1 if the enterprise introduced a new process, and 0 otherwise*)	150	0.193	0.396
Email (= *1 if the enterprise use email, and 0 otherwise*)	150	0.347	0.478
Website (= *1 if the enterprise has website, and 0 otherwise*)	150	0.133	0.341
Financial audit (= *1 if the enterprise's financial statements were certified by an external auditor, and 0 otherwise*)	150	0.273	0.447
Manager characteristics			
Experience of the manager (*Years of experience in the sector*)	150	13.513	10.261
Sex of the enterprise manager (= *1 if the manager is female, 0 otherwise*)	150	0.1833	0.374
Firm characteristics:			
Foreign (= *1 if enterprise has internationally recognized qualification certification, and 0 otherwise*)	150	0.120	0.326
Registration (= *1 if the enterprise has registered, and 0 otherwise*)	150	0.907	0.292
Size (= *1 if the enterprise is part of a large firm, and 0 otherwise*)	150	27.46	36.041
Age (*Difference between survey year and year firms stated operations*)	150	15.14	14.341
Export (= *1 if firm exports some % of sales, and 0 otherwise*)	150	0.093	0.292
Sector (= *1 if firm is in services sector, and 0 if in manufacturing sector*)	150	0.473	0.501

Source: Authors' own construction using World Bank Enterprise Survey 2017 in Sierra Leone.

Bivariate distributive analysis of key variables by sex of firm owner

To further explore the relationships between the key variables of the study, with emphasis on the sex of firm owner, we construct different graphs that show the linkages across the variables. While Panel (a) in Figure 2 was constructed using density functions of the respective sub-samples, panels (b), (c), and (d) were constructed using local linear non-parametric regression techniques. The pattern in Panel (a) suggests that average sales per employee were higher among firms with female owners. While the distribution across sex was similar, the concentration was higher for female-owned businesses.

In Panel (c), the distribution shows a more interesting pattern. While both male- and female-owned businesses at lower levels of sales were likely to report having credit constraint, this changes as level of sales increase. At higher sales levels, the

proportion of firms that were likely to report credit constraint reduces for both sexes. The rate of reduction was also similar across both sexes. This reveals that the problem of credit constraint is more predominant for firms with low levels of output. These may be small firms or start-ups that are not producing at high levels. Also, among these firms with low levels of output, male-owned firms were more likely to report facing credit constraint than female-owned firms.

Figure 2: Gender distributive analysis

Source: From authors using World Bank Enterprise Survey in Sierra Leone 2017
Note: Curves Constructed Using Non-Parametric Regression
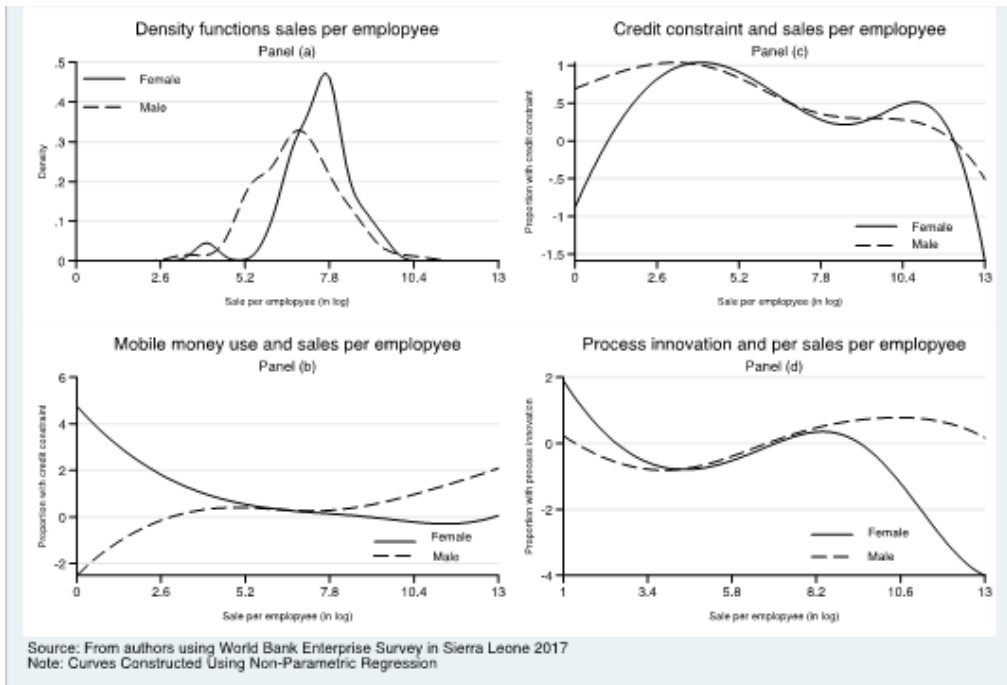
Another interesting evidence from the data has to do with the relationship between the likelihood of MoMo usage by owner's sex and sales per employee (Panel (b)). We observe that at lower levels of sales, female-owned businesses are more likely to report using MoMo than their male counterparts. However, as the firm's size grows, the proportion of female-owned business that report MoMo usage declines while that for male-owned businesses increase. A similar pattern is observed in Panel (d), where even though female-owned businesses were more likely to report process innovation at lower levels, this proportion declines as sales increased and firm size grows. These raise concerns about business sustainability of female-owned businesses compared to male-owned businesses.

