The Effect of Credit Programme Membership on Food Expenditure and Child Nutrition in Rural Malawi: Does Female Headship have a Differential Effect?

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Abstract

Although several country-level studies have investigated the impact of access to credit on various outcome variables, few of these studies have looked at the full effect of membership in a credit programme. This study was conducted on a Malawian dataset that was collected through a household rural finance survey. The study differs from other studies in that the operative explanatory variable is not monetary credit but credit programme membership. Contrary to findings in other related studies, this paper finds that the effect of membership does not depend on the gender of the household head. Credit programme membership, regardless of the gender of the household head, was found to make households better off, as manifested by the significantly lower food shares of member households. Female-headed households, irrespective of their membership status, were found to spend significantly more on food than their male-headed counterparts.

1. Introduction

Inadequate dietary intake is one of the primary causes of malnutrition in third world countries (Martorell, 1982). The United Nations Food and Agricultural Organisation (FAO) estimated that over one billion people in the world suffer from various types of malnutrition and the majority of them are in low income countries (Thirlwall, 1999). Of these affected people, young children are more susceptible to nutritional problems because of their higher nutritional needs, their vulnerability to infection, and because their diets are determined by others (Martorell, 1982). Child malnutrition is particularly grave because it stunts growth and mental development, adding another dimension to the vicious circle of poverty (Thirlwall, 1999).

Low-income levels of developing countries constrain the variation and amounts of food available for consumption (Martorell, 1982). It is the unfortunate recursive relationship between income and malnutrition that perpetuates the vicious cycle of poverty. Low income is the primary cause of malnutrition, and malnutrition resulting in diminished work efficiency and productivity also causes low income. As productivity drives economic growth,

malnutrition diminishes poor countries' prospects of alleviating poverty and moving out of its low-income status.

Women in developing countries have consistently been found to be better providers of nutrition, and to have less incidence of malnutrition in their households, despite their largely inferior economic position relative to that of men (Kennedy and Peters, 1992; Hoddinott and Haddad, 1995; Duflo, 2000). Credit programmes are institutions that contribute to enhancing household welfare (Thirlwall, 1999). Members of credit programmes have access to monetary and social benefits that have the potential to improve the well being of poor households. Given the evidence that a household in which a woman controls the resources, and a household that has a credit programme member, both have better nutrition, it can be argued that member households with a female head may have a differential effect on food expenditure and child nutrition.

This paper investigates the association of *credit programme membership* and *gender of the household head*, with household *food expenditure* and *child nutrition* in rural Malawi. This study further explores the differential effect of female headship on membership. An econometric analysis on data collected through a household rural finance survey conducted in five Malawian districts, generated the following results; households that are credit programme members are better off, as revealed by the significantly lower food shares across all member households, regardless of the gender of the head. However, food expenditure and child nutrition in member households are not significantly different from that of non-member households. With regards to the gender of the household head, irrespective of membership status, female-headed households spend significantly more on food than their male-headed counterparts. Child nutrition and food shares, though, do not differ significantly by gender of the household head. As to the differential effect of female headship on membership, this study finds that credit programme membership does not differentially affect the outcome variables when the gender of the head in the participating household is female.

A two-stage estimation is used to generate the probability of being a credit programme member, because this categorical regressor is endogenous: the probability of being a credit programme member depends on the same variables that explain the consumption expenditure and nutritional status of a rural household member. Choice based sampling was used, by the institutions conducting the survey, to collect a balanced sample of credit programme members and non-members. As this sampling method overweights the actual proportion of programme members in the population, a 'weighted average sampling maximum likelihood' specification is used to correct for the endogenous sampling framework used.

The paper is presented as follows: section 2 provides evidence on the positive effect that female headship has on consumption expenditure and child nutrition, and cites studies that report finding that membership and female headship has a differential effect on various outcome variables. Section 3 follows with a background on the data and a comparative analysis of the variables used in this study by gender of the household head and by membership. Section 4 outlines the econometric model used to account for the endogeneity of credit programme placement and the endogenous sampling framework used. Section 5 follows with a discussion of the econometric results. Section 6 rounds up the paper with a conclusion of the main results.

2. Credit Programme Membership and Gender of the Household Head

2.1 Gender Matters in the Provision of Food Consumption and Child Nutrition

This paper argues that households with female heads have better diets and nutritional outcomes than male-headed households. Female-headed households provide a more nurturing environment that mitigates a poverty-

ridden home (Handa, 1996). Hoddinott and Haddad (1995) found that adult female households in the Ivory Coast allocated a larger proportion of household expenditure to food. Rogers' (1996) study on the effect of the gender of the household head on consumption behaviour in the Dominican Republic found that while the self-defined female headship parameter had an insignificant effect on food expenditure, the effect of this parameter on both calorie and protein consumption was statistically significant and positive. Research studies conducted in the Malawi, Kenya, Jamaica and Ivory Coast have shown that women and men from the same households make different consumption choices (Kennedy and Peters, 1992; Louat *et al.*, 1993; Hoddinott and Haddad, 1995; Handa, 1996; Anderson & Baland, 2000). These studies have found that a higher proportion of men's consumption baskets consist of 'sin' goods (i.e. cigarettes and alcohol), whereas women's consumption baskets are largely composed of quality foods and goods.

Clearly female headship has a positive relationship with food expenditure, and subsequently manifests as better nutritional outcomes in households headed by women. It is the negative effect that male headship may have on consumption in the household, as was the case in India's rural Orissa, that is a policy concern (Panda, 1997). If household headship influences household welfare, then it has implications for the design and implementation of welfare enhancing programmes such as micro-credit programmes (Rogers, 1996).

The child nutrition literature supports the hypothesis that child nutrition in female-headed households is significantly better than it is in male-headed households (Kennedy and Peters, 1992; Kennedy and Haddad, 1994). Children in female-headed households have been found to be better off than those in male-headed households as women tend to be more children-centred in their expenditure patterns (Handa, 1996). Devi and Gervani (1994) found that the father's expenditure on luxury goods and amusements had a negative and significant effect on the current nutritional of his pre-school children, implying

that males that indulge in status expenditure are more likely to have pre-schoolers that are underweight.

A child's growth pattern is a sensitive indicator of malnutrition, which can signal deficiencies in nutrition. Nutritional deficiencies are generally defined in terms of anthropometric measures (Martorell, 1982). The anthropometric measures of a child under the age of six are defined as follows: *height-for-age* (H/A) reflects a child's past nutritional experience; *weight-for-height* (W/H) is an indicator of a child's current nutritional status; *weight-for-age* (W/A) combines information from the two aforementioned indicators as weight is affected by thinness and by height (Kostermans, 1994). A child's nutritional status can be expressed in the Z-score of one of the three measures: the value of the Z-score being the number of deviations that the child is away from the median of the respective indicator of the children of that age group or height from the standard population.[1] A Z-score of -2 is commonly used as the cut-off point to discriminate between well-nourished and malnourished children (Kostermans, 1994).

Table 1 compares the anthropometric results for the pre-school children studied in this paper to anthropometric results in the empirical literature. Kennedy and Peters' (1992) Kenya and Malawi studies, and Duflo's (2000) South Africa study show that pre-school children in male-headed households had on average lower Z-scores than their counterparts in female-headed households. Conversely, Louat *et al.'s* (1993) Jamaica study and Rogers' (1996) Dominican Republic study revealed that pre-schoolers in female-headed households had on average lower Z-scores than the pre-schoolers in

[1] The W/A, W/H or H/A Z-score compares the weight/height of a Malawian rural child of a certain height/age with the reference median weight/height of the World Health Organisation population reference for a child with the same height/age (Diagne and Zeller, 2001). The use of the WHO standard as the international benchmark is defended by the following facts; the differences in growth potential among children under 7 are small; the high cost if every country developed its own standard growth charts, with subgroups of children in each age group that are large enough to generate valid standards; one standard per country would not account for the racial and tribal differences within a country. One standard makes data across countries comparable (Kostermans, K (1994). So, the WHO standard may not be

male-headed households.[2] While the empirical evidence is mixed, the results from southern and eastern Africa suggest that pre-school children in female-headed households are better nourished. Table 1 further reports that the *height-for-age Z-scores* in this study are significantly different by *gender of the household head*. These results support Kennedy and Peters' (1992) findings and imply that pre-schoolers in male-headed households suffered relatively more from long-term food shortages and chronic illnesses than pre-schoolers in female-headed households.

2.2 Access to Formal Credit

Missing credit markets for poor households in the developing world's financial markets are a pervasive phenomenon (Morduch, 1995). Malawi's rural poor, like the rural poor of the average low income country, are heavily marginalised by formal finance institutions that require substantial amounts of physical collateral prior to the provision of loans (Bolnick, 1992). The poor rarely have physical collateral to offer for a loan, and the costs of travelling to a credit provider are often onerous. For banks, investigating the creditworthiness of each borrower is expensive (Khandker, 2001).

The alternative for credit institutions is the use of social collateral. Some micro-credit programmes have developed group-lending schemes whereby borrowers within a group guarantee one another's loans; no one in the group may receive a loan from a credit programme until all members have repaid the previous loan (Anderson and Baland, 2002). Micro-credit programmes play a significant role in the development process, as they fill the gap left by the commercial banks whose explicit objective is profit maximisation and not development (Thirlwall, 1999). Credit programmes are widely perceived to be welfare enhancing mechanisms that can relax the liquidity constraints of these

representative of Malawian children per se however it is an international standard that allows comparisons to be made across countries.

[2] Rogers (1996) attributes the higher nutritional status in female-headed households to the relatively greater dietary diversity found in households headed by women over that found in male-headed households.

marginalised households, and thereby provide the income required to improve the nutritional status of poor households (Thirlwall, 1999).

While there is some evidence of an income effect of micro-credit programmes on consumption expenditure and nutrition, programme membership exposes households to more than just receiving loans. Simply being a member can convey additional benefits that may contribute to improving the well being of households. Most of the literature on the impact of micro-credit has looked at the effect of monetary loans on various outcome variables (Pitt and Khandker, 1998; Swaminathan and Findeis; 2003). Access to formal credit was found to have no statistically significant effect on per capita daily food expenditure in Diagne and Zeller's (2001) Malawi study. [3]

The argument in this paper is that although not all programme members receive credit this does not exclude them from deriving some social benefit from the services, which include the business training and technical advice, that credit programmes offer.[4] So, this study goes beyond simply exploring the income effect of credit programmes and looks at the total benefit derived from membership in a credit programme. This approach to the study revealed that households that are credit programme members are better off than their counterparts that are not members of a credit programme.

