



The impact of credit access on household food security in Malawi

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ABSTRACT

This observational study examines the impact of access to either formal or informal credit on household food security in a credit-constrained developing country context of Malawi. Using the fifth Integrated Household Survey (IHS5), the study employs the Endogenous Regime Switching (ERS) approach and the Tobit regression model, in light of potential endogeneity between credit access and food security. Regression results show that key determinants of access to formal credit include education attainment and household size, whereas determinants of informal credit access include access to extension services, landholding size, household size and exposure to shocks. The study finds that although access to formal credit improves household food security, access to informal credit worsens food security within the context. Various policy implications are drawn from these results.

1. Introduction

A household's food security is highly dependent on the availability, stability, accessibility and utilisation of food preferences, according to the Food and Agriculture Organisation [1]. By this definition, Africa has seen the food security situation worsen over the past couple of years, with up to 250.3 million people reported to be undernourished on the continent in 2019 alone, 94% of which reside in the sub-Saharan African (SSA) region [2]. Within the SSA region, Malawi is one of the poor performers in terms of food security at the backdrop of a highly growing population, overreliance on agriculture, and lack of coping strategies amidst recurrent and seasonal shocks such as droughts and devastating floods. Particularly, the Malawi National Statistical Office [3] noted that up to 63.5% of households reported inadequate food security between 2019 and 2020, a significant surge from the 38.5% recorded about a decade earlier.

One of the key measures proposed to improve households' command over food, be it through production or to provide coping mechanisms in a crisis, is access to credit [4,5]. Credit access can be broken down into two main categories: formal credit sources and informal credit sources. While formal credit sources are given by banks or co-operatives that are supervised by the central bank as they are constituted by law, informal credit sources are normally given by money lenders, friends or relatives where there is no legal regulator to manage the credit activities. Regardless of the type of source, credit access is quite instrumental in fulfilling food emergency requirements. Credit has been identified as a

necessary vehicle that has potential to improve food security by allowing households to engage in more productive income-generating activities [6]. In addition, the [7] emphasizes the importance of providing credit to agriculture-based households due to the fluctuating nature of agricultural income in rural areas. This is because lack of access to such financial services prevents households from reaching their economic potential in, among others, savings mobilization and consumption smoothing. In the context of Malawi, credit access is quite limited due to high interest rates, prohibitive collateral requirements and poor conditions for repayment, especially for formal credit, all of which limit number of recipients. Practically, such challenges have recently seen informal credit sources gaining popularity at the expense of formal sources, as shown by Fig. 1. The figure shows that the highest proportions of loans in Malawi are obtained from informal sources, with village banks being the most prominent (obtained by 42.1% of respondents), and banks ranked amongst the lowest sources.

Economic theory states that a household has an "entitlement" to all possible combinations of food depending on their physical and economic access [8]. In combating food insecurity, households may try to improve their access to credit markets. This implies that credit access should positively impact a household's food security. However, the situation in Malawi has defied this theoretical prediction; noting that increases in credit access have not palpably translated into improvements in food security (see Fig. 2). Does elimination of liquidity constraints among households not have any effect on food security? The relationship between credit access and household food security in Malawi across the

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Integrated Household Surveys 2 (2004/05) through 5 (2019/20) is captured in Fig. 2.

Disparity of the observed credit access - food security nexus from the predicted trends could be explained by various factors, one key to which is that impacts of the various types of credit may differ (see Ref. [12] in the study of the impact of credit on welfare for the Gambia). Admittedly, not much research has gone into the relationship between credit access and food security. Of the few, Ref. [13,14] identify a positive relationship between access to credit and household food security in Ethiopia and Bangladesh respectively. From the Malawian perspective, Ref. [15] studied the impact of credit on income and food security with the conclusion that the impact is too small and insignificant to cause a difference in per capita incomes and food security. From 1998 to date, there have been many developments in the credit market which have changed credit access to individuals and households, and probably its impact on household food security. Also, as observed by Ref. [12]; the impacts of formal credit and informal credit may be different, and therefore worth separating. This study, therefore, sought to re-examine the impact of credit access on household food security in Malawi, in line with Sustainable Development Goal (SDG) number 2 which emphasizes ending hunger and improving nutrition of households, both of which are significant challenges in Malawi [16].

Employing a rich publicly available database (the Fifth Integrated Household Survey (IHS5)), with households that accessed various forms of credit and those that did not - alongside numerous control factors, the study adopted the Endogenous Regime Switching (ERS) econometric approach to handle potential endogeneity between credit access and food security, and the Tobit regression model in the absence of endogeneity. The main finding is that although formal credit is beneficial, informal credit degrades household food security. The study adds to the few observational studies on the role of eliminating credit constraints in improving household food security [13,14]. The rest of the paper is organized as follows: Section 2 summarizes the relevant literature; Section 3 presents the methodology used; Section 4 presents the results; and Section 5 concludes.

2. Literature review

2.1. The theory

A seminal study by Ref. [8] emphasized on the issues of consumption, demand and access to food spotlighting the entitlements of individuals and households. Ref. [8] noted that in every society, each person can be thought of as having an “entitlement” to all possible combinations of food implying that an individual has power or command over food. Food insecurity is therefore a consequence of unequal allocation of food due to unequal access to resources and opportunities [17]. This insinuates that it is not only about the availability of food, but also the ability of an individual or household to acquire a sufficient diet depending on their physical and economic access. To cope with food insecurity, households may interact with the credit market. As stated by the credit constraint theory, the life cycle model and permanent income hypothesis of Modigliani (1986) and Friedman (1957) state that households will try to maximize their utility by smoothing marginal utility over their life cycle [18]. It postulates that households try to maintain a fairly smooth pattern of consumption over their lifetime by borrowing when their income is low to finance current consumption [19] and will repay in period of high income [18]. According to the theory, households base their life-time expenditure on the expected flow of income over their lifetime, rather than just their current income. Access to credit markets, both formal and informal, allow households to acquire assets without having to reduce life-time expenditure [19]. Credit markets can help households in achieving their consumption objectives in several ways. Therefore, households cope with food insecurity by improving their access to intertemporal markets such as formal and informal credit markets. This is because intertemporal markets offer a quick and effective means of smoothing disposable income, therefore improving consumption and production through higher production factors [20].

2.2. Previous empirical studies

Various studies have been conducted on issues of access to credit, on the one hand, and household food security, on the other hand. Starting

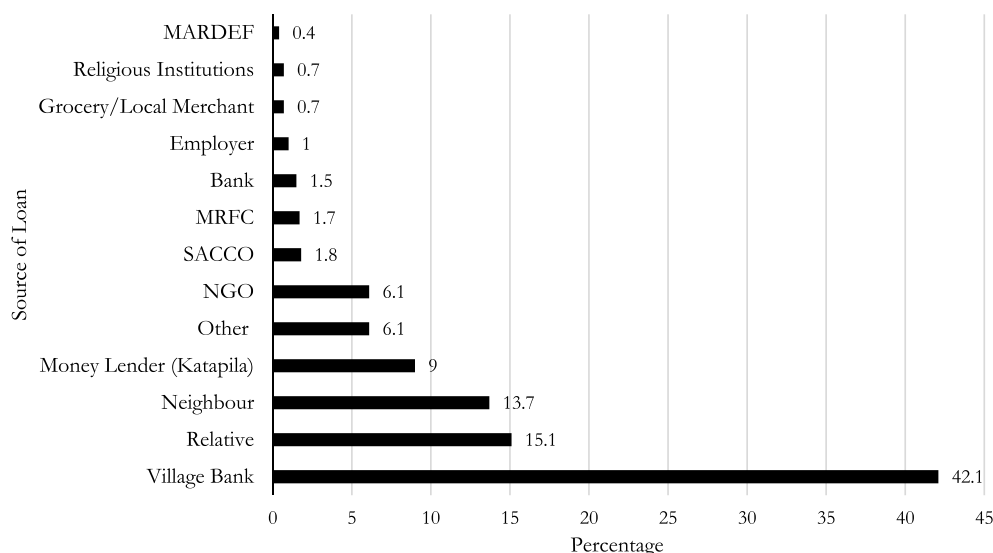


Fig. 1. Percentage Distribution of Source of Loan by Households

Notes: MARDEF = Malawi Rural Development Fund; MRFC = Malawi Rural Finance Company; SACCO = Savings and Credit Cooperative Organization; NGO = Nongovernmental Organization; Other includes loans from friends, agricultural cooperatives, among others.