Analysis of mean differences

Table 2 shows differences in mean of sales per employee for firms that use mobile money and reported facing credit constraints. The results indicate that, firms that reported using mobile money also reported higher sales per employee compared to firms that did not use mobile money. We, however, did not find that this mean difference of more than US$1,000 is statistically significant. In terms of credit constraint, the results show that, on average, firms that reported credit constraint also reported lower sales per employee compared to firms that did not report facing credit constraint. The results also showed that the mean difference of about US$1600 was also statistically significant.

Table 2: Mean difference in sales per employee by MoMo usage and credit constraint

	No MoMo (A) (N = 102)	MoMo (B) (N = 48)	Difference (A-B)	t-value	p-value
Sales per employee	1,844.445	2,884.341	-1039.896	-1.45	0.156
	Not constrained (N = 72)	Constrained (N = 78)	Difference (A-B)	t-value	p-value
Sales per employee	3,047.098	1,374.24	1672.859	2.5	0.014

Source: Authors' own construction using World Bank Enterprise Survey 2017 in Sierra Leone.

Table 3 reports a gender based mean difference analysis for all variables used in the study.

Table 3: Two-sample t-test with equal variances

Variable	Female (A)	Male (B)	Difference (A-B)	t-value	p-value
Sales per employee	2,580.398	2,096.575	483.823	0.550	0.599
Process innovation	0.320	0.168	0.152	1.750	0.080
Credit constraint	0.400	0.544	-0.144	-1.300	0.191
MoMo use	0.200	0.344	-0.144	-1.400	0.161
Manager's experience	10.160	14.184	-4.024	-1.800	0.073
Export	0.080	0.096	-0.016	-0.250	0.803
Foreign	0.080	0.128	-0.048	-0.650	0.504
Website	0.200	0.120	0.080	1.050	0.286
Email	0.400	0.336	0.064	0.600	0.542
Innovation index	0.075	-0.015	0.090	0.500	0.624
Registration	0.840	0.920	-0.080	-1.250	0.212
Enterprise age	14.040	15.360	-1.320	-0.400	0.676
Size	17.160	29.52	-12.36	-1.550	0.118
Services	0.520	0.464	0.056	0.500	0.612

Source: Authors' own construction using World Bank Enterprise Survey 2017 in Sierra Leone.

This analysis is considered relevant as it shows how our variables of interest differ across sex of firm owners. It also complements the graphical analysis reported in Figure 2. The results show that, on average, both sales per employee and process innovation are relatively higher for female-owned firms compared to their male counterparts. The mean difference is, however, only statistically significant for process innovation at 10% level. Credit constraint and MoMo use are both higher for male-owned firms compared to their female counterparts. In terms of the other control variables, manager's experience, export, foreign ownership, registered, older firms, and larger firms are higher among male-owned firms compared to female-owned firms. On the other hand, website use, email, and services sector favour female-owned firms. However, we did not find any statistically significant difference for all the control variables.