2.3 Differential Effect of Female Headship on Nutritional Status, Food Expenditures and Credit Programme Membership

Given the role that credit programmes can play in relaxing credit constraints, and the evidence that women are better providers of nutrition, an important policy question is whether women, or in this case households headed by

[3] A household is said to have access to a type of credit if at least one of its members has a strictly positive credit limit for that type of credit. The credit limit is used to assess the extent of that access (Diagne and Zeller, 2001; Swaminathan and Findeis, 2003).

[4] Credit programme members may not receive credit for primarily one of the following two reasons. Some members may have outstanding loans to repay, so will only be given credit once repayments have been cleared. These credit programmes largely lend to people organised in group lending schemes, and some groups may chose to allocate the loans to members on a

women, should be specifically targeted by credit programs. In response to the positive impact of an empowered woman on the development of a community, efforts to provide developmental assistance to poor women have increasingly concentrated on credit (Berger 1989; Goetz and Gupta, 1996; Haddad *et al.*, 1996; Buvinic and Gupta, 1997). Female-headed households are one of the most efficient ways to reach marginalised rural women as in this unit females are most likely to have greater control of any income that enters the household. Anderson and Baland's (2000) finding that Kenyan women were more likely to join a credit programme suggests that targeting women and female-headed households may be effectively achieved.

Several studies have found that income controlled by women, or income in female-headed households, has a more significant and positive effect on a family's welfare than income controlled by men (Bruce, 1989; Thomas, 1990; Strauss and Beegle, 1996). A Bangladeshi study found that annual household consumption expenditure increased more for a given amount borrowed by women from credit programmes than the increase in consumption that occurred when men borrowed that same amount (Pitt and Khandker, 1998). One South African study found that when a female household member is a recipient of a pension, the positive impact of nutrition on children in that household is greater than the impact of child nutrition when a male receives the pension (Duflo, 2000). Clearly, members of a household where a female controls the income have a superior welfare status.

Although there is ample literature that looks at the effect of income controlled by women on household welfare, there are a limited number of studies that explore the differential effect that female headship has on credit programme membership. Previous Malawi studies found that *both* access to credit and female headship in a household that has access to credit do not have a differential effect on the food expenditure behaviour of poor households. Contrary to the findings in Bangladesh and South Africa, Swaminathan and

rotational basis such that not every group member receives a loan every time a loan is

Findeis' (2003) Malawi study on the effect of credit by gender on a basket of goods found that only the male head's access to formal credit had a significant and positive effect on the household food share.

Sen (1999) argued that women's participation in economic initiatives does not just generate income for them it also provides social benefits that accrue from the empowerment of women. For instance, Panjaitan-Drioadisuryo *et al.* (1999) found that Indonesian female credit programme members make joint decisions with their husbands concerning the allocation of household money, as well as on household and community issues. They further found that households of credit programme members have more meals and a greater variety of foods (Panjaitan-Drioadisuryo *et al.,* 1999). This evidence supports the proposition that other than the income that credit provides, the other services that membership offers exposes member households to social benefits, which improve the wellbeing of household members.

Hashemi *et al.* (1996) found that the estimated probability of empowerment for women in Bangladesh is very low (about 2%) for women who are not members of a credit programme. They found this by developing empowerment measures for their study and using them as dependent variables in logistic regressions.[5] The dichotomous variables measured women's mobility, economic security, ability to make small purchases, involvement in major household decisions, relative freedom from domination within the family, political and legal awareness, and involvement in political campaigning and protests. Hashemi *et al.*'s (1996) empowerment measures findings showed that credit programme membership has the potential to empower women and thereby enhance household welfare.

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disbursed by the credit programme.

[5] Hashemi *et al.* (1996) developed, through a series of questions, a variety of different aspects of empowerment through extensive observation, personal interviews with respondents in the ethnographic study villages and with credit program staff, and from baseline survey data. The responses were consolidated into eight indicators that were constructed as scale variables. All of the operational measures of empowerment used reduced the empowerment data to dichotomous variables. Each measure attempted to separate those women who appear to be

The literature supports the argument that women that control household resources allocate more of the household budget to food and that children in female-headed households have a superior nutritional status. Evidence also shows that credit programme membership has great potential in enhancing the wellbeing of poor households in low-income countries. The developmental role that credit programme membership can play in poor households coupled with the positive influence of a female head in a member household suggests that the interaction between female headship and membership may have significant ramifications with regards to alleviating food insecurity and malnutrition in poor households.[6]

The following section describes the origin of the Malawi dataset used in this study to investigate the additive and multiplicative effect that membership and gender has on household nutrition. Section 3 also reports a comparative analysis of household characteristics by gender of household head and by membership status.

3. Data

3.1 Household Rural Finance Survey in Malawi

The dataset used in this study is a subset of a more comprehensive dataset collected through a household rural finance survey conducted by the International Food Policy Research Institute (IFPRI), based in Washington D.C., in collaboration with the Bunda College of Agriculture at the University of Malawi.[7] The households sampled were interviewed in a three-round

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relatively more empowered than most other poor women, but did not pick out highly unusual respondents.

[6] 'Member households' refers to households that have at least one person over the age of 17 that is a member of a credit programme.

[7] The dataset employed in this study was made available by Dr. A. Diagne. Diagne's dataset is a subset of a dataset collected through a household rural finance survey conducted by IFPRI, which is based in Washington D.C., in collaboration with the Bunda College of Agriculture, University of Malawi. Of the 627 households sampled in the survey, Diagne used only 377 in his study as these households had observations for all the variables required for IFPRI's research. This data set maintains the same sampling properties as the full data set. The

household survey. Round one of the survey was conducted in February-April 1995, round two in July-August 1995, and round three in November-December 1995. This dataset has 377 households in 44 villages spread over five districts, as illustrated in Figure 1. Note that each district is subdivided into areas and within the areas are villages.[8] There are in total 14 areas.

The survey was carried out at three levels: the household level, community level and credit group level.[9] The household-level questionnaire, consisting of seven modules, was administered in all three rounds. The seven modules in the household-level survey are (i) demographics, (ii) crop and livestock incomes, (iii) asset ownership and transactions, (iv) food and non-food expenditure, (v) credit and savings, (vi) non-farm income and time allocation, and (vii) anthropometric measures (Simtowe and Diagne, 1998).

Three out of the four credit programmes concentrated on in this study depend on group lending. The four credit programmes are:

- Promotion of Microenterprises for Rural Women (PMERW)
- Malawi Mudzi Fund (MMF)
- Malawi Rural Finance Company (MRFC)
- Malawi Union of Savings and Credit Cooperatives (MUSCCO)

The first two credit programmes (PMERW and MMF) are no longer in existence. The PMERW credit program brought small-scale non-farm income-generating technologies to rural areas and gave business training and technical advice to women organised in group-owned enterprises (Diagne and Zeller, 2001). The PMERW was a pilot project set up in 1986, funded and supported

principal objective of the IFPRI research study was to ascertain the determinants of access to and participation in formal and informal credit and savings programs, and examine their impacts on agricultural productivity, income generation and food security. (Simtowe and Diagne, 1998).

[8] An *area* is by definition a grouping of four or five villages and is referred to as a *traditional authority*. Districts were segmented into *traditional authorities* by the post-colonial government and the divisions were based on historical familial lines.

[9] The community-level and credit group-level questionnaires were administered in the second and third rounds, respectively. The community-level questionnaire supplies information on the socio-economic characteristics of the surveyed villages and surrounding communities. The credit group-level questionnaire gathered information on the structure, rules and performance for each of the credit groups operating in the surveyed areas (Simtowe and Diagne, 1998).

by the *Deutsche Gesellschaft fur Technische Zusammenarbeit*, GTZ (German Society for Technical Cooperation). The project did not go into full operation; it remained a pilot programme, which ended in 1996 and was superseded by self-administered credit schemes that were set up between 1991 and 1993 (Shawa, 2001).

The MMF granted loans for non-farm income-generating activities to poor rural households with less than one hectare of land (Diagne and Zeller, 2001). The MMF is now falls under the MRFC. The MRFC provides seasonal agricultural loans to smallholder farmers and MUSCCO's objective is to provide credit and savings options to low-income people who are not serviced by commercial banks (Diagne and Zeller, 2001; Bolnick, 1992). The credit programmes were selected for the IFPRI survey as they were representative of the range of formal credit and savings options available to Malawian households.

Two of the four Malawian credit programmes (the MMF and PMERW) targeted women in particular.[10] The MMF, modelled on the Grameen Bank, had initially provided loans to both men and women however, after experiencing a high default rate amongst men they chose to strategically target women.[11]

[10] As 2 of the 4 credit programmes operational in the areas sampled targeted women in particular, the dataset has an overrepresentation of women, and hence overstates the proportion of women in the population. This overrepresentation of women is not corrected for in this study, as the researchers did not choose to include more women in their study; choice based sampling was only done for credit programme members and this is corrected for. The reader should however keep in mind that the result on the effect of female headship on the outcome variables does not reflect the dynamics in the population.

[11] The Grameen Bank Project was set up in 1976 when Professor Muhammad Yunus, Head of the Rural Economics Programme at the University of Chittagong. The Bank provides banking services to the rural poor, and is based on group lending schemes. The groups provide morally binding guarantees in place of the physical collateral required by commercial banks (www.grameen-info.org). Sen (1999) considered the Grameen Bank's remarkable record of a high repayment rate to be a direct consequence of the response of women to the opportunities generated by micro-credit provision and their desire to ensure the continuation of this facility. It is highly likely that the very low default rate of poor rural Malawian women is attributed to the same factors. The Ministry of Women, Youth and Community Affairs set up the PMERW to advance the needs of rural women.

3.2 Consumption Expenditure Measures

The immediate effects of micro-credit membership are the impacts on income, consumption and employment. Consumption expenditure is one of the welfare indicators considered in this study.[12] Consumption is arguably a more accurate measure of welfare than income, as a household's well-being is best measured by the goods and services it consumes, and income data are more prone to errors than consumption data (Louat *et al*, 1993; Panda, 1997; Thirlwall, 1999). The latter is true for the data set used in this paper, where the consumption data was more comprehensive than the income data.[13]

As the focus of this study is on the wellbeing of households, the item of interest in this study from the consumption expenditure basket is food. Deaton (1997) points out that despite the merits of consumption expenditure data, its quality in developing countries is often deficient for reasons that especially apply to the context of the households in this study. Firstly, relatively wealthy farmers provide their domestic and agricultural workers with food as part of their remuneration package, so food expenditure for these households is likely to include food items that are consumed by the workers as well (Deaton, 1997). Secondly, many households consume what they produce, which leads to double-counting because home food produce is recorded as income and consumption (Deaton, 1997).