Data Source: [3].

with household food security, Malawi's food security is mainly defined in terms of adequate production and access to maize as it is the country's staple crop, accounting for 60% of total food consumption [21]. As most households rely on their own food production, agricultural land productivity is key, as echoed by Ref. [22] who argued that increased agricultural land productivity would decrease the likelihood of food insecurity. Looking at the effects of sex on household food security, Ref. [17] focused on the effects of endangered intra-household power dynamics on household food security in Malawi. Through use of the Tobit model, the study found that female headed households with male- or female-dominant voice are more food secure than female-headed households with a neutral or no voice.

Education is also a key determinant as it opens up for better off-farm jobs resulting in improved incomes [23]. Therefore, well-educated household heads allocate their resources better which can in turn increase production, as noted by Ref. [24] in Ethiopia. Similar results were found by Ref. [25] for Nigeria. Aside from education, Ref. [26] noted that household size negatively impacts household food security as the bigger the household, the less likely they are to be food secure. Shocks, be it negative or positive, also have an impact on household food security. Ref. [27] noted that food price shocks such as food price spikes negatively impact household food security. Similarly, Ref. [28], noted that climatic shocks negatively impact household food security as it reduces food supply in developing countries. Aiming to provide information to individuals on a certain project of change via extension services has also been found to affect food security. With this in mind, Ref. [29] noted that agricultural extension services in Uganda significantly improved household food security. However, Ref. [30] found that access to agricultural extension services in Malawi has no effect on food security.

Besides food security, a bulk of literature sought to explain access to credit in developing economies. Ref. [31] investigated the factors that influence the probability that households will be granted a loan in Ghana. With use of the Heckman Probit model, it was found that larger households are more likely to demand for credit due to a high dependency ratio. Using a similar model, Ref. [32] found that farm income positively affects credit as the amount of income generated from farm enterprise would be used to repay the loan. Ref. [33] observed that education levels determine access to credit as households with higher levels of education tend to borrow more due to higher literacy increasing chances of accessing credit in Ghana. In addition, Ref. [13] observed a negative relationship between the probability to take credit and the sex of the household head implying that female headed households have a

better chance of receiving credit than male headed households in Ethiopia.

Other empirical studies went ahead to examine the relationship between access to credit and household food security, with some studies finding a positive relationship. Taking on the instrumental variables approach, Ref. [14] argued that per capita calorie consumption appears to be higher for male-headed households and smaller households, and households with credit tend to consume approximately 60 calories more per capita on a daily basis than similar households without credit. Using the Endogenous Regime Switching (ERS) approach, Ref. [13] concluded that access to credit significantly improves the number of meals consumed by households by about 12%. Using the propensity score matching technique, Ref. [21] found that the more a household is educated in Malawi, the more it is financially included and this increases food security of a household.

However, some analyses did not find a significant relationship between credit access and food security. For example, Ref. [34] found that microfinance has a significant impact on investment by small business, on profits by pre-existing businesses, as well on expenditure in durable goods, but not on consumption. Ref. [35] argued that household isolation through use of self-reported indicators is negatively correlated with access to credit. The authors observed that food spending is not significantly higher among households with access, which is likely due to the relative inelasticity of food spending in general. In the Malawian context, access to formal credit was found to positively affect household income by reducing borrowing from costly informal sources [15]. However, the study concedes that the impact between the two is small and insignificant to cause a difference between per capita incomes and food security.

The literature shows that various techniques have been adopted to explore the relationship between credit access and household food security. While some studies use field experiments – which are the “gold-standard” – to examine the impact of credit access, other studies use quasi-experimental techniques or observational studies, in the absence of experimental data. When using observational data, it is important to keep in mind potential endogeneity between credit access and food security, as the decision to take credit is dependent of household characteristics. This makes application of ordinary least squares (OLS) yield biased estimates. Due to presence of these biases, econometric techniques used in the literature include the Heckman Probit [see Ref. [31]] and Instrumental variables (IV) approach [see Ref. [35]]. Though, the ERS approach is quite superior in that it deals with heterogeneity effects and accounts for endogeneity in access to credit and self-selection bias in

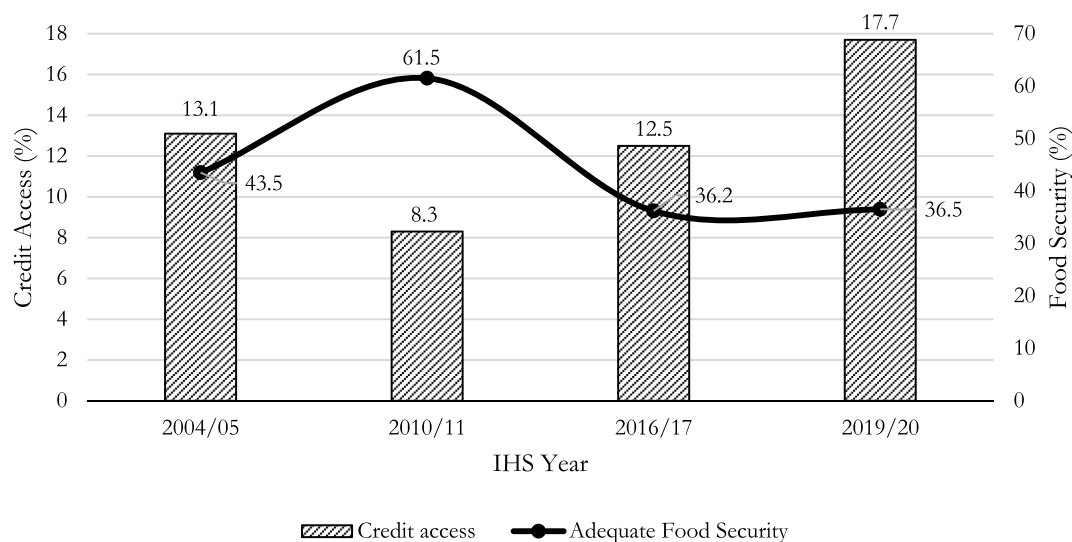


Fig. 2. Relationship between credit access and food security.
Data Sources: [3,9–11].

the decision to participate in credit [13]. In addition, it has the capability to estimate the variable under consideration to actual and hypothetical conditions [13].

3. Methodology

The study used data sourced from the fifth Integrated Household Survey (IHS5), collected over the period April 2019 to March 2020 by the National Statistical Office (NSO). The survey sampled 12,000 households statistically stratified into national, district, urban and rural levels, designed to provide information on the various aspects of household welfare in Malawi. From the 12,000 sampled households, 11,434 households were interviewed in the interest of the study. The main variables - food security and credit access - were sourced from the household questionnaire which compiled comprehensive information of household characteristics. The secondary data used in this study is publicly available and has no ethical concerns.

