

MICROFINANCE DIGITAL FINANCIAL SERVICES AND RURAL FARMERS' WELFARE AND SUSCEPTIBILITY TO POVERTY IN RURAL GHANA

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Abstract. Expanding access to the poor is a fundamental issue for Microfinance Institutions, although increasing the availability of credit is often viewed as a crucial element for achieving poverty reduction. Consequently, more trust has been reposed in the potentially game-changing effect of universal digital financial inclusion. However, there is little evidence linking digital financial inclusion to an individual's chance of poverty. The research assesses the influence of digital financial services on rural farmers' susceptibility to poverty in Ghana by employing data from 1050 rural farm households surveyed in selected communities in the Bono, Bono East and Bono Ahafo, Eastern and Ashanti Regions of Ghana. The Asset-Based Vulnerability model was used to measure the likelihood of future vulnerability to poverty of rural farmers. We found that farmers who make use of digital financial services are less vulnerable to risk. In addition, we demonstrate that the majority of these gains result from farmers' improved risk management abilities. Financial exclusion is a big issue in several developing countries, and Ghana's experience may be used to alleviate this problem.

Keywords: microfinance digital financial services; rural famers' susceptibility to poverty; instrumental variable estimation

I. INTRODUCTION

Increasing people's access to financial resources is often regarded as one of the most effective strategies for combating poverty (Mhlanga, Dunga, & Mloi [1]). Nevertheless, it is well-known that problems develop when financial institutions strive to expand their client base to include the poor (Abiona & Koppensteiner [2]). The government of Ghana, along with the governments of several other developing nations, has adopted a large number of steps to increase the provision of financial services in rural areas but the results have been often unsatisfactory (Coffie & Hongjiang [3]). According to Y. Xu, Peng, Sun, Zhan, and Li [4] conventional banks continue to ignore or underserve rural farmers mostly for high transaction costs, knowledge asymmetries, and a lack of collateral. Despite the existence of several financial institutions, such as Rural and Community Banks, Microfinance Institutions, and Microfinance Institutions, there remains a major barrier to entry for rural farmers in Ghana to have access to financing and other microfinance services (MFIs). Consequently, several academics and policymakers are focusing their attention on this subject (Demirgüç-Kunt, Klapper, Singer, & Ansar [5] Scott, Van Reenen, & Zachariadis [6]). Digital financial inclusion refers to providing traditionally underprivileged and excluded communities with access to the use of formal financial services via digital channels (Pazarbasioglu et al. [7]).

In 2018, Ghana was one of the first African nations to deploy an interoperable system, allowing clients of different telecommunications companies to conduct transactions with one another (Coffie & Hongjiang [3]). As of the end of 2019, the total amount of payments facilitated through

interoperability has reached 308 million Ghanaian cedis (GH), or \$57 million. In Ghana, mobile money quickly surpassed the adoption of all other distributed financial systems (DFS) (Bank of Ghana [8]). In recent years, Ghana's mobile money industry has gained international recognition. Not only is it one of the largest and fastest-growing in Africa, but it has also gained international recognition. By February 2021, the number of active mobile money accounts is predicted to reach 40,9 million, a 32,7 million increase from February 2020 (World Bank Group [9]). To utilise a mobile money service, customers must have a phone number associated with an electronic account. These accounts enable users to save, send, and receive financial transactions (World Bank Group [9]).

Since the advent of M-Pesa in Kenya in 2007, which represented a major achievement in the area of peer-to-peer (P2P) payment mobile money, the past ten years have seen the worldwide rise of viable business models for digital financial inclusion (Goldbarsht & de Koker [10]). Mobile network providers conduct the vast majority of users of the short messaging service (SMS) for the transfer and storage of currency (Mbiti & Weil [11]). Albania has joined the ranks of nations that are now allowed to utilise the programme, following in the footsteps of Tanzania, Afghanistan, South Africa, India, Romania, etc (Mbiti & Weil [11]). In Ghana, one may access the whole spectrum of banking, lending, investing, and other financial services online, from traditional banking to peer-to-peer lending to crowdfunding to insurance (Abor, Quartey, Ahmad, & Opoku-Afari [12]). To realise the full potential of extending access to digital financial services in Ghana, it is not sufficient to just modernise the country's payment infrastructure. Some regard the 2007 establishment

of the Ghana Interbank Payment and Settlement Systems (GhIPSS) as the beginning of the emergence of digital financial services and broader financial inclusion in Ghana (Abor et al. [12]).