In spite of the shortcomings of food expenditure data, *per capita* and *per adult equivalence food consumption expenditure* are the two most commonly used measures. Lampietti and Stalker (2000) argue that the equal allocation rule of the per capita measure is deficient for two reasons. Firstly, the dispersion of the data is not representative of the real picture, as individual consumption is either under- or over-stated. Secondly, *per capita* assumes that household

[12] Employment was not studied here because the employment data here was not available at the individual level, only at the household level. The employment data was hence not comprehensive or accurate enough to draw any meaningful inferences from.

[13] The consumption expenditure data is available at the per capita and per adult equivalent level and on a daily basis, whereas the income data is only available at the household level and it is seasonal income data.

members consume equal amounts, which may not be the case, or that each household member is treated equally. The *per adult equivalence consumption expenditure* measure corrects for these shortcomings to some extent and is hence used in this study instead of the *per capita* measure.[14] Equivalence scales are based on the different nutritional requirements of persons of different ages and gender within a household (Lanjouw, 2000; Coudel and Hentschel, 2000). For instance, a child below the age of five may be deemed to require only about one-third of the calories of an adult male in order to be able to function normally. An equivalence scale based on nutritional norms might therefore suggest that a young child count as one third of an adult. In a context where food consumption is a large component of total consumption, as is the case in poor households, the adult equivalence scales are especially appealing (Lanjouw, 2000; Coudel and Hentschel, 2000).

The food expenditure portion of the total consumption expenditure budget is traditionally large in poor households. The households in this sample fit this profile, as the average food share is 87 percent. Engel Curve theory tells us that as households become richer, they gain a higher total expenditure and their food share declines concurrently (Deaton, 1997). However, a decline in the food share does not necessarily imply that membership in a credit programme has translated into a higher total consumption expenditure budget for households; it may simply reflect a decline in food expenditure. Similarly, an increase in food expenditure does not inform us of what is happening to the food share and subsequently total consumption expenditure. Examining *both* food expenditure and the food share enables us to make more rigorous conclusions on the impact of membership. A decrease in food share may suggest that households are wealthier following their joining a programme; however for consistency on the conclusive benefits of membership it would be

[14] Given the highly statistically significant correlation between the two individual food consumption expenditure measures (per capita food consumption expenditure and per adult equivalence food expenditure) of 0.98, either of the measures could have been employed. Selection of one of the measures does not disregard the dynamics in the other, as they are so interdependent. Note that no information regarding the adult weightings and scale factors used to generate the per adult equivalent data used in this was available in the notes to the dataset provided by Diagne.

more thorough to rule out the possibility that the decline in food share is a result of a fall in food expenditure.

3.3 Data Analysis of Household Characteristics

A comparative analysis of the demographic, economic and social characteristics of households by membership status and by headship is reported in Table 2. This analysis reveals that despite the inferior economic and social position of rural Malawian women, households with female heads still manage to allocate relatively more expenditure towards food and deliver better nutrition to their children than the male-headed households.

1. *Characteristics of Households by Gender of the Household Head*

Female-headed households account for about 28% of all the households in this sample. They have significantly smaller *household sizes* and have fewer *adult equivalents*, yet their *dependency ratios* are significantly higher. In the education department, male household heads have relatively more *years of schooling* than female heads. Moreover, the average spouse in a *female-headed household* has significantly more *years of schooling* than the average spouse in a male-headed household implying that the men in this study, regardless of whether or not they are heads, are significantly more educated.

Despite the significantly lower *income wealth* and *asset wealth* of *female-headed households*, they have on average significantly higher *total consumption expenditures*, higher *food expenditures* and higher *food shares* than male-headed households. These findings support the evidence that female heads allocate more income to consumption expenditure and that women's consumption baskets are largely composed of quality goods and foods (Kennedy and Peters, 1992; Louat *et al.*, 1993; Hoddinott and Haddad, 1995; Handa, 1996; Rogers, 1996; Anderson & Baland, 2000)

With regard to amenities, a significantly lower proportion of households headed by women *have pit latrines* than male-headed households. Appleton (1996) found a similar result for pit latrines in Uganda and attributes this result

to the observation that pit latrines require construction by men who are presumed to be scarce in female-headed households (only 20% of the female heads in this study are married). And as to the *health centres for children under the age of 5*; female-headed households are significantly closer to the child clinics yet, only one of the three anthropometric measures, the *height-for-age Z-score*, is significantly higher for pre-schoolers in households headed by women implying that pre-schoolers in male-headed households are relatively more stunted than pre-school children in households headed by women.

2. *Characteristics of Households by Credit Programme Membership*

Member households have on average a significantly larger *household size*, more *adult equivalents* and larger *dependency ratio* than non-member households. Diagne and Zeller (2001) attributed the larger household sizes to the fact that a large proportion of member households were into tobacco farming which required a large team to manage the farm. The workers are often counted as part of the household in addition to the immediate family, explaining the higher household sizes.

With regards to food expenditure behaviour, *member households* have significantly lower *food shares* than non-member households. However, their *food expenditures* are not significantly different. The significantly lower food share of member households coupled with the insignificant difference in food expenditures suggests that member households have larger consumption expenditure budgets, although the difference in *total consumption expenditures* is insignificant for member and non-member households. The significantly higher income and asset values of member households support the deduction that member households are wealthier.

As to the education levels, both heads and spouses of *member households* have relatively more *years of schooling* than their counterparts in non-member

households. As the credit programmes offer business training amongst other skills, membership enhances the education of members.

Now we turn to household amenities where a significantly higher proportion of *member households have latrines* than the proportion of non-members households that do, and *member households* are on average closer to a *clinic for pre-school children* than the average non-member household is. The proximity of member households to child health clinics appears to have a positive effect on child nutrition as is evident from all three anthropometric measures that show that pre-schoolers in member households are less likely to be malnourished. However, only the *weight-for-height Z-scores* of pre-schoolers in *member households* are significantly higher. If pre-schoolers from households that are participating in credit programmes are less likely to have malnutrition then a strong argument can be made that credit programme membership may contribute to reducing acute malnutrition.

3. *Characteristics of Credit Programme Member Households by Gender of the Household Head*

Although the structure of member households in terms of active adults and dependents is the same, *member households with female heads* have significantly smaller *household sizes* and significantly less *adult equivalents*.

Food expenditure per adult equivalent is significantly higher in *member households with female heads*. The *food share*, however, does not differ by gender of the head in the participating household implying that *member households with female heads* have higher *total consumption expenditures* than their counterparts. Although *member households headed by females* have higher *total consumption expenditures* than non female-headed member households, the difference is not statistically significant. Overall, the asset wealth, income and consumption expenditure results suggest that despite the lower income and wealth status of member households with female heads,

they allocate more to consumption expenditure and significantly more to food expenditure.

Iodine, a nutrient that prevents malnutrition, is used by a significantly greater proportion of *member households headed by females* than the proportion of member households headed by males. *Child health care centres* are significantly closer to *member households headed by women* than they are to member households headed by men. *Pit latrines*, which dispose of effluent more efficiently and hence reduce the risk of infection and malnutrition, are more prevalent in member households headed by men.

In summary, the evaluation of household characteristics by gender of the household head and by membership status brings us to the following main conclusions. Although female-headed households have less income, wealth and education than their male counterparts, they have higher consumption expenditure budgets, higher food expenditures and have pre-schoolers with superior past nutritional experiences. Member household have lower food shares implying that they are better off, which is affirmed by their higher incomes and wealth, and have pre-schoolers with a superior current nutritional status. Member households' lower food shares coupled with food expenditures that do not differ significantly from non-member households suggests that the credit is being used for entrepreneurial activities and not food. Being a female headed household *and* a member household significantly increases food expenditure relative to that of member households with male heads, however this interaction effect on child nutrition is not significant.

The findings of this section have revealed that the gender of the head, membership status and member households with female heads have differential effects on the well being of households. The following econometric analysis explores the validity of these hypotheses.

4. Econometric Models

Thusfar, this paper has cited studies that have found that female headed households allocate relatively more consumption expenditure towards food and that show the differential effect that an influential female in a household with access to credit has on both food consumption expenditure and the nutritional status of pre-school children. A comparative data analysis of the demographic, economic and social characteristics of Malawian rural households across headship and membership revealed that although female-headed households have less human and physical capital, they are better providers of nutrition than their male-headed counterparts, and member households are not only relatively better off, their pre-schoolers are also less likely to be malnourished than pre-schoolers in non-member households.

In order to pursue the relationships that where identified in the data analysis, an econometric analysis is used to estimate the association between household membership in a credit programme and, household food consumption behaviour and the nutritional status of children under the age of six, respectively. The secondary question is the differential effect of gender on the outcome variables. The econometric analysis is done on a panel data set, which has three observations for each sampled household. The baseline specification used in this analysis is outlined below.

4.1 Baseline Specification

The conditional demand for *per adult equivalent food consumption expenditure* in household i of village j (Y_{ij}), conditional on programme participation (C_{ij}) is expressed as follows,

$$Y_{ij} = \alpha_y + \lambda_y X_{ij}^{Y} + \beta C_{ij} + \delta_y I_{ij} + \mu_i^y + \varepsilon_i^y \qquad (1)$$

where, X_{ij} is a matrix of household characteristics (excluding household income), C_{ij} is a measure of *credit programme participation* in household i in

village j, I_{ij} is total household income, δ_y and λ_y are vectors of parameters, β is an unknown parameter, μ_i^y is an unmeasured determinant of Y_{ij} that is fixed within a household i, and ε_{ij}^y is a non-systematic error picking up, in part, unmeasured determinants of Y_i that vary over households such that $E(\varepsilon_{ij}^y \mid X_{ij}, \mu_i^y) = 0$.[15] Household income is excluded from the household characteristics matrix because even though it is a household characteristic, it is an endogenous variable.

Similarly, the conditional probability that the average pre-school child is malnourished in household i of village j (N_{ij}) is conditional on *membership in a credit programme* (C_{ij}) is expressed as follows,

$$P(N_{ij} = 1 \mid X, C) = \lambda_n X_{ij}^N + \beta_n C_{ij} + \delta_v I_{ij} + \mu_i^n + \varepsilon_i^n \qquad (2)$$

As some of the variables that explain *food expenditure* behaviour and the *nutrition of pre-schoolers* (age, gender or income of the household head) also explain *credit programme membership* and *household income*, it is likely that there are some unmeasured determinants of food expenditure and child nutritional status, expressed in their respective error terms, that are the same as the unmeasured determinants of credit programme membership and household income, expressed in the latter outcome equations' error terms. The likelihood that *credit programme membership* and *household income* are correlated with the omitted variables, which are contained in the error terms of the former outcome equations ($\varepsilon_{ij}^y, \varepsilon_{ij}^n$), suggests that *credit programme membership* and *household income* are endogenous explanatory variables.