Impact of mobile money and credit constraint on process innovation

Table 4 presents results of the impact of mobile money on firms' ability to introduce a process innovation. For that purpose, we have estimated three different models. The first model (1) assesses the relationship between the use of mobile money and process innovation among firms, without controlling for credit constraint faced by firms and without accounting for any interaction between the use of mobile money and the credit constraints on the one hand, and the use of mobile money and the sex of the firm's manager, on the other hand. The second model (2) estimates the impact of mobile money on process innovation by controlling for credit constraints and by introducing an interaction effect between the use of mobile money and credit constraint. The third model (3) estimates the effect of mobile money on process innovation by accounting for the interaction effect between the use of mobile money and the sex of the firm's manager.

The results of our estimations (Table 4) show that the use of mobile money is associated with a higher level of firms' process innovation. Models (1) and (2) show positive and significant effect of the use of mobile money by MSMEs on their ability to innovate. Specifically, the use of mobile money significantly increases the likelihood of MSMEs to innovate by about 34% and 39% in model (1) without any interaction and in model (2), respectively. In model (2), we found that firms facing credit constraints have 32% less chance to introduce process innovation in their business. However, the interaction term between mobile money and credit constraint is negative but not significant. This suggests that the positive effect of mobile money on process innovation is reduced when a firm is credit constrained.

Table 4: Effect of mobile money on enterprises' process innovation

	(1)	(2)	(3)
MoMo	0.339***	0.391**	0.246
	(0.111)	(0.179)	(0.397)
Credit Constraint	_	-0.323**	_
	_	(0.136)	_
MoMo ×Credit Constraint	_	-0.171	_
	_	(0.222)	_
Owner's Sex (Male)	-0.242	-0.164	_
	(0.156)	(0.144)	_
MoMo ×Owner's Sex (Male)	_	_	0.105
	_	_	(0.411)
Manager's experience	-0.017***	-0.013**	-0.017***
	(0.006)	(0.006)	(0.006)
Firm size (Employees)	0.362***	0.326***	0.362***
	(0.068)	(0.069)	(0.069)
Firm Age	0.140**	0.118**	0.140**
	(0.054)	(0.054)	(0.055)
Registered (ref=Not registered)	-0.006	-0.004	-0.002
	(0.193)	(0.199)	(0.194)
Exporter (ref=Non-exporter)	0.321	0.278	0.325
	(0.213)	(0.178)	(0.216)
Foreign (ref=Domestic firm)	0.518***	0.432**	0.517***
	(0.180)	(0.177)	(0.181)
Services (ref=Manufacturing)	0.268**	0.241**	0.271**
	(0.110)	(0.106)	(0.110)
Constant	-1.199***	-0.969***	-1.184***
	(0.254)	(0.298)	(0.257)
N	148	148	148
R-squared	0.497	0.539	0.497

Source: Authors' own construction using World Bank Enterprise Survey 2017 in Sierra Leone.
Notes: Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

The effect of the use of mobile money on innovation is positive but not significant in the third model (3). This model also shows a positive effect of the interaction term between the use of mobile money and sex of the manager. This suggests that businesses that are managed by men and using mobile money have a greater chance to introduce process innovation than businesses managed by women and using mobile money. The result was, however, not statistically significant at any of the conventional levels.

In Table 5, we present estimation results of the effect of credit constraints on MSME's ability to innovate using OLS (models (1) and (2)) and 2SLS (models (3) and (4)) estimation methods. Models (2) and (4) included interaction effects between credit constraints and sex of the firm's manager, while model (1) and (3) did not. We found that credit constraints have negative and significant effect on firms' ability to innovate. Firms that reported facing credit constraints are more likely to report process innovation compared to firms that did not report facing such constraints. The results did not, however, show any significant interactive effect by sex of firm owner. That is, the impact of credit constraints did not differ between male and female firm owners.