GhIPSS has continued to be an essential part of several payment systems, despite the issues that have arisen with e-Zwich. The Ghana Interbank Payment and Settlement System (GhIPSS) unites all DFS providers in Ghana, including banks, telecom firms, and fintech startups (Bank of Ghana [8]). Mobile money transactions are now more streamlined, quick, and cost-effective across all networks because of the interoperability that GhIPSS established in 2018. The incorporation of digital financial services has been shown in several studies to have a direct link with self-employment, income growth, and an increase in the welfare of rural farmers (Abiona & Koppensteiner [2]; Mhlanga et al. [1])

Despite the growing demand for digital financial services, particularly in rural areas, there is a significant information gap about the correlation between increased access and poverty reduction. This research, one of the first of its kind, evaluates the impact of access to digital financial services from MFIs on the susceptibility of rural Ghanaian farmers to poverty. Indicators of ex-ante poverty assess the possibility that a household would be impoverished in the future. In contrast, alleviation of poverty is a byproduct of assistance. Being susceptible to poverty suggests that there is a substantial probability that a family's income will fall below the national poverty line. Despite the Ghanaian government's assurances that poverty would be abolished by 2030, rural agricultural households are particularly vulnerable to poverty. Therefore, avoiding poverty is more important than relieving it (Potnis & Gala [13]). The Asset-Based Vulnerability model is first applied to survey data on 1050 rural farm families to assess the likelihood that these families may fall into poverty. Then, using a two-stage least-squares (2SLS) regression with an instrumental variable (IV), we investigate how the usage of digital financial services by farmers affects their risk of poverty. Additionally, we study how farmers' access to digital financial services may influence their vulnerability to poverty through a variety of pathways. This section of the paper discusses the literature on digital financial services and their susceptibility to poverty. Based on the literature reviewed and the conceptual framework of the study, the hypotheses were developed.

Digital Financial Services

Microcredit, microfinance, and financial inclusion were all significant industry development milestones. However, we have now entered a new era referred to as "digital financial inclusion," which emphasizes the significance of information and communication technology in expanding people's access to financial services. Microcredit, microfinance, and financial inclusion were significant industry development milestones (Senyo, Karanasios, Gozman, & Baba [14]). Microcredit is referred to organisations like Bangladesh's Grameen Bank, whose aim was to lend modest amounts of money to economically disadvantaged individuals (Saleem [15]). Microcredit was enlarged in the early 1990s to include the considerably larger

notion of microfinance, which refers to the provision of a wide variety of financial services other than loans, such as savings, mutual funds, and insurance. These services are provided via microfinance to people who would not otherwise have access to them., etc (Sudibyo, Puspasari, & Restianto, [16]). In 2006, the United Nations and CGAP advocated renaming "microfinance" as "financial inclusion," indicating yet another substantial departure from the vocabulary of the past (Durango, Lara-Rubio, Galera, & Blanco-Oliver [17]).

Microcredit, microfinance, and financial inclusion were first formed by traditional financial organizations such as Grameen Bank based on manual and field-based operations, which hindered their efficacy in assisting the poor (Dhawan, Wilson, & Zademach [18]). Fourth-generation financial inclusion, facilitated by ICT, introduces digital financial inclusion, a game-changing innovation for the people at the base of the pyramid (Tan, Purba, & Widjaya, [19]). Also, Pozzebon, Christopoulos, and Lavoie [20] contend that fundamental changes must be made to both technology and business strategy to do business with individuals living at the base of the economic pyramid. DFI refers to the use of and access to digitally supplied formal financial services by underserved and excluded populations (Pazarbasioglu et al. [7]). In 2007, Kenya introduced M-PESA, an innovative new mechanism for collecting electronic payments that have subsequently gained widespread popularity (Buku & Meredith [21]). In Kenya, mobile money is commonly used for electronic transactions (Mulwa & Ngigi [22]). Recent papers provide some evidence associating the adoption of this payment mechanism with economic development (Sapovadia [23]).