4.2 Accounting for Endogeneity of Credit Programme Membership

According to Pitt and Khandker (1998), the *endogeneity of group-based lending* may occur for one of three reasons: the credit programmes may have

[15] A list and discussion of the set of variables that are included in the X_{ij} matrix is available in

been placed systematically instead of randomly; there may be unmeasured village attributes that affected the participation of households in credit programmes; and there may also be unmeasured household characteristics that affected the participation of households in credit programmes.

1. Placement of credit programmes is non-random

The placement of credit programmes in this study largely depended on the objective of the respective programme. The MRFC was directed towards the poorest 25% of the population.[16] MUSSCO targeted low-income Malawians not serviced by the commercial banks. [17] The PMERW programme was run in areas that were designated as rural growth centres in 1986 and clearly targeted poor rural women.[18] The commonality of these objectives is their explicit targeting of credit constrained Malawians. Government infrastructure and the location of a cluster of members largely dictated the placement of these programmes, implying that the programmes were not randomly placed.

2. Unmeasured village attributes affecting the participation in credit programmes, food consumption expenditure and the nutritional status of pre-school children.

Characteristics of villages that are not well measured in the Malawi dataset may affect credit programme membership, food consumption behaviour and child nutrition. For instance, villages located along Lake Malawi tend to have

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Table 3 in the Appendix.

[16] The infrastructure that the MRFC currently uses is that which was set up by the Ministry of Agriculture. The Ministry of Agriculture operates from Rural Development Offices which are located in each district administration office that were set up by the government when they created the ministry for the administration of agricultural extension services. Mrs. N. Shawa, who is Manager in the Commercial Credit Division at the MRFC, provided this information.

[17] MUSSCO is a composition of Savings and Credit Cooperatives (SACCOs), which are autonomous member owned financial cooperatives that operate as group-lending schemes. SACCOs are established and placed on common bond of members. In the case of a community, the SACCO is located in the area where the members live. If the SACCO is employee based, its offices are located at the head office of the company or organisation that employees these members. Mr. D. Chidzanja, Business and Planning Officer of MUSSCO, provided this information.

[18] The PMERW was part of an economic empowerment project that was set up for women in 1986 by the then Ministry of Women, Youth and Community Services (MOWYCS), and was supported by the GTZ. Dr. Shawa, who provided this information, was Deputy Director of Women Affairs at the Ministry of Gender, Women and Children Affairs (this ministry superseded MOWYCS) when the PMERW was still operational. She is now Permanent Secretary at the Ministry of Health.

relatively more business enterprises and a greater variety of enterprises than inland villages because of the lakeshore tourism and fishing opportunities available along the lake. As most of these credit programmes specifically target households involved in enterprises, the likelihood that households situated along the lake are credit programme members is higher plus the greater enterprise opportunities along the lake suggest that lakeshore villages have greater income to allocate towards consumption expenditure. A categorical time-invariant village attribute, 1=*village is located along the lake*, has been employed in the outcome equations to capture some of this village attribute and control some of the heterogeneity of villages that influences membership, and hence indirectly affects food consumption behaviour and the nutritional status of pre-schoolers.

3. Unmeasured household attributes affecting the participation in credit programmes, food consumption expenditure and the nutritional status of pre-school children.

Within a population of heterogeneous households there may be homogenous groups of households. One such homogenous group may join credit programmes and lead one to attribute to credit programme membership certain behaviour that is a product of the homogenous characteristic. A random effects specification is employed to account for the unobservable effects that explain the heterogeneity of households. This specification controls for the endogenous participation of households in credit programmes.

The conventional approach to the problem of estimating equations that have endogenous regressors, such as equations (1) and (2), is to employ an instrumental variable in a reduced form model whereby the endogenous regressor, *credit programme membership*, is expressed as a function of all other exogenous variables and its instrumental variable. The predicted probability of *credit programme membership* is hence used as an exogenous regressor in the outcome regressions.

The reduced form equation for *credit programme membership*, C_{ij}, is expressed as follows:

$$P(C_{ij}=1 \mid X,W)=\lambda_c X_{ij}+\delta W_{ih}+\mu_j^c+\varepsilon_{ij}^c \quad (3)$$

where X_{ij} is a vector of household characteristics and W_{ih} is an area characteristic distinct from the X_{ij} variables in that it affects C_{ij} but not other household behaviours conditional on C_{ij}. λ_c and δ are unknown parameters, μ_i^c is an unmeasured determinant of C_{ij} that is fixed within a household, and ε_{ij}^c is a non-systematic error that reflects unmeasured determinants that vary over households such that $E(\varepsilon_{ij}^c \mid X_{ij}, W_{ih}, \mu_j^c)=0$.

In the above set of simultaneous equations, the exogenous regressor W_{ih} in equation (3) is the identifying instrumental variable (IV), *distance to government office*. Given that the credit programmes predominantly used government infrastructure as their offices, *distance to government office* was considered an appropriate instrument for *credit programme membership*. For *distance to government office* to be a suitable IV, it has to be significantly correlated with the *credit programme membership* variable as shown in equation (4) below. However, the IV cannot be correlated with the error term in the *food consumption expenditure* equation, as shown in equation (5) as follows,

$$Corr(C_{ij}, W_{ih}) \neq 0 \rightarrow \delta \neq 0 \quad (4)$$

$$Corr(W_{ih}, \varepsilon_{ij}^y)=0 \quad (5)$$

For the relationship in equation (5) to hold, the instrument, *distance to government office*, has to be uncorrelated with the omitted variable in the *food consumption expenditure* equation, Y_{ij}, (and nutritional status equation, N_{ij}) as the error term in that equation, ε_{ij}^y (ε_{ij}^n), represents variation in the omitted variable.

4.3 Two-Stage Estimation

The presence of endogenous variables in the outcome equations led to the employment of a *Two-Stage Least Squares (2SLS)* specification for the food expenditure equations and a *Simultaneous Two Equation Probit Model (S2EPM)* for the nutritional status models (Wooldridge, 2002; Greene, 2003).[19]

The probability that a household is a member of a credit programme is estimated in the first stage, by regressing the categorical variable on all exogenous variables including the instrument, *distance to government office*. Similarly, the predicted values of household income are estimated by regressing income on all exogenous variables and *total household income of 1994*, I_{94}, which instruments for *household income of 1995*, I_{95}, because although $Cov(I_t, \varepsilon_t) \neq 0$ it is reasonable to assume that ε_t is uncorrelated with past values of C and I. The previous period's household income, I_{t-1}, is hence a suitable instrumental variable for current income (Greene, 2003).

The outcomes, food consumption expenditure and nutritional status of pre-schoolers, are estimated in the second stage using the fitted probability value and the continuous predicted income values from the first stage as pre-determined regressors in the second stage.

The conditional *food consumption expenditure* (Y_{ij}), conditional on *membership in a credit programme* (C_{ij}) is expressed as follows,

$$Y_{ij} = \alpha_y + \lambda_y X_{ij}^{Y} + \beta C_{ij} + \delta_y I_{ij} + \mu_i^{y} + \varepsilon_{ij}^{y} \qquad (6)$$

where β is the effect of *credit programme membership*.

[19] When the reduced form model in a two-stage specification is estimated using a probit specification, and the structural model is estimated using a least squares estimation, Keshk (2003) refers to the two-stage model as a *two-stage probit least squares* (2SPLS) model.

The conditional probability that the average pre-school child in a household is malnourished is conditional on *membership in a credit programme* (C_i), is expressed as follows,

$$P\left(N_{ij}=1 \mid X, C\right)=\lambda_n X_{ij}^N+\beta_n C_{ij}+\delta_y I_{ij}+\mu_i^n+\varepsilon_i^n \tag{7}$$

The nutritional measures (N^*) employed in this study are the *weight-for-age*, and *height-for-age Z-scores*, which represent the current and long-term nutritional status of children under the age of six, respectively. The empirical literature on the nutritional status of pre-school children commonly employs a Z-score of -2 as the cut-off point to discriminate between well-nourished children and malnourished children (Kostermans, 1994). The *critical or threshold level* of the nutritional measure is –2; if the Z-score is less than –2 then the child is malnourished, and if the Z-score equals and exceeds –2 then the child is not malnourished. Children under the age of six with a Z-score less than –2 are given a value of 1 and 0 otherwise. So, a Z-score that takes on one of two values, 0 and 1, is observed. The latent variable, the nutritional status of pre-schoolers (N^*), is defined as follows,

$$N^*=X_i\beta+\varepsilon_i \tag{8}$$

The observed N^* variable is not employed as regressand in this study, instead N, which takes on values of 0 or 1, is used according to the following rule:

$$N_i=\begin{cases}1 \;\; if \;\; N_i^* \prec -2 \\ 0 \;\; otherwise.\end{cases} \tag{9}$$

It is also assumed that $\varepsilon_i \sim N\left(0,\sigma^2\right)$. This study sought to explore the probability of the average pre-school child in a rural Malawian household having malnutrition as opposed to the absolute Z-score that the average child has. Moreover, the likelihood of a pre-schooler having malnutrition for a unit

change in one of the independent variables holds more meaning for policy makers than the resultant absolute value of malnutrition.

When the reduced form regressands and the outcome equation regressands are both binary dependent variables, a *simultaneous two equation probit model* is employed instead of the 2SLS employed where the regressands are continuous.

4.4 Accounting for Choice Based Sampling

Households that had credit programme members were deliberately over-sampled. At the time of the data collection (1994/95) credit participation was not common in Malawi. For this reason only villages that hosted a programme were studied. Out of all the households interviewed, 12% were current members of a credit programme. This proportion is an overstatement of the population of Malawian households that are credit programme members. In order to ensure that sufficient credit programme participants were included in the study, the researchers stratified along the programme membership status variable and random selection occurred within each stratum. So, about half of the sample households were selected from participants in the four credit programmes.

When the composition of ones and zeroes in the observed sample of the dependent variable is deliberately skewed in favour of one outcome or the other to generate a more balanced sample than random sampling would produce, the sampling is said to be *choice based* (Greene, 2003). Choice-based sampling enables researchers to derive the most efficient statistical inference given the cost of data collection (Diagne and Zeller, 2001; Pitt and Khandker, 1998). Given that credit programme participation was an uncommon phenomenon at the time of the Malawi survey, choice based sampling enabled the researchers to generate relatively efficient statistics from the survey given the limitations of their expenditure budget. As, choice-based sampling biases

parameter estimates, a specification that accounts for the endogenous sampling framework would have to be used to prevent this bias.