As the decision to take on credit and household food security are endogenously related variables, this study mainly employed the Endogenous Regime Switching (ERS) regression approach, as was done by Ref. [13]. In the ERS, the decision to take credit and its impact on household food security is estimated in two separate stages. First considered is the decision of the household on whether to access credit or not. Second, the impact of credit access on household food security is examined. The two-step process employed in the ERS enables the estimator to perform better than most alternative estimators (such as the instrumental variables [IV] estimator) in minimizing selection biases that can confound such observational studies. The study also adopted the Tobit model as explained below. Worth mentioning of course is that, resources permitting, randomization in a controlled trial would be the ideal strategy.

3.1. Estimation techniques

3.1.1. Endogenous Regime Switching (ERS)

The impact of access to credit on household food security was modelled following a random utility function approach expressed below, following after Ref. [13]. Assuming U_{1i}^* represents a latent variable of the expected utility that the i th household derives by taking credit compared with the one which does not take credit, U_{0i}^* . Considering the cost of borrowing, households decide to take credit if the net benefit exceeds the cost, which is, $C_i^* = U_{1i}^* - U_{0i}^* > 0$. The net benefit C_i^* is a function of latent variables determined by observable household characteristics and the error term which is given by:

$$C_i^* = W_i' \tau + v_i \quad (3.1)$$

$$C_i = \begin{cases} 1 & \text{if } C_i^* > 0 \text{ if credit is taken} \\ 0 & \text{otherwise} \end{cases} \quad (3.2)$$

where C_i : is the observed decision variable for access to credit

W_i : represents factors affecting expected benefits of access to credit; such as sex, education of household head and household size

τ : represents unknown parameters to be estimated

v_i : represents independent and identically distributed (i.i.d) normal random variables with $v \sim N[0, \sigma^2]$.

The average number of meals consumed by adult members per day is used as a proxy for food security. It is an important indicator as average number of meals consumed in a household is positively associated with a household's food security status whereby more food secure households consume more meals per day than less food secure households [36].

Let Y_i^* denote the average number of meals eaten by adult household members which depends on exogenous and endogenous variables, with

the latter including access to credit according to equation (3.1). In this case, the second stage of the ERS estimates coefficients for the impact of credit on average number of meals consumed by adults per day. This is done by considering two equations (credit access regimes - one for households that take credit and the other for those without credit). This is therefore expressed by:

$$Y_i^* = \begin{cases} Y_{1i} = X_{1i}\beta_1 + \varepsilon_{1i} & \text{if } C_i = 1, \text{ credit is accessed} \\ Y_{2i} = X_{2i}\beta_2 + \varepsilon_{2i} & \text{if } C_i = 0, \text{ credit is not accessed} \end{cases} \quad (3.3)$$

where X_{ij} is a set of independent variables which explain the outcome variable (number of meals consumed per day), presented in a reduced-form equation as:

$$Y_i^* = \beta_0 + \beta_1 \text{SexHH} + \beta_2 \text{AgeHH} + \beta_3 \text{EduHH} + \beta_4 \text{MStatusHH} + \beta_5 \text{HHsize} \\ + \beta_7 \text{LandSize} + \beta_8 \text{Shocks} + \beta_9 \text{Extension} + \beta_{10} \text{Residence} + \beta_{11} \text{Region} \\ + \alpha C_i + \mu_i \quad (3.4)$$

with SexHH representing sex of the household head; AgeHH representing age of the household head; EduHH representing education qualification of the household head; MStatusHH representing the marital status of the household head; HHsize representing the household size; LandSize representing the landholding size of the household; Shocks representing the shocks faced by the household; Extension representing the extension services received by the household; Residence representing the residential area the household is located: rural or urban; and Region representing the location for the household: north, central or southern region. The error terms (ε_{1i} , ε_{2i} , μ_i) are assumed to have a trivariate normal distribution with zero mean and covariance matrix Σ , $N(0, \Sigma)$.

An efficient method to estimate endogenous models is by full information maximum likelihood estimation [37,38]. Attainment of identification of the model, in this case, requires use of exclusion restrictions (that is, selection instruments), beyond and above the instruments that are automatically generated by the nonlinearity of the selection model of credit access [37]. This can be done by adopting variables that only affect credit access, but not food security; and verifying this by performing falsification tests. The analysis in this study employed land size and access to information (as proxied by access to extension services) as instruments, following Ref. [37]. The FIML estimation is provided as follows:

$$E[\varepsilon_{1i}|C_i = 1] = \sigma_{1\eta} \frac{\varphi(W_{1i})}{\Phi(W_{1i})} = \sigma_{1\eta} \lambda_{1i} \quad (3.5)$$

$$E[\varepsilon_{2i}|C_i = 0] = -\sigma_{2\eta} \frac{\varphi(W_{2i})}{1 - \Phi(W_{2i})} = -\sigma_{2\eta} \lambda_{2i} \quad (3.6)$$

where $\varphi(\cdot)$ is the standard normal probability density function. The distribution of the error term is derived from the logarithmic likelihood function as:

$$\ln L_i = \sum_{i=1}^N C_i \left[\ln \varphi \left(\frac{\varepsilon_{1i}}{\sigma_1} \right) - \ln \sigma_1 + \ln \varphi \left(\theta_{1i} \right) \right] + (1 - C_i) \left[\ln \varphi \left(\frac{\varepsilon_{2i}}{\sigma_2} \right) - \ln \sigma_2 + \ln \left(1 - \varphi \left(\theta_{2i} \right) \right) \right] \quad (3.7)$$

The ERS regression model can estimate the effect of credit access for actual and hypothetical conditions by considering heterogeneity among households. This is given by calculating the impact of the credit treatment on the treated (TT) and on the untreated (TU) for those who did not access credit. It is the difference between the expected outcome before and after they receive credit, estimated as:

$$TT = E[y_{1i}|C_i = 1] - E[y_{2i}|C_i = 1] = X_{1i}(\beta_1 - \beta_2) + (\sigma_{1\eta} - \sigma_{2\eta})\lambda_{1i} \quad (3.8)$$

$$TU = E[y_{1i}|C_i = 0] - E[y_{2i}|C_i = 0] = X_{2i}(\beta_1 - \beta_2) \quad (3.9)$$

3.1.2. The Tobit model

The second proxy for food security used in the study is the coping strategy index (CSI). The CSI captures household food security by aggregating the number of coping strategies that households use in reducing the food problem, with its index ranging from 0 to 56 [17,39]. Severity food insecurity is determined by the number of strategies that households employ. These coping strategies include the frequency at which households; rely on less preferred or less expensive foods, limit portion size at meal times, reduce number of meals eaten in a day, restrict consumption by adults so children can eat, and borrow food or rely on help from a friend or relative. Therefore, the more coping strategies a household employs, the less food secure the household is, as the household is forced to use the strategies as stated above.

The functional form of the Tobit model can be given as:

$$CSI_i = \alpha_0 + \sum_i B_i X_i + \sum_i \gamma_i V_i + \varepsilon_i \quad (3.10)$$

where CSI captures the measure of household food security; α_0 is the constant term; X_i is a vector of household-specific variables as stated by equation (3.4); B_i is a vector of the corresponding parameters; ε_i is the error term; and V_i is a vector of other exogenous factors such as shocks.

4. Results

4.1. Descriptive analysis of the data

This section uses descriptive statistics such as the mean, standard deviation, minimum and maximum of values to summarize the variables of interest alongside the factors that may feed into credit access to impact household food security, as presented in the methodology. These are presented in Table 1.

Table 1 shows that about 30% of the sampled households had access to credit, with about 3% accessing formal credit and about 26% accessing informal credit. About 70% of the households are male-headed

with an average head age of 43 years. A higher percentage sample of education qualification was found in households with no education qualification (67%), and as the education qualification increases, the average number of household heads with those qualifications decreased. On average, a household had 4 members and over 80% of households were reported to be residing in rural areas (which is close to the 84% nationwide figure reported in the most recent population census by the Malawi National Statistical Office [40]). Married household heads comprised about 70% of the sample, with the lowest (6%) held by separated household heads. The southern region had the highest proportion of the sample at 46%, with the northern region reporting the lowest proportion (19%), all in line with NSO figures. While the average landholding size was 0.7 ha, the reported standard deviation shows that reported values relatively deviated more from the mean. Interestingly, up to 90% of the sampled households were affected by shocks; an occurrence that could potentially affect household food security.