In Ghana, digital financial inclusion encompasses much more than access to a payment mechanism. It comprises three primary industries: online purchasing (or other digital payments), online investment, and online borrowing (Coffie & Hongjiang [3]). According to existing literature, there are significant differences between analogue and online methods of financial inclusion. First, the lower marginal cost of digital financial services is particularly advantageous in rural areas with greater transaction costs (Mhlanga [1]). Due to their reliance on Information and Communication Technology (ICT) some financial services do not need physical storefronts (Mhlanga [1]). Due to the expansion of online services and commodities, the information asymmetry between customers and financial institutions has decreased (Darby, Miller, Williams, & McKenzie [24]). This includes social networking platforms and online markets (Darby et al., [24]). Last but not least, digital technology may make it simpler for farmers with bad credit ratings to get loans (Protopop & Shanoyan [25]). Utilizing big data analysis and cloud computing, peer-to-peer (P2P) lending and other forms of digital finance may provide options for unsecured loans (Protopop & Shanoyan [25]). In conclusion, digital financial inclusion is seen as an excellent approach to aiding farmers, especially those in disadvantaged circumstances, in overcoming their restricted access to finance (Chen & Sivakumar [26]). During the past decade, the push for more individuals to have digital access to financial services has gained progress in various nations. Grameen

Bank, the most well-known microfinance organization, has built a comprehensive online business model to automate its operations (Benami & Carter [27]).

Susceptibility to Poverty

The World Bank [28] is often credited with coining the term "vulnerability to poverty," which refers to the likelihood that a family's income would fall below the poverty line during the next several years. The ex-ante poverty indicator of vulnerability examines a family's preparedness for future threats, while the ex-post poverty indicator of wellbeing measures how much money a family has (Vatsa [29]). A growing body of academic research on the topic has produced a variety of conceptualizations and techniques, such as "vulnerability as projected poverty," "vulnerability as poor expected utility," and "vulnerability as uninsured exposure to risk" (VER). Janzen, Carter, and Ikegami [30] note that the VEP approach, along with a large number of other methodologies, fails to dissect the nature of vulnerability and the many contributing elements. Janzen et al. [30] developed the asset-based vulnerability method by combining the VEP technique with a quantitative examination of farmers' asset endowments. As a consequence, the approach of asset-based vulnerability is used throughout this paper. Using this strategy, we can differentiate between structural vulnerability and risk-induced vulnerability, enabling us to pinpoint the causes of vulnerability with more precision. According to Günther and Harttgen [31], risk-induced vulnerability occurs when a family is exposed to both positive and negative risk events, such as heavy rainfall and drought, which causes them to shift in and out of poverty. Drought and excessive rainfall are two instances of risk events. In contrast to structural vulnerability, risk-induced vulnerability arises when a household move in and out of poverty owing to changes in asset level (such as land endowment). Understanding the distinction between structural vulnerability and risk-induced vulnerability is crucial for evaluating whether farmers' sensitivity is a result of prior issues or random occurrences (Günther & Harttgen [31]).

Conceptual Framework

There are two main forms of susceptibility to poverty among farmers: structural vulnerability and risk-induced vulnerability. When households retain a low level of spending in the future owing to poor asset endowments, the structural vulnerability exists. The risk-induced vulnerability occurs when families confront changes in consumption owing to random occurrences in the future. Figure 1 depicts the two ways in which farmers' access to digital financial services affects their susceptibility; this understanding guides the study analysis.

II. RESEARCH METHODS

The data for the study was obtained from rural farmers in the Bono, Bono East and Bono Ahafo, Eastern and Ashanti Regions of Ghana. These regions are considered agriculture-dominated regions with rural smallholder farmers who engaged in various agriculture businesses. Smallholder farmers produce a broad variety of foods, some of which are

for their use and others of which are intended for sale in the regional and local markets. This results in an increase in the level of life for the farmers, as well as in increased money from exports and increased food security for the country. The survey data were collected from November 5, 2022, to January 15, 2023, using questions on DFS. The data were obtained using the stratified random sample survey of 1050 rural farm households using a structured questionnaire. The survey was carried out as follows: In the first instance the notable agriculture communities such as Sampa, Prang, Sene East, Atiwa West, Atwima Mponua districts in the Bono, Bono East and Bono Ahafo, Eastern and Ashanti Regions of Ghana respectively. We also, select three agriculture-dominated villages using their level of GDP per capita (GSS [32]). In every village, we randomly select farm households which are generally between 45-64 households. In total, 1,155 questionnaires were administered and after editing for inconsistencies and missing data, we have 1,050 valid samples for analysis.

Measurement of Variables

We include payment, investment and financing as key indicators of DFS. Thus, we follow the approach adopted by He and Li [39] to measure rural farmers' use of microfinance DFS relating to digital payments (DP), digital investments (DI), and digital financing (DF) by MFIs. The questions used to measure the microfinance DFS are as follows: Payment (which DP methods offered by MFIs have you used? Mobile banking transfer, online payment method, digital payment platform). The digital payment was assigned 1 for any response other than , and 0, otherwise. Investment (have you put money into any of the following MFI financial products? Bonds, Treasury bills, stocks, online investment, none. The digital investment was assigned 1 for any response apart from or , and 0, otherwise. Financing (Have you ever used the web to borrow or raise money from a MFI? yes or no). DF was assigned a value of 1 if the response is , and 0, otherwise. In addition, we control factors such as the nature of the characteristics of the household head, and the residents' willingness to accept risks. Variables such as family composition, number of household workers, and total land area characterise a home. Typically, age, education, and financial literacy are used to identify the primary breadwinner in a home. Employment stability, access to formal bank loans, and informal insurance networks may improve a person's risk management skills.