The *weighted exogenous sampling maximum likelihood* (WESML) specification was developed to correct for choice based sampling (Greene, 2003). The WESML specification maximises a weighted log likelihood function with weights for each choice equal to the ratio of the population proportion to the sample proportion for that choice. This requires knowing the true population parameters, ω_1 and ω_0, as well as the sample proportions of ones and zeroes, p_1 and p_0. The estimator is obtained by maximising a weighted log-likelihood,

$$\ln L = \sum_{i=1}^{n} w_i \ln F\left(q_i \beta' X_i\right) \tag{10}$$

where, $\omega_i = \left(C_{it} = 1\right) * \left(\omega_1 / p_1\right) + \left(C_{it} = 0\right) * \left(\omega_0 / p_0\right)$.

Thus, in order to control for the endogenous sampling framework used, the reduced form *credit programme membership* equation (3) is estimated using the corrected membership weights, which reflect the proportion of members in the population, sampled. The preferred sets of estimates in the subsequent multivariate analysis are the random effects' estimates that have been generated using weights, which correct for the endogenous sampling framework used.

5. Multivariate Analysis

5.1 Food Consumption Models

Policymakers that promote the virtues of credit programmes argue that the credit and non-financial services that credit programmes offer contribute to developing income-generating activities amongst members, which translate into higher expenditure budgets (Hashemi *et al.*, 1996). Members' food shares (per adult equivalent food expenditure as a percentage of per adult equivalent

total expenditure) are hence expected to fall as the income-generating activities increase their total consumption expenditure.[20] Given that food security is a concern among poor Malawian households (Diagne and Zeller, 2001), it is also expected that access to credit will contribute towards increasing the food expenditures of member households. In order for membership to have a positive effect on welfare, it is expected that membership will increase food expenditure but by less than the increase in total consumption expenditure, so ultimately the food share declines.

The *food expenditure* regression results in Tables 4 and 5, and the *food share* regression results in Tables 6 and 7, are presented in four columns; the first column presents estimators that were generated using an *ordinary least square* (OLS) specification on a pooled dataset.[21] The pooled dataset is an amalgamation of three time observations per household, as though there were no time dimension in the dataset. The pooled OLS estimators are biased because of the endogeneity of *credit programme membership*. In column two, the coefficient estimators have been corrected for endogeneity through the use of an instrumental variable; the specification in column two is *two-stage least squares* (2SLS).

A random effects panel model is presented in column three, which controls for the unobserved heterogeneity of households. The random effects estimators attribute the within-household time variation to unobserved heterogeneity. Column four's coefficient estimates account for the choice-based sampling framework used to over-represent the proportion of *member households* in this dataset. Correcting for the endogenous sampling framework generates estimators that are not biased. The random effects estimators in column four are the preferred set of estimators as not only do they control for the

[20] Panjaitan-Drioadisuryo *et al.* (1999) believed their findings in Indonesia confirmed Engel's law that the first and largest investment of income for the poor will be improved quality and quantity of their diet

[21] For ease of interpretation of the coefficients and for universal understanding of the results, the logarithm of *food consumption expenditure* is employed, as one of the food expenditure behaviour dependent variables, rather than the Malawi Kwacha value.

endogeneity of *credit programme membership* and account for the unobservable heterogeneity of households, but also WESML specification is used on the reduced form model for *credit programme membership* to correct for the endogenous sampling framework used. The analysis will hence report the significance and sign on the estimates in column four unless otherwise specified.

Table 4 presents the coefficient membership and gender estimates for the *food expenditure* equation. According to the OLS *membership* coefficient estimate in column one, member households spend 8% less on food than non-members, which we know to be the case from the results depicted in Table 2. The insignificant *membership* estimator in column two suggests that the association of lower *food expenditure* with member households in column one was due to endogenous participation of households in credit programmes. Self-selection of the poorest households into credit programmes may hence explain the lower food expenditure of members exhibited in column one. Ultimately when endogenous take-up, unobservable household heterogeneity and endogenous sampling are all controlled for, membership does not have a significant effect on food expenditure (see Table 4, column four).

Female-headed households spend 12.9% more on food than male-headed households do, according to the statistically significant gender estimate in column four of Table 4. This result is robust even after controlling for endogeneity, heterogeneity and choice-based sampling. The interaction effect of *female headship* and *membership* is only statistically significant after controlling for endogenous participation (see Table 5, column two). The interaction dummy suggests that female-headed member households spend less on food than other types of households. However, this effect is not robust when the unobservable heterogeneity of households is controlled for (Table 5, columns three and four).

In brief, the membership and gender estimates reveal that membership does not significantly affect food expenditure, although the signs on the coefficients in Table 4 suggest a negative relationship exists between membership status and food expenditure. Female-headed households spend, on average, more on food, however it does not appear as though member households with female heads are significantly different in food expenditure behaviour. The membership estimates suggest that credit programme membership was not used to finance food expenditure.

Now we turn to the *food share* findings presented in Tables 6 and 7. The *credit programme membership* estimate presented in column one of Table 5 suggests that member households have significantly lower *food shares*. However, correcting for the endogeneity of programme membership weakens the significance of this estimate (see column two, Table 6). When a random effects' estimation was used the significance of the *membership* estimator was restored (see columns three and four of Table 6). Ultimately, the *membership* coefficient estimates presented in Table 6 show that member households have *food shares* that are 3.2% less than that of non-member households. Table 4 reported that member households did not have significantly different *food expenditures* from non-member households; this result coupled with the lower *food shares* of member households reported in Table 6, suggest that member households' had higher *total consumption expenditures*, and that the credit was used for non-food expenditures.

The insignificant gender estimates in Table 6 suggest that *food shares* do not differ significantly by gender of the household head. Similarly, Table 7 reports that the interaction effect of *female headship* and *membership* is not statistically significant.

In summation, the food share equations reveal that credit programme membership gives member households higher incomes through access to credit, as reflected by their lower food shares, which is used for non-food

consumption. There are no significant differences in food shares by gender of the household head. Together the higher food expenditures of female-headed households and the food shares that do not differ significantly by gender, suggest that the total consumption expenditures of households headed by females are higher than those of households headed by men.

Given that the credit programmes mostly targeted groups organised in some form of enterprise and hence mostly provided 'business' loans as opposed to 'consumption' loans, it is not surprising that food expenditure of member households' was not significantly different from that of non-members. However, the member households' lower food shares may reflect the higher economic status of enterprising members, which allowed members to consume goods other than food and add more goods to the total expenditure budget.

Apart from membership status and gender of the head, other household characteristics, including household *asset values, years of schooling, dependency ratio*, and *location along Lake Malawi*, affected the *food expenditure* and the *food shares.* Households with relatively higher *asset values* spent significantly more on food (see Table 4). This result is robust even after controlling for endogeneity of programmes, heterogeneity of households and choice-based sampling. Panda (1997) also found that in rural Orissa, India, per capita land ownership had a significant and positive influence on the per capita consumption of the household members.

The more educated a household head the lower their *food shares,* according to the *household head's years of schooling* estimate (see Table 6). As earnings and education are positively correlated, the lower food shares may be attributed to the likelihood that heads with more years of schooling are better off, with higher total consumption expenditures, and according to Engel's theory will have lower food shares as the households are enabled to consume more goods other than food. This finding is supported by the literature; Panda's (1997) rural Orissa, India study found that the education of the

household head had a significant and positive effect on the per capita consumption of the household members. Louat *et al* (1993) Jamaica study found that an extra year of schooling for the head raised per capita consumption by about 2.5%.

Household structure has significant implications on *food expenditure* and the *food share* (see Tables 4 and 6). Households with proportionately more dependants than adults have lower *per adult equivalent food expenditure* and higher *per adult equivalent food shares* as one would expect. Panda (1997) and Louat *et al.* (1993) also found that households with relatively more dependants spent significantly less on per capita food expenditure, in their respective India and Jamaica studies.

Households in villages along Lake Malawi have higher *food expenditure* and lower *food shares* than households that are in villages that are not located along the lake. This is attributed to the greater scope for entrepreneurial activities along the lake. Lakeshore households hence have relatively higher total consumption expenditures that they can adequately allocate to food and still have plenty left over to allocate to other household uses.

There are two main results from the *food expenditure* and *food share* regressions. Firstly, credit programme membership does not affect food expenditure per se, but significantly lowers food shares. Member households are hence better off even after controlling for unobservable household heterogeneity and for the endogeneity of the sampling framework used. The result that member households are better off but they do not spend any more on food than non-member households do, suggests that the credit obtained from membership is not been used for food consumption. Secondly, although female heads spend significantly more on food, there is no differential effect of female headship on credit programme membership for food expenditure and for the food share. With regards to membership, it appears as though credit is being used for non-food expenditure across member households, irrespective

of the gender of the household head. And as to female headship, if the objective of the credit programmes was to increase the wealth of female-headed households this has been unsuccessful as the food shares of this group have not changed significantly.

5.2 The Nutritional Status Models

As this paper argues that credit programme membership has the potential to improve household welfare, another area of interest is whether membership translates into better nutritional outcomes for young children, especially as they are more vulnerable to nutritional problems that result from inadequate diets.

The marginal effect coefficients for the child nutrition equations are presented in Tables 8 and 9. Like the *food expenditure* and *food share* results, the child nutrition regression results are presented in four columns. However, instead of a two-stage least squares specification in column two, a *simultaneous two equation probit model* (S2EPM), which is a two-stage specification for binary dependent variables, is used.

Table 8 reports the membership and gender estimates for the nutritional status equations. When only the endogeneity of programme membership is addressed (column two) the membership estimates become statistically significant and they suggest that the probability of member households having *wasted* and *stunted* pre-schoolers is about 12.7% and 11.5% lower, respectively, than it is for non-member households. However, when the unobservable heterogeneity of households and choice-based sampling is controlled for (column four), the *membership* estimate in the *height-for-age* equation loses significance altogether, and the statistical significance of the *membership* estimate in the *weight-for-age* equation weakens. Exploring the interaction effect of *female headship* and *membership* (see Table 9) did not improve the statistical significance of the *credit programme membership* estimate: female-headed member households had no significant effect on the nutritional status of pre-

schoolers. So, there is weak evidence that children in member households have better nutritional outcomes. The food consumption results, which suggested that the credit gained from membership was not being spent on food, may explain the weak effect that membership had on child nutrition in member households.

Pre-schoolers in households headed by females are 8.1% less likely of being *wasted* and 14.6% less likely of being *stunted* after controlling for endogeneity of programme placement (see column two of Table 8). This result is not robust when we control for unobservable heterogeneity and the endogeneity of the sampling framework (column four), although the signs on the coefficients still suggest a negative relationship. Again, there is weak evidence that children in female-headed households have better nutrition and the same holds true for member households with female heads. However, when all inconsistencies have been accounted for (endogeneity and unobservable heterogeneity), female-head households have no significant effect on child nutrition.