Table 2 presents the mean differences for the variables defined in Table 1, by access to credit, comparing equality of averages and proportions for continuous and binary variables, respectively. Starting with access to formal credit, the table shows that there are statistical differences in all variables (for at least one category). Particularly, while 77% of males accessed formal credit, a slightly lower proportion of females (70%) reported accessing the same. Statistical differences are also noted for education. For no qualification, fewer household heads (38%) accessed credit than those that did not (67%). Similar results are found with household heads holding MSCE/GCSE as more households (23%) accessed credit than those without credit (8%). This also holds for household heads with tertiary qualification. There are differences in informal credit access by extension as those who accessed credit (51%) are more than those that did not (43%). The table also shows that there are heterogeneities – as depicted by statistically significant differences in average values – in the key dependent variables (adult meals consumed and coping strategy index) by credit access, with more meals consumed by households that accessed formal credit, and more coping strategies adopted by households with no access to formal credit, as expected. Similar heterogeneities are also observed for access to informal credit. Though, the heterogeneities were not confirmed for the CSI, and hence CSI models were estimated using the Tobit model.

4.2. Econometric results

4.2.1. Endogenous Regime Switching results

To examine the impact of access to credit on household food security, equations (3.2) and (3.3) were estimated using the Endogenous Regime Switching (ERS) regression model, efficiently estimated by the FIML procedure. This was performed by the “movestay” syntax in Stata 17.0 developed by Ref. [41]. The first step of the econometric analysis was to establish that the selection instruments are valid. Using falsification tests, Appendix A1 shows that land size and access to information are jointly statistically significant determinants of all forms of credit access, as shown by the significant chi-square statistics (Columns 1, 3 and 5); but the variables do not jointly affect household food security for households that did not access credit (insignificant F-statistics in Columns 2, 4 and 6). Having established admissibility of the instruments used, Table 3 answers whether credit access and non-credit access households differ in their number of adult meals consumed, respectively capturing cases of any credit access, formal credit access and informal credit access (each represented by a dummy variable taking 1 if the household has access to that type of credit type, and 0 if otherwise).

Table 3 shows that different factors affect household food security in the different regimes. The likelihood-ratio test statistics of all three models of the joint significance are statistically significant. This shows that the equations in the models are not jointly independent and should not be estimated disjointedly. This supports the use of ERS to control the selection bias and the issue of endogeneity in the sample. Of course, such endogeneity could be from multiple sources, including omitted variable

Table 1

Summary statistics.

Variable	Obs	Mean	SD	Min	Max
Adult meals consumed	11432	2.419	0.582	1	5
Coping Strategies Index (CSI)	11431	7.486	8.507	0	56
Credit access (Yes = 1, No = 0)	11434	0.289	0.453	0	1
Formal credit access	11434	0.029	0.168	0	1
Informal credit access	11434	0.259	0.439	0	1
Sex (Male = 1, Female = 0)	11434	0.699	0.459	0	1
Age	11434	43.129	16.085	15	100
Education Qualification					
None	11434	0.669	0.47	0	1
PSLCE	11434	0.112	0.316	0	1
JCE	11434	0.091	0.287	0	1
MSCE/GCSE	11434	0.090	0.286	0	1
Tertiary qualification	11434	0.038	0.191	0	1
Household size	11434	4.415	2.091	1	22
Marital Status					
Never married	11434	0.033	0.179	0	1
Married	11434	0.700	0.458	0	1
Separated	11434	0.058	0.234	0	1
Divorced	11434	0.086	0.281	0	1
Widowed	11434	0.122	0.327	0	1
Urban	11434	0.183	0.387	0	1
Rural	11434	0.817	0.387	0	1
Region1 (North)	11434	0.190	0.393	0	1
Region2 (Central)	11434	0.346	0.476	0	1
Region3 (South)	11434	0.464	0.499	0	1
Land size	11056	0.722	1.331	0	102
Shocks (Yes = 1, No = 0)	11434	0.895	0.307	0	1
Extension (Yes = 1, No = 0)	11434	0.457	0.498	0	1

Data Source: IHS5 [3].

Table 2

Balance tests for access to credit.

Variable	FORMAL CREDIT ACCESS				INFORMAL CREDIT ACCESS			
	Without	With	Mean diff	p-value	Without	With	Mean diff	p-value
Adult meals consumed	2.411	2.668	−0.256	0.0000***	2.424	2.403	0.021	0.0931*
Coping Strategy index	7.549	5.363	2.187	0.0000***	7.269	8.103	−0.834	0.0000***
Sex (Male = 1, Female = 0)	0.697	0.770	−0.073	0.0043***	0.699	0.700	−0.001	0.8866
Age	43.186	41.193	1.993	0.0263**	44.095	40.377	3.718	0.0000***
Highest qualification								
No qualification	0.678	0.384	0.294	0.0000***	0.675	0.654	0.020	0.0435**
PSLCE	0.112	0.127	−0.015	0.3936	0.103	0.140	−0.037	0.0000***
JCE	0.089	0.130	−0.041	0.0113**	0.086	0.102	−0.016	0.0092***
MSCE/GCSE	0.086	0.236	−0.150	0.0000***	0.091	0.086	0.006	0.3665
Tertiary qualification	0.035	0.124	−0.088	0.0000***	0.045	0.018	0.027	0.0000***
Household size	4.405	4.743	−0.338	0.0037***	4.338	4.632	−0.293	0.0000***
Marital status								
Never married	0.033	0.045	−0.013	0.2095	0.036	0.026	0.009	0.0147**
Married	0.698	0.761	−0.063	0.0139**	0.690	0.729	−0.039	0.0001***
Separated	0.059	0.051	0.007	0.5827	0.057	0.062	−0.004	0.3781
Divorced	0.087	0.066	0.020	0.1936	0.086	0.087	−0.001	0.8913
Widowed	0.123	0.076	0.048	0.0087***	0.131	0.096	0.035	0.0000***
Reside (Urban = 1, Rural = 0)	1.821	1.668	0.154	0.0000***	1.806	1.849	−0.043	0.0000***
Region 1	0.189	0.245	−0.056	0.0105**	0.199	0.166	0.033	0.0001***
Region 2	0.345	0.375	−0.030	0.2605	0.355	0.319	0.036	0.0004***
Region 3	0.467	0.381	0.086	0.0020***	0.446	0.515	−0.069	0.0000***
Land size	0.718	0.861	−0.143	0.0597*	0.713	0.746	−0.033	0.2572
Shocks	0.896	0.849	0.047	0.0060***	0.882	0.931	−0.049	0.0000***
Extension	0.456	0.495	−0.040	0.1546	0.437	0.513	−0.076	0.0000***

Notes: Significance levels denoted by: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3

The impact of credit access on household food security.