Table 5: Effect of credit constraints on enterprises' process innovation

	OLS		IV	
	(1)	**(2)**	**(3)**	**(4)**
Credit Constraint	-0.411***	-0.731***	-4.219***	-4.537*
	(0.119)	(0.231)	(1.532)	(2.675)
Owner's Sex (Male)	-0.128	-0.285	0.590	0.458
	(0.143)	(0.223)	(0.469)	(1.204)
Credit Constraint × Sex (Male)		0.381		0.337
		(0.252)		(2.821)
Manager's Experience	-0.010*	-0.010*	0.032	0.033
	(0.006)	(0.006)	(0.025)	(0.024)
Firm Size (Employees)	0.314***	0.321***	-0.078	-0.075
	(0.074)	(0.074)	(0.241)	(0.246)
Firm Age	0.092	0.080	-0.069	-0.080
	(0.057)	(0.058)	(0.174)	(0.192)
Registration	0.065	0.052	-0.108	-0.121
	(0.191)	(0.194)	(0.598)	(0.619)
Export	0.296	0.281	-0.144	-0.161
	(0.196)	(0.198)	(0.363)	(0.374)
Foreign	0.354*	0.369**	-0.564	-0.560
	(0.182)	(0.184)	(0.624)	(0.636)
Sector	0.253**	0.261**	0.019	0.024
	(0.107)	(0.108)	(0.325)	(0.331)
Constant	-0.864***	-0.735**	1.795	1.934
	(0.294)	(0.330)	(1.324)	(1.564)
N	148	148	148	148
R-squared	0.512	0.519	-3.509	-3.575
Under-identification			6.350	4.025
Weak identification			6.960	2.228

Source: Authors' own construction using World Bank Enterprise Survey 2017 in Sierra Leone.
Notes: Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

Credit constraint and firm performance

Table 6 presents results of the relationship between credit constraint and firm performance. Results from both OLS and 2SLS estimations are reported in the table. For each of the two methods, we estimate two different models. Models (1) and (3) do not account for an interaction between credit constraints and the manager's sex, while models (2) and (4) include this interaction. The various tests conducted to confirm the validity of the IV in model (3) and (4) were all satisfactory and are reported in Table 6.

Table 6: Effect of credit constraints on enterprises' performance

	OLS		IV	
	(1)	**(2)**	**(3)**	**(4)**
Credit Constraint	-0.575***	-0.281	-2.103*	-0.022
	(0.191)	(0.504)	(1.168)	(2.489)
Owner's Sex (Male)	-0.291	-0.149	-0.083	0.568
	(0.239)	(0.252)	(0.313)	(0.772)
Credit Constraint × Sex (Male)	-	-0.344	-	-1.931
	-	(0.531)	-	(2.042)
Manager's Experience	-0.020*	-0.020*	-0.005	-0.026**
	(0.011)	(0.011)	(0.016)	(0.011)
Firm Age	0.260***	0.266***	0.189	0.313***
	(0.088)	(0.089)	(0.120)	(0.107)
Registration	-0.150	-0.140	-0.176	-0.078
	(0.237)	(0.239)	(0.339)	(0.306)
Export	0.052	0.053	-0.120	0.101
	(0.238)	(0.239)	(0.376)	(0.316)
Foreign	-0.480*	-0.509*	-0.744*	-0.607*
	(0.260)	(0.267)	(0.404)	(0.329)
Email	0.421*	0.435*	-0.192	0.658**
	(0.223)	(0.227)	(0.538)	(0.331)
Website	0.503*	0.529*	0.851**	0.587*
	(0.274)	(0.275)	(0.430)	(0.310)
Sector (ref=Manufacturing)	0.478***	0.467***	0.433**	0.419**
	(0.175)	(0.178)	(0.214)	(0.194)
Constant	6.885***	6.753***	7.724***	5.844***
	(0.320)	(0.330)	(0.775)	(0.999)
N	**148**	**148**	**148**	**148**
R-squared	0.363	0.365	0.0832	0.281
Under-identification	-	-	5.605**	4.230**
Weak identification	-	-	5.392	2.001

Source: Authors' own construction using World Bank Enterprise Survey 2017 in Sierra Leone.
Notes: Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

The results of model (1) show a negative and significant relationship between firm performance and credit constraint. With performance measured by the productivity of labour (sales per employee), this indicates that being credit constrained is associated with a 57% probability of recording lower level of sales per employee. This negative relationship is even stronger once we account for endogeneity using the instrumental variable. However, if the interaction term is accounted for, the statistical power is lost, and the relationship becomes insignificant. Also, similar to our earlier findings, the relationship does not suggest a significant variation across sex of firm owner.

6. Discussion

In this study, we sought to understand the relationship between financial inclusion (measured as mobile money usage and credit access), innovation, and performance of MSMEs in Sierra Leone. We pursue this objective using data from a country recovering from civil war. Using data from the World Bank's Enterprise Survey for Sierra Leone and estimating OLS as well as IV models, we found that credit constraints and mobile money usage are important factors in firm's ability to innovate or perform better. The results also reveal limited sex-related variations in the impact we estimated.