The location of households in villages that border Lake Malawi has reduces the probability of having malnourished pre-school children. This statistically significant result corresponds to the food expenditure regression results that reported higher food expenditures for lakeshore households, which indirectly suggests that child nutrition is superior in these households.

Ultimately the child nutrition models show that membership, female headship and participating female heads do not have a statistically significant effect on the nutritional status of pre-school children. However, the coefficients have negative signs suggesting very weak evidence that children in member households or female-headed households have better nutritional outcomes. Location of a household located along Lake Malawi appears to have had a statistically significant robust positive effect on child nutrition.

6. Conclusions

Several studies have examined the impact of credit programme membership on a basket of household goods (Pitt and Khandker, 1998; Swaminathan and Findeis, 2003). However, this study diverged from the mainstream by estimating the effect of programme membership per se, not the loan amount, on the wellbeing of household members. The economic wellbeing of households was measured by food expenditure per adult equivalent and food share per adult equivalent, and anthropometric measures were used to measure the physical wellbeing of a sensitive group of household members, pre-schoolers. Furthermore, this study looked at whether female headship matters when considering the effects of credit programme membership.

The endogeneity of participation in group-based lending programmes was corrected for through IV estimation, a random effects estimation controlled for unobservable household heterogeneity and choice based sampling was accounted for by estimating the reduced form membership equation using a *weighted exogenous sampling maximum likelihood* (WESML) specification. Following these controls, it was found that credit programme membership is significantly associated with lower food shares. However, the food expenditure and child nutrition in member households does not differ significantly from that of non-members. As programme services (loans included) were largely for entrepreneurial use and not for consumption, it is not surprising that membership had no significant effect on food expenditure and child nutrition. The only significant effect that membership had was to economically empower member households with higher income, which is reflected in their lower food shares that show that households were enabled to consume more goods other than food.

The higher per adult equivalent food expenditures in female-headed households supports the gender literature, which argues that female heads allocate more of the household budget towards food (Panjaitan-Drioadisuryo

et al., 1999). However, one would expect the gender estimates in the child nutrition equation to correspondingly show that there is a significantly lower probability of being malnourished in households headed by women, but this is not the case. The reason for this result may be that, on average female-headed households are the poorest of all the households, so even though female-heads may allocate relatively more expenditure to food than their male counterparts, the difference is not big enough to show a significant difference in the physical wellbeing of pre-school children by gender. Furthermore, female-headed households have much higher dependency ratios making the provision of nutrition a more challenging task.

Although, female headship had a positive effect on food expenditure, member households with female heads did not have a significant differential effect on food expenditure, the food share or on child nutrition than any other type of household. If the intention of the micro-credit programmes was to improve food consumption in poor households by targeting female-headed households then this has been unsuccessful. Despite the poor performance of the membership variable and the interaction effect of gender and membership, one observable variable, household is in a village along Lake Malawi, had significant and very robust estimates. Households located along Lake Malawi had higher food expenditures, lower food shares and a lower probability of having malnourished pre-school children.

Ultimately, the one conclusive result is that member households have lower food shares but the same food expenditures thus implying that member households use their credit for non-food expenditures. The robust lakeshore estimate suggests that take-up amongst lakeshore households was relatively higher than that of non-lakeshore households simply because of the greater enterprise opportunities available along the lakeshore which were precisely what some of the programmes were targeting. Since causality has not been established here, it may be that richer lakeshore households predominantly took up membership, which explains the lower food shares, or that

membership exposed households to enterprise opportunities, and thereby economically empowered them, or a mixture of both.

Further study on this topic could seek to explore the causality between membership and consumption expenditure. Extending the survey period studied to longer than 10 months may also establish more significant differences in the effects of membership as a longer period would allow for more significant shifts in nutritional outcomes to occur.

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TABLE 1: A COMPARATIVE ANALYSIS OF THE NUTRITIONAL STATUS OF PRE-SCHOOL CHILDREN IN MALE-HEADED HOUSEHOLDS AND FEMALE-HEADED HOUSEHOLDS

AUTHORS	COUNTRY	DATE	MEASURE	RESULT	
				Male-headed HH	Female-headed HH
Kennedy and Peters	Kenya	1992	W/A	-1.07	-0.87*
			H/A	-1.66	-1.41*
			W/H	-0.06	-0.01
Kennedy and Peters	Malawi	1992	W/A	-1.45	-1.38
			H/A	-2.41	-2.31
			W/H	-0.06	-0.05
Duflo, E.	South Africa	2000	H/A	-1.46	-1.38
			W/A	0.12	0.28
Louat, Grosh and van der Gaag	Jamaica	1993	W/A	-0.14	-0.29
			H/A	-0.05	-0.25*
			W/H	-0.14	-0.13
Rogers, B. L.	Dominican Republic	1996	H/A	-0.97	-0.98
			W/H	0.06	-0.02
This Study	Malawi	2004	W/A	-0.84	-0.70
			H/A	-2.04	-1.72*
			W/H	0.25	0.22

Notes

1. The asterisk indicates that the Z-scores of pre-school children in female-headed household are significantly different from the Z-scores of pre-schoolers in male-headed households at the five percent level of significance.
2. W/A abbreviates for *Weight-for-Age Z-scores*, H/A abbreviates for *Height-for-Age Z-scores* and W/H abbreviates for *Weight-for-Height Z-scores*.

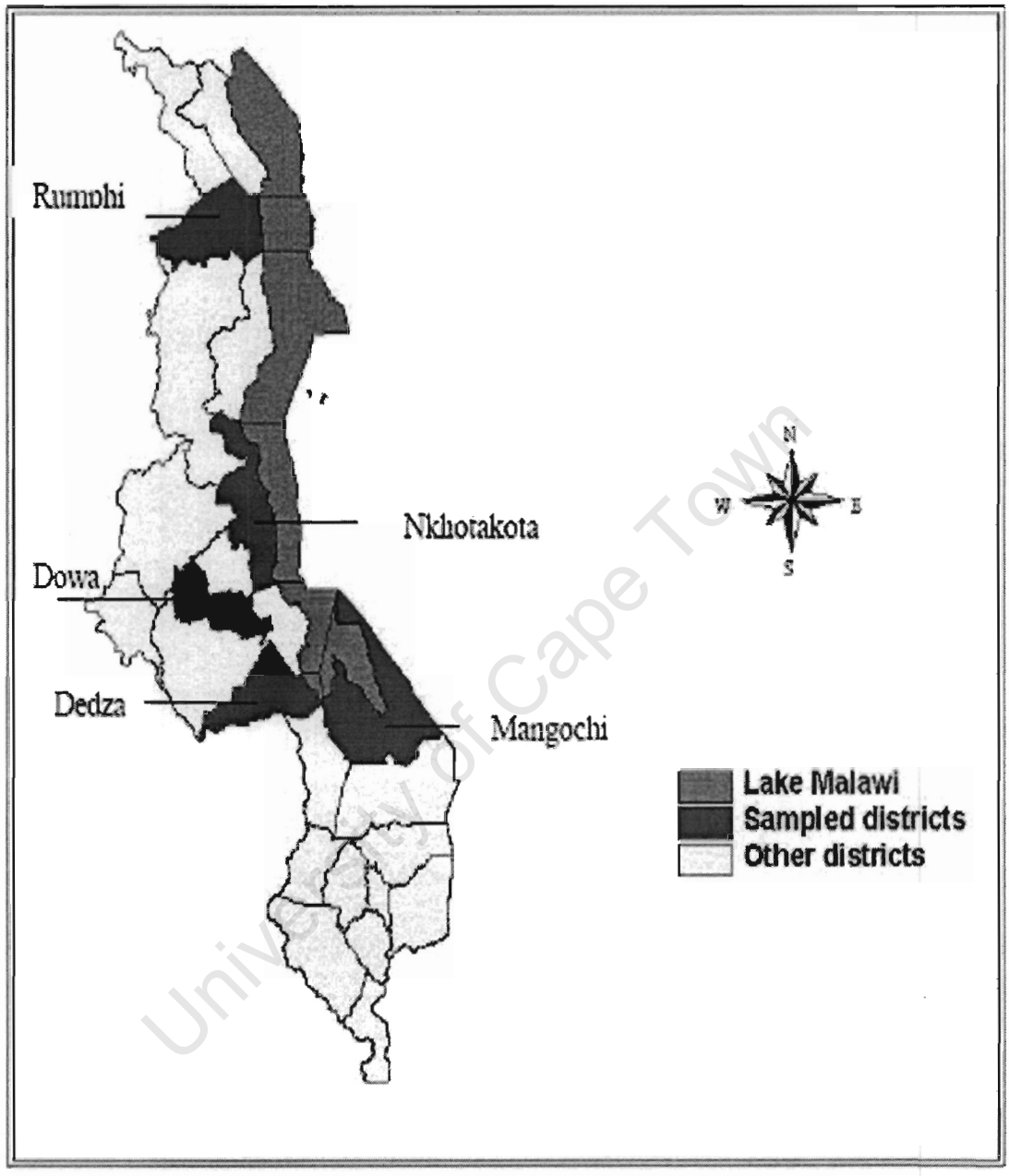

FIGURE 1: LOCATION OF THE IFPRI RURAL FINANCE SURVEY SITES

Source:
Franklin Simtowe, Graduate student and Research Analyst, Rural Development Department, Bunda College of Agriculture.