Variable	Any Credit			Formal Credit			Informal Credit		
	Selection	Without Credit	With Credit	Selection	Without Credit	With Credit	Selection	Without Credit	With Credit
Sex	−0.063	−0.001	0.030*	−0.064	−0.004	0.015	−0.056	−0.002	0.031*
Log(Age)	−0.425***	−0.018***	0.081***	−0.161**	−0.022***	−0.067	−0.448***	−0.020**	0.093***
Education of head									
PSLCE	0.225***	0.083***	0.018	0.296***	0.080***	0.045	0.186***	0.086***	0.027*
JCE	0.127***	0.109***	0.075***	0.288***	0.104***	0.130***	0.075	0.115***	0.084***
MSCE/GCSE	0.109***	0.183***	0.131***	0.561***	0.171***	0.152***	−0.044	0.190***	0.173***
Tertiary qualification	−0.208***	0.282***	0.268***	0.542***	0.242***	0.212***	−0.499***	0.287***	0.359***
Log(Household Size)	0.226***	0.001	−0.054***	0.175***	0.009*	0.083***	0.222***	0.006	−0.059***
Rural	−0.221***			−0.184***	−0.129***	−0.034	−0.181***		
Marital Status of head									
Married	0.039	0.074***	0.041	0.203*	0.083***	−0.081	0.036	0.068***	0.058
Separated	0.075	0.038*	0.010	0.106	0.041**	−0.043	0.073	0.035*	0.025
Divorced	0.030	0.015	0.032	−0.048	0.034*	−0.078	0.026	0.01	0.049
Widowed	0.012	0.053***	0.057	0.044	0.057***	−0.036	0.027	0.048**	0.068*
Region2 (Centre)	0.030	−0.076***	−0.067***	−0.150***	−0.065***	−0.039	0.021	−0.073***	−0.073***
Region3 (South)	0.177***	−0.082***	−0.112***	−0.307***	−0.074***	−0.037	0.199***	−0.079***	−0.126***
Shocks	0.184***	−0.057***	−0.083***	−0.071	−0.032***	−0.024	0.214***	−0.055***	−0.094***
Log(Landsize)	0.184***			0.085*			0.158***		
Extension	0.108***			0.047			0.101***		
Constant	0.455***	0.888***	0.166***	−1.165***	1.013***	1.139***	0.430***	0.900***	1.048***
rho_0	1312.70**			320.32**			−4.31**		
rho_1	4.02**			−0.03			−78.38**		
LR test of indep. Eqns. (chi2)	237.65***			717.96***			196.84***		
chi2	1064.866			2008.073			1204.822		
P	0.000			0.000			0.000		
N	11054			11054			11054		

Notes: All analyses conducted at the household level using the ERS model estimated by FIML. LR = log-Likelihood. Significance levels denoted by: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

bias (due to exclusion of, say, climatic factors). Data limitations of the IHS5 could not permit controlling for climatic conditions in this study. Nonetheless, the ERS can handle any source of endogeneity. The first stage of the ERS shows selection results expressing the different variables that lead to an increase or decrease in the probability of accessing credit types. Education qualification, household size, households located in the southern region, land holding size, shocks and extension

increases the probability of accessing any credit. However, age of the household head, tertiary education qualification of the head and rural residence decreases the probability of accessing any credit. This is also expressed with formal credit as education qualification and household size increase the probability of obtaining formal credit. Lastly, holding a PSCLE, having a higher household size, residing in the southern region, having more land, being exposed to shocks and accessing extension

services increases the probability of obtaining informal credit. The sign of the coefficient on household size may be signalling the network effects that are usually important to access informal loans.

Beyond the selection equations, the correlation coefficients (ρ_0 and ρ_1) in the table capture the possible differences in household food security for households that access the types of credit, subject to statistical significance. With any credit, both values of ρ are positive and statistically significant expressing that households without any credit access are worse off in terms of number of adult meals consumed in comparison to random households in the sample. With formal credit, the positive and statistically significant value of ρ_0 in formal credit suggests that households that do not access formal credit are worse off in terms of number of adult meals consumed. The negative ρ_1 indicates that households that access formal credit have more adult meals consumed than random households in the sample. The negative and statistically significant values of ρ for informal credit access suggest that households that accessed informal credit are better off than random households in the sample.

The second stage of the model for household food security is the switching regression model. Education qualification is found to have positive statistical significance with all types of credit access. This shows that the higher the qualification of household heads, the more the number of adult meals consumed in the household making them more food secure, just as Ref. [24] suggested. Age of the household head has positive statistical significance to those with access to any credit and informal credit. This implies that the older the household head, the higher the number of meals consumed per day, which is quite contrary to the findings of Ref. [42]. The coefficient for household size is negative and statistically significant for households with any and informal credit access, as an additional household member decreases the number of meals consumed by the household, in line with the findings of Ref. [26]. However, the variable also has a positive and significant coefficient for households with formal credit access which is quite contrary to what was expected, as it implies that an additional household member increases the number of adult meals consumed. Of course, this finding is not very strange as additional productive household members may improve food security.

The coefficients for households' location in the central and southern regions are negatively statistically significant for any and informal credit which suggests households in these regions with the credit access mentioned, are more likely to consume a smaller number of meals per day. Shocks have a negative impact on food security for households with and without any and informal credit access, as previously suggested by Ref. [28]. The coefficient for married households without credit access is positive and statistically significant suggesting that married households are more likely to consume lower number of meals per day, possibly because marriage in the context may come with increasing household size, as Ref. [25] found.

4.2.1.1. The impact of credit access on household food security. Table 4 displays results for the impact of access to credit on household food security, showing the average treatment effect of credit: on the treated (ATT), on the untreated (ATU), and as a difference between the treated and control group (ATE) expressed as percentages. In interpreting such

Table 4
Estimates of treatment effects.

	ATT	ATU	ATE
Any credit	-0.087***	0.654***	0.437***
Formal	0.969***	0.164***	0.187***
Informal	-0.095***	0.776***	0.546***

Notes: All analyses conducted at the household level. Significance levels denoted by: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. ATT = Average Treatment Effect on the Treated; ATU = Average Treatment Effect on the Untreated (ATU); and ATE = Difference between the Treated and Control group.

results, Ref. [43] note that there may be conflicting findings between the ATT, on the one hand, and the ATU and ATE, on the other hand. Such conflict is observed in the findings for any credit and for informal credit. Ref. [43] claim that the ATU and ATE results are more reliable than the ATT results, and so the ATU and ATE are adopted for this study. The ATU shows that if households that do not access any type of credit got the credit, they would have consumed 65% more meals per day. With informal credit, results show that if those that did not access credit actually accessed it, they would have consumed about 78% more meals. In terms of formal credit access, the ATT reveals that if households that accessed formal credit did not access it, then they would have consumed about 97% less meals. Similarly, the ATU reveals that if households that did not access formal credit received this type of credit, they would have consumed 16% more meals. Furthermore, the ATE reveals that households that accessed any credit, formal credit and informal credit consumed about 44%, 19% and 55% more meals respectively than households that did not access the types of credit listed above.

The positive impact of formal credit on household food security signals the need for more initiatives aimed at expanding formal credit networks. This could be done by relaxing collateral constraints, as suggested by Ref. [14]. Another possible initiative is to raise access to formal credit by providing more information on formal credit availability. Access to credit has been found to be crucial in attaining household food security, particularly in years of shocks as also expressed by Ref. [14]. It is therefore instrumental in satisfying emergency food requirements.

To further explain the impact of access to credit on food security, illustrations through use of Kernel density graphs are made in Fig. 3. The first row of graphs represents any credit access predicted levels of household food security for excluded (without credit access) and included (with credit access) households respectively. This is followed by formal credit access in the second row and informal credit access in the third row. The results show that there is a clear difference in food security between households that have access to credit and their counterfactuals. It therefore emphasizes the positive impact that credit access has on household food security for both actual and hypothetical cases of current credit receivers.