Rural Farmers' susceptibility to Poverty Measures

Researchers employ the Asset-Based Vulnerability Approach developed by Chiwaula, Witt, and Waibel [34] to assess farmers' sensitivity to poverty. Carter and Barrett [35] developed the Asset-Based Poverty Approach, which establishes a causal connection between assets and welfare measures such as consumption. The Asset-Based Vulnerability Approach incorporates uncertainty over future income or consumption into the Asset-Based Poverty Approach (Chiwaula et al. [34]). The vulnerability of farmers may be calculated using the following formula: Vulnerability is the probability that a family will enter or exit poverty in the future.

III. RESULTS AND DISCUSSION

We present the results of the study based on the objectives of the study and the hypotheses tested. Additionally, robustness was also done to confirm the baseline results.

Rural Farmers' Use of DFS and Susceptibility to Poverty

First, we investigate how farmers' increased use of DFS has altered their vulnerability to financial difficulty. Table 2 displays the results of the OLS regression analysis. In columns (1) through (3) of Table 2, the vulnerability of farmers serves as the dependent variable. This susceptibility is established by the Ghanaian poverty line, which is 792 Ghanaian cedis. Each estimate incorporates the county dummy variables. Column (1) displays the correlation when there are no other control variables present. In the second column, the relatively external control elements are added one by one. These factors include the size of the family, the dependency ratio, the land area, and the age of the head of the household. All conceivable variables are considered in the third column. Similarly, the dependent variables in columns (4) to (6) of Table 2 are calculated vulnerability based on the worldwide poverty level of \$1.90. These columns represent comparable OLS regression findings. Farmers that use DFS had a decreased likelihood of slipping into poverty across all indices of poverty, according to the findings. In contrast to farmers who do not use digital banking services, this is the case. In columns (1) to (3) of Table 2, the DFI coefficients are shown as negative values. This effect holds regardless of whether or not the control variables are included, suggesting that farmers' usage of digital financial services reduces their vulnerability to poverty. As shown in there is a negative and statistically significant association between the use of digital financial services and the vulnerability of farmers. Jack and Suri [36] concur that the widespread usage of mobile money in Kenya has a significant impact on poverty reduction. Our research spans both digital investing and digital finance, while theirs focuses solely on digital payment systems.

We employ the two-stage least-squares (2SLS) regression and the instrumental variable (IV) technique mentioned in Section 3 to handle the risk of endogeneity. This is because there is a probability that the ordinary least squares (OLS) regression is biased. The results of both the Initial Step and Final Step of the 2SLS regression are summarised in Table 3, which can be found here. The OLS models in Table 4 are relatively comparable to the 2SLS models that were used for this analysis; the only difference is that the poverty levels for the 2SLS models were set at GHS 792 and \$1.90 respectively, rather than zero. While this was going on, we were also working on constructing 2SLS models that increasingly contained control variables. In Table 3, Columns 1 through 6, both the Cragg-Donald F-statistics and the Hansen J-statistics are significant. As a result, it would seem that the IV we are using is correct. The findings of the second round of regressions indicate that the DFI coefficients in columns (1) through (6) are statistically significant when interpreted as having a negative direction. This not only establishes the relationship between DFS and vulnerability but also allays endogeneity concerns.

Digital Financial Inclusion on Susceptibility to Poverty: Structural/Risk-Induced