TABLE 2: COMPARATIVE ANALYSIS OF MEAN VALUES HOUSEHOLD CHARACTERISTICS BY GENDER OF HOUSEHOLD HEAD AND BY MEMBERSHIP STATUS

Variables	*Gender of Household Head*			*Credit Program Membership*			*ONLY MEMBERS split by Gender of Household Head*		
	MHH (β_1)	*FHH* (β_2)	β_1-β_2=0 *t-stat*	*Member* (β_3)	*Non-Member* (β_4)	β_3-β_4=0 *t-stat*	*MHH* (β_1)	*FHH* (β_2)	β_5-β_6=0 *t-stat*
Household Structure:									
No. of HHs in sample:	273	104		646	485		481	165	
Household Size	5.45	4.72	4.80	5.73	4.61	8.28	5.87	5.33	2.72
Household (AE) Population:	4.34	3.62	5.91	4.52	3.62	8.35	4.67	4.11	3.48
Dependency Ratio: (population<15 and >64)/Household size	0.49	0.52	-1.96	0.51	0.48	2.64	0.51	0.51	-0.14
Daily Adult Equivalent Consumption Expenditure:									
Per AE food expenditure:	4.67	5.27	-2.63	4.81	4.87	-0.30	4.68	5.21	-1.78
Per AE Food Share	0.86	0.88	-1.81	0.86	0.88	-3.53	0.85	0.89	-1.18
Per AE Total Consumption Expenditure	5.53	6.01	-1.77	5.69	5.62	0.30	5.59	5.99	-1.12
Income:									
Total Income 94/95:	1256.9	1006.5	2.43	1425.8	870.87	6.06	1496.8	1218.9	1.79
Assets:									
Total Value of All Assets in 1995:	2474.2	1747.5	2.25	2717.4	1682.80	3.58	2960.3	2009.5	1.88
Value of Land, 1995:	4490.5	3402.9	1.75	5457.8	2502.43	5.32	5803.3	4450.8	1.25
Housing Amenity:									
Have Pit Latrine (%)	82	77	2.10	84	77	2.82	86	78	2.25
Use Iodised Salt	51	47	1.03	53	45	2.84	52	58	-1.47
Distance from House to Paediatric Clinic	3.96	3.10	3.74	3.50	4.02	-2.51	3.56	3.33	0.76
Years of Schooling:									
Years of Schooling of Head:	4.50	3.39	5.08	4.57	3.68	4.61	4.81	3.93	2.94
Years of Schooling of Spouse:	3.03	3.45	-2.10	3.33	2.89	2.42	3.13	3.93	-2.92
Anthropometrics[3] (children under age six only):									
W/A Z-scores:	-0.84	-0.70	-1.28	-0.77	-0.88	1.21	-0.78	-0.70	-0.60
H/A Z-scores:	-2.04	-1.72	-2.07	-1.94	-1.98	0.27	-1.94	-1.94	-0.02
W/H Z-scores:	0.25	0.22	0.22	0.32	0.12	2.08	-0.31	-0.35	-0.31
% of HHs with Child Malnutrition									
W/A Z-score < -2:	15.7	13.1	0.60	14.1	15.2	-0.37	13.8	15.0	-0.30
H/A Z-score < -2:	53.9	49.4	1.03	51.4	53.6	-0.55	51.2	51.6	-0.06
W/H Z score < -2:	3.3	3.8	-0.29	2.5	4.8	-1.59	2.2	3.2	-0.56

Notes

1. Computed t-statistics that exceed 1.64 imply that the respective household statistics are significantly different at the 10% level.
2. Consumption expenditure is expressed in Malawi Kwacha
3. AE is an abbreviation for the expression Adult Equivalent.
4. HH is an abbreviation for Household(s), MHH abbreviates for Male-headed Household(s), and FHH abbreviates for Female-headed Household (s).
5. As households were credit programme members in some periods and non-members in other periods the *number of households* variable reports the number of households in the 'pooled sample' that were members.
6. The dataset did not have Z-scores for individual children under the age of six. Instead, the average Z-score of pre-school children in a household was reported as the nutritional status of the average pre-schooler in a given household.
7. *Member households* are households that have at least one person over the age of 17 that is a member of a credit programme.

TABLE 3: A DISCUSSION OF THE SET OF VARIABLES THAT ARE INCLUDED IN THE X_{ij} MATRIX OF HOUSEHOLD CHARACTERISTICS

THE X_{ij} MATRIX VARIABLES	MOTIVATION BEHIND THE USE OF THESE VARIABLES	SPECIFICATIONS THAT INCLUDE THIS VARIABLE
Total Value of Household Assets Owned	The wealth of the household is proxied by this variable. It is expected that the wealthier a household is the higher the consumption expenditure that is allocated towards food. The logarithm of this variable is used in the specification, so the estimated parameter for this variable reveals the percentage effect of a 1% change in the value of assets owned.	• Food Consumption Expenditure
Per Adult Equivalence Total Consumption Expenditure	The specification of food share (food consumption expenditure as a proportion of total consumption expenditure) equations include total consumption expenditure so that the effect of a one unit change in total consumption expenditure on the food share, all other factors being equal, can be estimated. According to Engel curve theory, there is a negative relationship between the two variables because households with higher total consumption expenditures spend a smaller proportion of that expenditure on food.	• Food Share
Total Value of Household Land owned/10000	This variable is employed to proxy for the wealth of a household in the food share equations. This variable was employed instead of the value of household assets in the food share equations because of a mis-specification when the latter variable was used. This variable was divided by a factor of 10,000 to increase the magnitude of the effect of this variable otherwise as is it was negligible.	• Food Share
Age of Household Head	This demographic variable was used as a regressor to determine whether the age of the household head affected food expenditure, the food share or the nutritional status of children in a household in any way. If this parameter is found to be statistically significant, the vulnerable households can be identified and social policy tailored to suit the segment of households of a certain age group that have relatively lower food expenditures or high incidences of malnutrition. The squared value of this variable is used to test for a quadratic relationship between the age of the head and the outcome variables.	• Food Consumption Expenditure • Food Share • Nutritional Status of Pre-schoolers
Female-Headed Household	One of the central questions in this study is the impact of the gender of the household head on food expenditure, on the food share and on the nutritional status of young children. There is evidence in the literature that households headed by women allocate relatively more expenditure towards food, which manifests in better nourished pre-schoolers. This variable is employed here to test this hypothesis.	• Food Consumption Expenditure • Food Share • Nutritional Status of Pre-schoolers
Years of Schooling of the Household Head	The head's years of schooling proxies for human capital, and is used to test the hypothesis that human capital is positively related to income; so households with relatively more educated heads have lower food shares. If the parameter on the education variable is statistically significant and positive, then it can be inferred that consumption expenditure increases as years of education do, and also that the head with relatively more years of schooling has a higher absolute value of food consumption expenditure. Following the same line of argument, it is expected that households with relatively higher food expenditures are less likely to have pre-school children with malnutrition. The squared value of years of schooling is also employed as a regressor to test whether the relationship between years of schooling and food expenditure is quadratic.	• Food Consumption Expenditure • Food Share • Nutritional Status of Pre-schoolers
Dependency Ratio (population<15 and >64)/Household size	It is expected that the more dependants in a household relative to the active population, the higher the food share, the lower the food expenditure per adult equivalent in that household and the higher the likelihood that pre-schoolers in that household have malnutrition.	• Food Consumption Expenditure • Food Share • Nutritional Status of Pre-schoolers
Village bordering Lake Malawi	The fishing industry and tourism along the lakeshore generates relatively higher incomes for villages located there. It is hence expected that the consumption expenditures of those households will be relatively higher so they are able to allocate more expenditure to food, and their food expenditure as a proportion of total consumption expenditure is expected to be relatively lower because lakeshore households have more income for other consumption expenditures. Accordingly, pre-schoolers in lakeshore households are expected to have a lower probability of having malnutrition.	• Food Consumption Expenditure • Food Share • Nutritional Status of Pre-schoolers
Household has a Latrine	The disposal of effluent is likely to affect the nutritional status of pre-schoolers. Households that do not have a latrine are expected to have a lower probability of having malnourished children.	• Nutritional Status of Pre-schoolers
Household uses Iodised Salt	Households that do not have iodised salt are missing nutrients in their diets and are hence likely to have malnourished children.	• Nutritional Status of Pre-schoolers
Distance to Under 5 Clinic	It is expected that households that are relatively closer to clinics for pre-school children have a lower probability of being malnourished, as it is inferred that the proximity of the clinic implies that the household has access and hence is more likely to prevent unhealthy conditions from advancing.	• Nutritional Status of Pre-schoolers

- *Female-headed household* is a dummy variable that takes on a value of 1 if the household has a female head and 0 otherwise.
- *Village bordering Lake Malawi* is a dummy variable that takes on a value of 1 if the household is in a village that borders Lake Malawi and 0 otherwise.
- *Household has a Latrine* is a dummy variable that takes on a value of 1 if the household has a latrine and 0 otherwise.
- *Household uses Iodised Salt* is a dummy variable that takes on a value of 1 if the household uses iodised salt and 0 otherwise.

TABLE 4: FOOD CONSUMPTION EXPENDITURE ESTIMATION (2SLS ESTIMATES)

DEPENDENT VARIABLE: PER AE FOOD EXPENDITURE	POOLED OLS	POOLED 2SLS		PANEL 2SLS		PANEL 2SPLS (CBS)	
INDEPENDENT VARIABLES	Log of Food Expenditure	Log of Food Expenditure	Reduced Form Membership Equation (MLE)	Log of Food Expenditure	Reduced Form Membership Equation	Log of Food Expenditure	Reduced Form Membership Equation
Household is a Member of a Credit Programme	-0.08** (2.12)	0.035 (0.61)		0.04 (0.79)		-0.109 (1.37)	
Distance to Government Office			-0.018*** (-3.25)		-0.198*** (-4.68)		-0.075** (-2.17)
Log of Total Household Income 1995	0.054*** (3.61)	-0.012 (-0.50)		-0.012 (0.52)		-0.012 (-0.49)	
Log of Total Value of Household Assets Owned	0.163*** (8.17)	0.182*** (7.92)	0.176*** (4.08)	0.187*** (8.54)	-0.119 (-0.80)	0.186*** (8.48)	0.018 (0.10)
Age of Household Head	-0.029*** (-3.93)	-0.035*** (-3.81)	0.106*** (6.34)	-0.034*** (-4.16)	0.577*** (6.64)	-0.029*** (-3.84)	0.483*** (5.68)
Age of Household Head Squared	0.0002*** (3.28)	0.0003*** (3.28)	-0.001*** (-5.83)	0.0003*** (3.56)	-0.005*** (-6.17)	0.0003*** (3.31)	-0.004*** (-5.15)
Female-Headed Household	0.118* (1.64)	0.136*** (1.87)	-0.171 (-1.08)	0.152*** (1.97)	-3.23*** (-2.76)	0.129* (1.76)	-1.78* (-1.74)
Years of Schooling of Household Head	-0.032 (-1.61)	-0.033* (-1.63)	0.068 (1.56)	-0.031 (1.55)	-0.004 (-0.02)	-0.028 (-1.38)	0.954 (1.57)
Years of Schooling of Female Household Head	0.016 (0.40)	0.02 (0.50)	-0.016 (-0.18)	0.016 (0.40)	0.397 (0.83)	0.022 (0.54)	0.383** (2.06)
Years of Schooling of Household Head Squared	0.003* (1.82)	0.004* (1.93)	-0.005 (-1.21)	0.004* (1.85)	-0.003 (-0.15)	0.003* (1.73)	-0.03 (-1.23)
Years of Schooling of Female Household Head Squared	-0.002 (0.43)	-0.003 (-0.63)	0.006 (0.65)	-0.003 (-0.59)	0.035 (0.74)	-0.003 (-0.59)	-0.069 (-1.42)
Dependency Ratio (population <15 and >64)/Household Size	-0.257*** (-3.15)	-0.277*** (-3.15)	0.68*** (3.73)	-0.27*** (-3.23)	2.01*** (2.84)	-0.271*** (-3.27)	-0.199 (-0.31)
Village Bordering Lake Malawi	0.23*** (5.77)	0.203*** (4.92)	0.124 (1.36)	0.196*** (4.58)	1.35*** (3.62)	0.232*** (5.45)	2.43*** (4.93)
∂Dependent Variable/∂Female Household Head	0.168	0.203		0.196		0.196	
R-Squared (or Pseudo R-Squared)	0.18	0.16	0.08	0.16	0.46	0.15	
F-stat (or Chi-squared)	21.02***	19.55***	125.15***	18.45***	662.95***	17.81***	173.80***
Observations	1131	1131	1131	1131	1131	1131	1131

Notes:

A single asterisk indicates significance at the 10 percent level, a double asterisk indicates significance at the 5 percent level, and three asterisks indicate significance at the 1 percent level. The computed t-statistics are given in parentheses. The dependent variable is the welfare indicator, *per adult equivalent food consumption expenditure*. The reduced form equation's reported coefficients are maximum likelihood estimates.