4.2.2. Tobit results

Whilst estimating the second dependent variable (coping strategy index, CSI) using the ERS, it was noted that the likelihood ratio was not statistically significant. This implies that there is not enough evidence for endogeneity, emphasising no correlation between CSI and the error term as there are no sample selection errors. In this case, it was not necessary to estimate the model using a model that handles heterogeneity; and as such, the estimation was done using the Tobit model because the dependent variable (CSI) is limited – with values strictly bound between 0 and 56. Particularly, up to 29.19% of the respondents did not adopt any coping strategy (CSI = 0) while 0.08% adopted all coping strategies (CSI = 56). Table 5 shows results the impact of credit access on food security, as captured by the coping strategy index (CSI). Columns 1 to 3 represent separate regressions that include any credit, formal credit and informal credit access respectively. Each of the regressions in this table is estimated on the full sample ($N = 11,053$), such that while the treatment group has the specific type of credit access, all other households fall in the control group.

The Tobit results show that the relationship between any credit access and informal credit access, on the one hand, and CSI, on the other hand, is positive and statistically significant, in line with Ref. [17] who found that households that access informal credit are susceptible to food insecurity. This finding is worrisome given that households often lack access to formal credit, and so they opt for informal credit [20]. This calls for efforts to adopt innovative ways of extending informal credit and encouraging financial institutions to improve access to formal services, as suggested by Ref. [44]. Essentially, this calls for special efforts in the design of rural financial policy so as to support informal

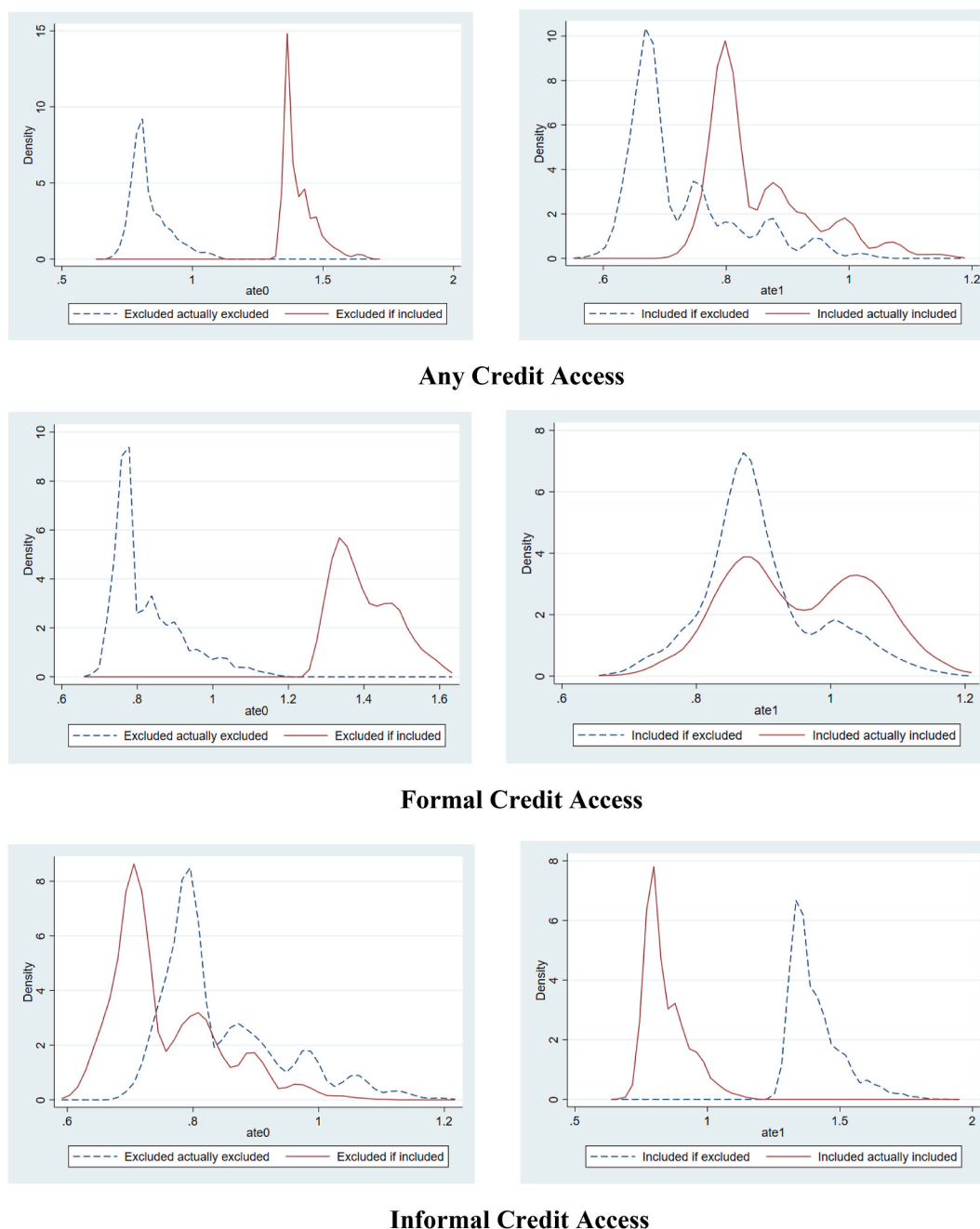


Fig. 3. Kernel Densities of Predicted Household Food Security without and with any Type of Credit Access.

institutions, as expressed by Ref. [45].

The negative statistical significance between education qualification of the household head and CSI, as expressed by Ref. [12]; implies that the higher the education qualification of the household head, the lesser the number of coping strategies employed implying lower food insecurity for the household. The negative coefficient of sex of household head across all models implies that female headed households are more likely to be food secure in comparison with male headed households, as was found by Ref. [13]. Rural location is positively and statistically significant in relation to CSI across all models, suggesting that rural households are less secure as they employ more coping strategies than urban households. Given that the majority of rural residents in Malawi are smallholder farmers, the finding calls for initiatives to enlighten the rural residents of the need to improve crop storage, among other agricultural practices. The negative and statistically significant relationship

between landholding size and CSI suggests that an increase in land holding size by a household is likely to decrease food insecurity, as land size increases opportunities in improving land productivity, in line with Ref. [22].

Results also express that households that experienced shocks are more food insecure than those that did not, as this reduces household's command over food which is in accordance to Ref. [8]. Furthermore, it is noted that access to extension services reduces the likelihood of employing coping strategies, emphasising that households become more food secure than those without extension services. This result corroborates the finding by Ref. [29]. These are both consistent with all types of credit listed. To more effectively inform policy decisions, [Appendix A2](#) presents the effects of formal and informal credit on the specific coping strategy mechanisms, namely; (1) relying on less preferred/expensive foods, (2) limiting portion size at mealtimes, (3) reducing number of

Table 5
Impact of access to credit on coping strategy index.

Dependent Var: Coping Strategy Index (CSI)	(1)	(2)	(3)
Credit access (yes = 1, no = 0)	0.810***		
Formal credit (yes = 1, no = 0)		−0.132	
Informal credit (yes = 1, no = 0)			0.872***
Sex (male = 1, female = 0)	−1.654***	−1.675***	−1.657***
Ln(Age)	−0.093	−0.201	−0.083
Education of head			
PSLCE	−1.358***	−1.287***	−1.350***
JCE	−2.860***	−2.808***	−2.848***
MSCE/GCSE	−5.327***	−5.253***	−5.279***
Tertiary qualification	−10.616***	−10.609***	−10.539***
Ln(Household size)	2.138***	2.194***	2.138***
Married	−1.085	−1.069	−1.083
Separated	0.003	0.028	0.003
Divorced	0.046	0.055	0.045
Widowed	−0.489	−0.482	−0.493
Region2 (Centre)	3.162***	3.167***	3.163***
Region3 (South)	3.927***	3.973***	3.920***
Rural	2.960***	2.948***	2.943***
Ln(Land size)	−3.793***	−3.753***	−3.781***
Shocks	5.419***	5.450***	5.411***
Extension	−0.684***	−0.645***	−0.681***
Constant	−5.204***	−4.718***	−5.206***
F	81.194	79.742	81.185
P	0.000	0.000	0.000
N	11,053	11,053	11,053

Notes: All analyses conducted at the household level for all households, with a separate model estimated for each type of credit (hence keeping the other type in the control group). The CSI is censored both to the left (at CSI = 0) and to the right (at CSI = 56). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Estimates based on robust standard errors.

meals eaten in a day, (4) restricting consumption by adults so children can eat, and (5) borrowing food, or relying on help from friends and/or relatives. The results confirm that access to informal credit is highly associated with higher food insecurity as the households that accessed the credit type had a higher chance of employing each of the five coping mechanisms.