Specifically, we found that firms that reported using mobile money were more likely to innovate compared to firms that did not use mobile money. Also, firms that reported facing credit constraints were less likely to innovate and perform better. We did not find any significant heterogeneous effect with regards to sex of the firm's owner. The results conform to findings from previous studies from different settings that have showed that financial inclusion, in general, propels MSMEs to grow their business and develop innovative ideas (Gosavi, 2018; Okello et al., 2018; Oteng-Peprah et al., 2020). Indeed, the justification for this finding is also widely supported in the literature. Lorenz and Pommet (2021) showed that firms that use mobile money save time and cost related to financial transactions that require physical travel. The time and cost saved can be monetized and invested into developing innovative ideas or improving business operations to increase performance. The authors also hypothesized that mobile money usage can revive savings culture, bookkeeping, and responsible business practices that can improve innovation.

Our results point out the importance of financial inclusion for the development of entrepreneurship in fragile states such as Sierra Leone. Beyond government efforts, an important component of driving the country's recovery from the effects of civil war will involve providing a supportive environment for entrepreneurship and innovation. One way of achieving this will be by making it easy for MSMEs to access credit for investment and innovation purposes. Indeed, at the heart of the credit access constraint is the challenge of financial inclusion. It is expected that improved financial inclusion would translate into improved credit access and firm performance. However, while we found evidence of a significant impact of mobile money use on innovation, we did not find evidence this translated into credit access. This highlights the currently low levels of mobile money uptake and the implementation challenges that have reduced effectiveness. Indeed, as mentioned above, only 11% of the population aged more

than 15 years own a mobile money account in Sierra Leone. Also, only 14% of male population and 9% of female population own mobile money account (WB, 2020). This implies that there remains much work to be done to fully exploit the benefits that mobile money services have to offer in the context of Sierra Leone.

The success of mobile money in countries such as Kenya and Ghana show that mobile money use has much more potential beyond just facilitating the transfer of funds (Abdul-Rahaman & Abdulai, 2022; Islam et al., 2018; Kirui & Onyuma, 2015; Zumanu, 2019). Credit facilities and even insurance services have now been integrated into mobile money platforms, helping to bring formal financial services much closer to the majority of the population, especially the unbanked. Sierra Leone's National Financial Inclusion Strategy aimed at a 2% growth per annum in the percentage of adults with an active mobile money account between 2017 and 2020. And a report by BoSL (2021) showed that, about 30% of adults were actively using a digital payment account by the end of 2019. While this is good progress, it is also important to ensure that the services offered on the platform provide a variety that will help to boost productivity among entrepreneurs.

Another finding from our study that deserves some discussion is the consistent lack of significant gender gap in the impact of mobile money and credit constraint. While evidence from elsewhere have showed that female owned businesses are likely to be left behind in the financial inclusion agenda (Islam & Muzi, 2020), we could not confirm this in our study. A potential justification for this is the fact that mobile money adoption and use are currently low in Sierra Leone and therefore both males and females are equally constrained. It also highlights the need to accelerate efforts to harness the benefits of the industry while ensuring these efforts are gender sensitive.

While the findings of the study reveal some relevant evidence to guide policy efforts in Sierra Leone, we also acknowledge some limitations of the study. The relatively few numbers of observations in the Enterprise Survey for Sierra Leone limited the sub-sample analysis that could be conducted. The sampling structure is however standard and does not bias our findings. Secondly, given the fact that the data is secondary, our quest to find the most appropriate instrumental variable for all estimations was limited. Future studies should consider conducting more disaggregated analysis to unpack nuances that may exist in the country's context.

Notes

1. https://www.forbes.com/sites/tobyshapshak/2019/06/29/africas-fintech-ecosystem-raised-320m-and-grew-60-in-two-years/#40b089727226

2. https://www.mfw4a.org/country/sierra-leone

3. https://globalfindex.worldbank.org/index.php/#data_sec_focus

4. https://www.enterprisesurveys.org/content/dam/enterprisesurveys/documents/methodology/ES_QuestionnaireManual_2019.pdf

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