The results of the regression that were just provided indicate that farmers' usage of DFS has a direct influence on their susceptibility. In this section, we go further into how digital financial services might aid rural farmers by concentrating on the channels via which this assistance can be delivered. We divide susceptibility into two categories: structural vulnerability, which results from inadequate asset endowments, and risk-induced vulnerability, which results from random events. Table 4 displays the outcomes of the Logit regression for susceptibility, with the poverty line set at GHS792 in Panel A and \$1.90 in Panel B, respectively. As seen in Table 4, the use of DFS has a substantial and positive effect on the decrease of risk-induced vulnerability. Having access to DFS may reduce the likelihood of slipping into poverty through the risk management channel, as shown by the findings. Panel A of Table 4 demonstrates that the DFS coefficients in Columns (1), (3), and (5) are all highly negative and statistically significant at the 1% level, but the DFS coefficients in Columns (2), (4), and (6) are not. This is evident when comparing the DFS coefficients in Columns (1), (3), and (5). (6). The fact that each DFS coefficient has a negative value demonstrates this (6). As a direct consequence, it would seem that the usage of digital financial services has a substantial influence, simply because it increases vulnerability. Panel B of Table 4 confirms the results of Panel A by showing that the DFS coefficients are substantially negative only at the 1% level in columns (1), (3), and (4). (5). Panel A's results are consistent with this conclusion. According to Benami and Carter [35], the availability of commercial banks' financially inclusive services has a greater impact on the risk-induced susceptibility of farmers than structural susceptibility.

Further Robustness Checks

The results in Table 5 holds independent of the poverty criterion or the use of instrumental variable estimation; our key findings imply that farmers who use DFS more often are less likely to be susceptible. This result remains true whether or not an instrumental variable estimate is used. In this study, we discuss the outcomes of additional robustness tests; these findings give further evidence that digital financial inclusion reduces the chance of farmers falling into poverty. To begin, we use a supplementary variable to gauge farmers' degree of engagement with DFS. This assists us in reducing the margin of error associated with our results. For instance, the following survey question allows us to determine how often farmers utilized digital payment methods (DP_N). How often do you make online purchases? There are four acceptable answers: never, once, sometimes, and often. No value was assigned to DP_N if the answer was never, 1 if it occurred only once, 2 if it occurred regularly, and 3 if it occurred often. Calculating the DP_N index for the same age group in the community requires the use of instruments. Table 4 displays the results of ordinary least squares and two-stage least squares regressions, which indicate that DP_N has a statistically significant influence on the susceptibility of rural farmers regardless of the selected poverty line

IV. CONCLUSION

Following the important phases of microcredit, microfinance, and financial inclusion, financial inclusion has entered its fourth stage of growth. The exponential expansion of digital financial inclusion in Ghana. This stage of financial inclusion development occurs after the crucial phases of microcredit, microfinance, and financial inclusion. The relationship between growing access to digital financial services and reducing poverty rates, especially at the local level, remains little understood. Utilizing survey data acquired from 1,050 rural Ghanaian farmers, this study throws light on this relationship and its putative effect pathways. The most significant results are listed below. First, the growing participation of farmers in digital financial inclusion programmes has a large and beneficial influence on reducing their susceptibility. According to the findings of our empirical study, the adoption of DFS is often connected with a decrease in farmers' vulnerability. Traditional financial services are separate from DFS, which have the potential to greatly enhance farmers' access to money second, the results of this study provided insight into how the accessibility of digital financial services may help to minimize the vulnerability of farmers. To analyse the various possible effect routes, we classify farmers' sensitivity into two distinct categories: structural vulnerability and risk-induced vulnerability. Structural vulnerability is based on the endowments of assets, while the risk-induced vulnerability is based on the occurrence of risk events. The implementation of DFS has a large impact on risk-induced vulnerability but a marginal impact on structural vulnerability. In a theoretical sense, our results point to the risk management capabilities channel as the means through which digital financial inclusion may reduce variances in consumption and, as a result, reduce farmers' susceptibility. This channel is comparable to an insurance policy. Our findings have substantial effects on public policy. The expansion of availability and use of DFS, especially digital finance to farmers, has clear policy consequences. To expand farmers' familiarity with digital financing, it may first be necessary to implement more targeted efforts and programmes. The majority of participants in our survey were cautious to use online lending platforms because of fear about the security of their personal information. Financial knowledge is equally as crucial as infrastructure such as high internet penetration and smartphone availability in encouraging farmers to use digital financial services. Creating digital financial models requires, as a second stage, the development of a comprehensive data warehouse. Governments should foster the growth of e-commerce in rural areas to enhance the transmission and collection of data about farmers' purchasing patterns and market circumstances. Local governments may be able to expand the availability of data by developing a public information-sharing system that includes both direct and indirect credit information. This system may include credit default records, tax and social security information, and similar information. If policymakers want to reduce the vulnerability of farmers via digital financial inclusion, they must also evaluate the influence of financial technology on

long-term income growth. Our study reveals that DFS have an insignificant impact on labour market outcomes, hence increasing structural vulnerability due to inadequate resources. It is crucial, then, to encourage the expansion of funding for production-oriented products and services in rural Ghana.

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