5. Conclusion

The study analyzed the impact of credit access on household food security in Malawi. Household food security was proxied by two variables: number of meals consumed per day per adult household member and the coping strategy index (CSI). The study made use of data from the Malawi IHS5 and STATA software version 17 was used to implement the Endogenous Regime Switching approach (regressing average number of meals consumed per day) and Tobit model (regressing the coping strategy index). Amongst possible estimators for observational studies, the ERS model is good at reducing potential biases in estimating endogenously determined outcome variables. Balance tests were first performed to look at the mean differences of formal and informal credit access for the different variables used in the models.

The ERS regression results point out that the decision to take credit is influenced by certain household characteristics at different levels of

statistical significance. These include the education qualification, household size, land size, extension and shocks appear to positively increase the probability of taking the different types of credit. It was observed that factors that positively and statistically impact credit access on household food security at 1% level include the education qualification of the household head and age of the household head. However, shocks and household size negatively impact a household's food security. The ATT showed that any and informal credit access negatively impact a household's food security whilst formal credit access positively impacts a household's food security status. The Tobit results showed that access to informal credit negatively impacts a household's food security as households need to employ more coping strategies. The results also revealed that households' location in the central and southern region, rural residence and exposure to shocks are factors that are associated with households employing more coping strategy measures. On the contrary, sex of the household head, education attainment, landholding size and access to extension services negatively impact the coping strategy index emphasising that these households are more food secure as they employ less to no coping strategy measures.

Based on the research findings above, it is key to note a number of points. Firstly, accessing credit is crucial to attaining household food security, particularly in years of shocks such as floods or droughts. Secondly, the positive impact that formal credit access has on household food security calls for more initiatives in expanding formal credit networks. This could be done by relaxing collateral constraints and providing information on formal financial services. Lastly, informal credit is easily accessible, as seen by the proportion of the sample that accessed it, yet has a negative impact on household food security. This calls for the design of rural financial policy to improve conditions of informal credit access.

One expected challenge with the observational study is in terms of minimizing selection biases that are expected in such research. Ideally, randomized control trials (RCTs) are the best approach to map out the impacts. Nonetheless, given that RCTs are quite expensive, this study is a fair attempt to answer a policy question that has remained unanswered for some time within the context. Data limitations could not permit controlling for climatic factors in the study.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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APPENDICES.

Appendix A1

Test on the Validity of Selection Instruments

	Any Credit		Formal Credit		Informal Credit	
	(1)	(2)	(3)	(4)	(5)	(6)
Ln(Land size)	0.076*	−0.008	0.141*	0.005	0.045	−0.007
	(0.042)	(0.010)	(0.076)	(0.009)	(0.043)	(0.010)

(continued on next page)

Appendix A1 (continued)

	Any Credit		Formal Credit		Informal Credit	
	(1)	(2)	(3)	(4)	(5)	(6)
Extension	0.154*** (0.026)	0.006 (0.006)	0.042 (0.050)	0.005 (0.005)	0.154*** (0.027)	0.005 (0.006)
_cons	-0.657*** (0.025)	0.842*** (0.006)	-1.993*** (0.047)	0.838*** (0.005)	-0.728*** (0.025)	0.846*** (0.006)
Wald (χ^2)	27.93***		5.27**		20.00***	
F	0.635		0.668		0.493	
p	0.000		0.075		0.000	
N	11056		11056		11056	

Note: All analyses conducted at household level. Estimates in Columns 1,3 and 5 are from the Probit model for the whole sample; while estimates in Columns 2,4 and 6 are from the ordinary least squares only for households that did not access the respective type of credit. Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix A2

Effect of Access to Credit on 5 Specific Coping Mechanisms

Variable	(1)	(2)	(3)	(4)	(5)
Formal credit	0.125	-0.030	0.029	-0.158*	0.024
Informal credit	0.156***	0.099***	0.108***	0.091***	0.131***
Sex (male = 1, female = 0)	-0.164***	-0.124***	-0.116***	-0.118**	-0.151***
Ln(age)	-0.013	-0.053	-0.074*	-0.195***	-0.233***
Education of head					
PSLCE	-0.053	-0.112***	-0.165***	-0.105**	-0.117***
JCE	-0.240***	-0.251***	-0.261***	-0.165***	-0.240***
MSCE/GCSE	-0.439***	-0.480***	-0.538***	-0.422***	-0.427***
Tertiary qualification	-0.841***	-0.847***	-1.142***	-0.866***	-0.934***
Ln(Household size)	0.095***	0.222***	0.205***	0.774***	0.102***
Married	0.083	0.005	-0.163**	0.301**	-0.181**
Separated	0.140	0.084	-0.001	0.530***	-0.100
Divorced	0.123	0.075	-0.043	0.471***	-0.104
Widowed	0.128	0.020	-0.074	0.417***	-0.039
Region2 (Centre)	0.375***	0.246***	0.243***	0.193***	0.237***
Region3 (South)	0.354***	0.378***	0.442***	0.282***	0.267***
Rural	-0.219***	-0.258***	-0.274***	-0.167***	-0.273***
Ln(Land size)	-0.381***	-0.342***	-0.343***	-0.333***	-0.379***
Shocks	0.526***	0.619***	0.387***	0.380***	0.416***
Extension	0.086***	0.030	0.013	-0.023	-0.103***
Constant	-0.319**	-0.666***	-0.282*	-1.791***	0.115
chi2	919.029	932.322	921.586	880.725	625.142
p	0.000	0.000	0.000	0.000	0.000
N	11056	11056	11056	11056	11056

Results obtained from Probit estimation with robust standard errors. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Notes on column definitions:

- (1) = Rely on less preferred/expensive foods.
- (2) = Limit portion size at mealtimes.
- (3) = Reduce number of meals eaten in a day.
- (4) = Restrict consumption by adults so children can eat.
- (5) = Borrow food, or rely on help from friends and/or relatives.

References

- [1] Food and Agriculture Organisation, Deriving food security information from national household budget surveys: experiences, achievements, challenges, Food. Agri. Organ. United Nations (2008). Rome. Retrieved from, <http://www.ipcinfo.org/ipc-country-analysis/details-map/en/c/1152878/?iso3=MWI>.
- [2] Food and Agriculture Organisation, European Commission for Africa, African Union Commission, African Regional Overview of Food Security and Nutrition 2020: Transforming Food Systems for Affordable Health Diets, Accra: FAO, 2021, <https://doi.org/10.4060/cb4831en>. Retrieved from.
- [3] National Statistical Office, The Fifth Integrated Household Survey (IHS 5) 2020 Report, National Statistical Office, Zomba, 2020.
- [4] P. Varangis, J. Buchenau, D. Arias, T. Ono, To Avoid Food Insecurity, Keep Finance Flowing, 2020, May 27. Retrieved from World Bank Private Sector Development Blog: <https://blogs.worldbank.org/psd/avoid-food-insecurity-keep-finance-flowing>.
- [5] M. Ivanic, W. Martin, Ensuring Food Security, Finance & Development, 2008, pp. 37–39.
- [6] IFPRI, Sustainable Food Security for All by 2020 Report (2000): Addressing World Food Shortage, International Food and policy Research Institute, Germany, 2001.
- [7] World Bank, World Development Report 2004: Making Services Work for Poor People, World Bank, Washington D.C, 2004.
- [8] A. Sen, Ingredients of famine analysis: availability and entitlements, Q. J. Econ. 96 (3) (1981) 433–464.
- [9] National Statistical Office, Integrated Household Survey 2004-2005 Volume 1 Household Socio-Economic Characteristics, National Statistical Office, Zomba, 2005.
- [10] National Statistical Office, Integrated Household Survey 2010-2011 Household Socio-Economic Characteristics Report, National Statistical Office, Zomba, 2012.
- [11] National Statistical Office, Integrated Household Survey 2016-2017 Household Socio-Economic Characteristics Report, National Statistical Office, Zomba, 2017.
- [12] L.P. Manja, I.A. Badjie, The welfare effects of formal and informal financial access in the Gambia: a comparative assessment, Sage Open 12 (1) (2022) 1–19.
- [13] T.F. Bocher, B.A. Alemu, G.Z. Kelbore, Does access to credit improve household welfare? Evidence from Ethiopia using endogenous regime switching regression, Afr. J. Econ. Manag. Stud. 8 (1) (2017) 51–65.
- [14] S. Bidisha, A. Khan, K. Imran, B. Khondker, G. Suhrawardy, Role of credit in food security and dietary diversity in Bangladesh, Econ. Anal. Pol. (2017) 33–45, <https://doi.org/10.1016/j.eap.2016.10.004>.
- [15] A. Diagne, Impact of Access to Credit on Income and Food Security in Malawi, International Food Policy Research Institute, 1998. FCND Discussion Paper No. 46.
- [16] United Nations, Transforming Our World: the 2030 Agenda for Sustainable Development. UN General Assembly, 2015. Retrieved from, <https://www.refworld.org/docid/57b6e3e44.html>.

- [17] D.E. Zingwe, L.P. Manja, E.W. Chirwa, The effects of endangered intra-household power dynamics on household food security and nutrition in Malawi, *J. Gend. Stud.* (2021), <https://doi.org/10.1080/09589236.2021.1940110>.
- [18] K. Chen Chen, M. Chivakul, What Drives Household Borrowing and Credit Constraints? Evidence from Bosnia and Herzegovina, *International Monetary Fund*, 2008.
- [19] S. Andreou, The borrowing behaviour of households: evidence from the Cyprus family expenditure surveys, *Cyprus Econ. Pol. Rev.* 5 (2) (2011) 57–83.
- [20] M. Zeller, G. Schrieder, J.V. Braun, F. Heidhues, Rural Finance for Food Security for the Poor, *International Food Policy Research Institute*, Washington D.C, 1997.
- [21] D. Damiyano, C. Musapatika, N. Dorasamy, The impact of financial inclusion on food security: a comparative approach of Malawi and Zimbabwe, *J. Critical Rev.* 7 (16) (2020) 2111–2122.
- [22] T. Makombe, P. Lwin, M. Fisher, The Determinants of Food Insecurity in Rural Malawi: Implications for Agricultural Policy, *International Food Policy Research Institute*, 2010.
- [23] P. Pankomera, N. Houssou, M. Zeller, Household food security in Malawi: measurements, determinants, and policy review, in: *Conference on International Research on Food Security, Natural Resource Management and Rural Development*, Hamburg, 2009.
- [24] H. Kidane, Z. Alemu, G. Kundhlande, Causes of household food insecurity in koredagaga peasant association, oromiya zone, Ethiopia, *Agrekon* 44 (4) (2005) 543–560.
- [25] T.I. Akukwe, Household food security and its determinants in agrarian communities of southeastern Nigeria, *Journal of Tropical Agriculture, Food. Environ. Extension.* 19 (1) (2020) 54–60.
- [26] M. Asmelash, Rural household food security status and its determinants: the case of laelaymychew woreda, central zone of tigray, Ethiopia, *J. Agric. Ext. Rural Dev.* 6 (5) (2014) 162–167.
- [27] A. D'Souza, D. Jolliffe, Conflict, Food Price Shocks, and Food Insecurity: the Experience of Afghan Households, *IZA Discussion*, 2012, June. Paper No. 6621.
- [28] F. Badolo, S.R. Kinda, Climatic Shocks and Food Security in Developing Countries, 2012, October 1. MPRA Paper No. 43006.
- [29] Y. Pan, S.C. Smith, M. Sulaiman, Agricultural Extension and Technology Adoption for Food Security: Evidence from Uganda, *IZA Discussion*, 2015. No. 9206.
- [30] C. Ragasa, J. Mazunda, M. Kadzamira, The Impact of Agricultural Extension Services in the Context of Heavily Subsidized Input System: the Case of Malawi, 2016, January. IFPRI Discussion Paper 01498.
- [31] G.A. Arthur, D. Turkson, The welfare impact of household loans: an analysis for Ghana, *J. Finance Econ.* 9 (2) (2021) 83–92.
- [32] J.K. Langat, B.K. Mutai, M.C. Maina, H.K. Bett, Effect of credit on household welfare: the case of "village bank" credit in bomet county, Kenya, *Asian J. Agri. Sci.* 3 (3) (2011) 162–170.
- [33] M. Ayanga, D.B. Sarapong, S. Asuming-Brempong, Factors influencing the decision to participate in micro-credit programme: an illustration for northern Ghana, *Ghana J. Dev. Stud.* (2006) 57–65.
- [34] E. Duflo, A. Banerjee, R. Glennerster, C.G. Kinnan, The miracle of microfinance? Evidence from a randomized evaluation, *Am. Econ. J.* 7 (1) (2015) 22–53.
- [35] A. Amendola, M. Boccia, G. Mele, L. Sensini, Financial Access and Household Welfare Evidence from Mauritania. *Macroeconomics and Fiscal Management Global Practice Group*, World Bank Group, 2016.
- [36] C. Zizza, P. Duffy, S. Gerrior, Food insecurity is not associated with lower energy intakes, *Obesity* 16 (8) (2008) 1908–1913.
- [37] S. Di Falco, M. Veronesi, M. Yesuf, Does adaptation to climate change provide food security? A micro-perspective from Ethiopia, *Am. J. Agric. Econ.* 93 (3) (2011) 829–846.
- [38] L. Lee, Simulation estimation of dynamic switching regression and dynamic disequilibrium models- some Monte Carlo results, *J. Econom.* 78 (2) (1997) 179–204.
- [39] T. Amemiya, Tobit models: a survey, *J. Econom.* 24 (1–2) (1984) 3–61.
- [40] National Statistical Office, 2018 Malawi Population and Housing Census: Main Report, NSO, Zomba, 2019.
- [41] M. Lokshin, Z. Sajaia, Maximum likelihood estimation of endogenous switching regression models, *STATA J.* 4 (3) (2004) 282–289.
- [42] J. Dzanja, M. Christie, I. Fazey, T. Hyde, The role of social capital in rural household food security: the case of dowa and lilongwe districts in Central Malawi, *J. Agric. Sci.* 7 (2) (2015) 165–176, <https://doi.org/10.5539/jas.v7n12p165>.
- [43] B.M. Abu, I. Haruna, Financial inclusion and agricultural commercialization in Ghana: an empirical investigation, *Agric. Finance Rev.* 77 (4) (2017) 524–544, <https://doi.org/10.1108/AFR-02-2017-0007>.
- [44] M. Mujeri, Improving Access of the Poor to Financial Services. A Report Prepared for the General Economics Division of the Planning Commission to Serve as a Background Study for Preparing the 7th Five Year Plan (2016–2020) of Bangladesh, 2015.
- [45] H. Tonch, W. Sohn, The impact of informal credit on household welfare: evidence from rural Ethiopia, *Appl. Econ. Lett.* 29 (1) (2022) 12–16.