- *Household is a Member of a Credit Programme* is a dummy variable that takes on a value of 1if the household has a credit programme member and 0 otherwise.
- *Female-headed household* is a dummy variable that takes on a value of 1if the household has a female head and 0 otherwise.
- *Village bordering Lake Malawi* is a dummy variable that takes on a value of 1if the household is in a village that borders Lake Malawi and 0 otherwise.

TABLE 5: FOOD CONSUMPTION EXPENDITURE ESTIMATION (2SLS ESTIMATES)

DEPENDENT VARIABLE: PER AE FOOD EXPENDITURE	POOLED OLS	POOLED 2SPLS		PANEL 2SPLS		PANEL 2SPLS (CBS)[23]	
INDEPENDENT VARIABLES	Log of Food Expenditure	Log of Food Expenditure	Reduced Form FHH Membership Equation	Log of Food Expenditure	Reduced Form FHH Member Equation	Log of Food Expenditure	Reduced Form FHH Membership Equation
Household is a Member of a Credit Programme	-0.058 (-1.31)	0.063 (1.05)		0.049 (0.95)			
Female HH Head is a Member of a Credit Programme	-0.079 (-0.99)	-0.147* (-1.77)		0.083 (1.09)			
Distance from average FHH to Government Office			-0.033*** (-3.05)		0.682*** (4.64)		
Log of Total Household Income 1995	0.055*** (3.67)	-0.009 (-0.38)		-0.011 (-0.45)			
Log of Total Value of Household Assets Owned	0.162*** (8.11)	0.181*** (7.85)	0.086 (1.02)	0.186*** (8.51)	-0.041 (-0.11)		
Age of Household Head	-0.03*** (-4.00)	-0.037*** (-4.02)	0.035 (1.20)	-0.036*** (-4.27)	0.08 (0.55)		
Age of Household Head Squared	0.0003*** (3.35)	0.0003*** (3.52)	-0.0002 (-0.74)	0.0003*** (3.67)	-0.0003 (-0.17)		
Female-Headed Household	0.154* (1.91)	0.196** (2.44)	8.38 (0.00)	0.134** (1.69)			
Years of Schooling of Household Head	-0.032* (-1.66)	-0.035* (-1.77)	-0.004 (0.00)	-0.031 (-1.55)	0.315 (0.66)		
Years of Schooling of Female Household Head	0.017 (0.43)	0.029 (0.72)	0.073 (0.00	0.013 (0.31)			
Years of Schooling of Household Head Squared	0.003* (1.84)	0.004** (1.99)	-0.00006 (0.00)	0.004* (1.84)	-0.003 (-0.08)		
Years of Schooling of Female Household Head Squared	-0.002 (-0.40)	-0.003 (-0.60)	0.001 (0.00)	-0.002 (-0.52)			
Dependency Ratio (population <15 and >64)/Household Size	-0.263*** (-3.22)	-0.294*** (-3.32)	0.046 (0.14)	-0.269*** (-3.20)	-0.728 (-0.38)		
Village Bordering Lake Malawi	0.232*** (5.81)	0.218*** (5.19)	0.337* (1.90)	0.189*** (4.33)	4.03*** (2.95)		
∂Dependent Variable/∂Credit Programme Membership	-0.137	-0.084		0.132			
∂Dependent Variable/∂Female Household Head	-0.130	0.146		0.255			
R-Squared (or Pseudo R-squared)	0.18	0.17	0.58	0.15	0.53		
F-stat/Chi-squared	19.48***	18.32***	544.51***	18.92***	409.44***		
Observations	1131	1131	1131	1131	1131		

Notes:
A single asterisk indicates significance at the 10 percent level, a double asterisk indicates significance at the 5 percent level, and three asterisks indicate significance at the 1 percent level. The computed t-statistics are given in parentheses. The dependent variable is the welfare indicator, *per adult equivalent food consumption expenditure*. The estimation for column 4 was abandoned because after correcting for choice-based sampling, the coefficient estimate on the instrumental variable, *distance from FHH to government office* was statistically insignificant. The reduced form equation's reported coefficients are maximum likelihood estimates.

- *Household is a Member of a Credit Programme* is a dummy variable that takes on a value of 1if the household has a credit programme member and 0 otherwise.
- *Female household head is a Member of a Credit Programme* is a dummy variable that takes on a value of 1if the household has a credit programme member and 0 otherwise.
- *Female-headed household* is a dummy variable that takes on a value of 1if the household has a female head and 0 otherwise.
- *Village bordering Lake Malawi* is a dummy variable that takes on a value of 1if the household is in a village that borders Lake Malawi and 0 otherwise.

TABLE 6: FOOD SHARE ESTIMATION (2SLS ESTIMATES)

DEPENDENT VARIABLE: PER AE FOOD SHARE	Pooled OLS	Pooled 2SPLS		Panel 2SPLS		Panel 2SPLS (CBS)	
INDEPENDENT VARIABLES	Food Share	Food Share	Reduced Form Membership Equation (MLE)	Food Share	Reduced Form Membership Equation (MLE)	Food Share	Reduced Form Membership Equation (MLE)
Household is a Member of a Credit Programme	-0.022*** (-2.85)	-0.014 (-1.23)		-0.016* (-1.63)		-0.032** (-2.04)	
Distance to Government Office			-0.017*** (-3.10)		-0.332*** (-7.02)		-0.073* (-1.92)
Log of Per AE Total Consumption Expenditure	-0.004 (-0.65)	-0.004 (-0.62)	-0.002 (-0.03)	-0.004 (-0.70)	-0.521** (-2.06)	-0.005 (-0.76)	-0.117 (-0.54)
Total Value of Household Land Owned/10000	-0.008** (-2.04)	-0.009** (-2.22)	0.662*** (5.28)	-0.01** (-2.36)	2.46*** (5.56)	-0.006 (-1.08)	3.71*** (5.63)
Age of Household Head	0.004** (2.43)	0.004** (2.32)	0.099*** (5.85)	0.003** (2.21)	0.461*** (5.61)	0.003** (2.03)	0.182** (2.04)
Age of Household Head Squared	-0.00003** (-2.03)	-0.00003** (-2.01)	-0.0009*** (-5.32)	-0.00003* (-1.82)	-0.004*** (-4.97)	-0.00003* (-1.63)	-0.001 (-1.37)
Female-Headed Household	0.004 (0.35)	0.002 (0.19)	-0.276** (-2.02)	0.004 (0.28)	-1.95** (-2.47)	0.004 (0.32)	-3.01*** (-2.91)
Years of Schooling of Household Head	-0.003** (-2.14)	-0.003** (-2.07)	0.047 (0.93)	-0.002 (-1.59)	0.195*** (4.70)	-0.003** (-2.25)	0.123** (2.00)
Years of Schooling of Female Household Head	0.002 (0.62)	0.002 (0.73)	0.014 * (1.64)	0.002 (0.65)	0.349 (1.20)	0.002 (0.70)	0.475*** (2.74)
Dependency Ratio (population <15 and >64)/Household Size	0.029* (1.72)	0.031* (1.75)	0.561*** (3.07)	0.027* (1.62)	1.15*** (1.71)	0.025 (1.47)	0.535 (0.79)
Village Bordering Lake Malawi	-0.05*** (-6.05)	-0.049*** (-5.72)	0.139 (1.49)	-0.046*** (-4.99)	1.98*** (5.16)	-0.047*** (-5.41)	2.91*** (4.75)
∂Dependent Variable/∂Female Household Head	0.012	0.010		0.012		0.012	
R-Squared (Pseudo R-squared)	0.08	0.07	0.10	0.07	0.45	0.06	0.21
F-stat (Chi-squared)	10.23***	9.51***	147.63***	10.05***	627.48***	7.91***	187.24***
Observations	1131	1131	1131	1131	1131	1131	1131

Notes:

A single asterisk indicates significance at the 10 percent level, a double asterisk indicates significance at the 5 percent level, and three asterisks indicate significance at the 1 percent level. The computed t-statistics are given in parentheses. The dependent variable is the welfare indicator, *per adult equivalent food share* (*per adult equivalent food expenditure* as a percentage of *per adult equivalent total expenditure*). The reduced form equation's reported coefficients are maximum likelihood estimates.

- *Household is a Member of a Credit Programme* is a dummy variable that takes on a value of 1if the household has a credit programme member and 0 otherwise.
- *Female-headed household* is a dummy variable that takes on a value of 1if the household has a female head and 0 otherwise.
- *Village bordering Lake Malawi* is a dummy variable that takes on a value of 1if the household is in a village that borders Lake Malawi and 0 otherwise.

TABLE 7: FOOD SHARE ESTIMATION (2SLS ESTIMATES)

DEPENDENT VARIABLE: PER AE FOOD SHARE	POOLED OLS	POOLED 2SPLS		PANEL 2SPLS		PANEL 2SPLS (CBS)	
INDEPENDENT VARIABLES	Food Share	Food Share	Reduced Form FHH Membership Equation	Food Share	Reduced Form FHH Membership Equation	Food Share	Reduced Form FHH Member Equation
Household is a Member of a Credit Programme	-0.024** (-2.65)	-0.01 (-0.83)		-0.015 (-1.47)		-0.025 (-1.44)	
Female HH Head is a Member of a Credit Programme	-0.007 (0.43)	-0.016 (-0.87)		0.004 (0.29)		0.109 (1.38)	
Distance from average FHH to Government Office			-0.03*** (-2.70)		0.997*** (3.18)		0.746 (1.54)
Log of Per AE Total Consumption Expenditure	-0.004 (-0.64)	-0.004 (-0.68)	-0.067 (-0.58)	-0.004 (-0.69)	-0.854 (-1.20)	-0.004 (-0.68)	-1.90* (-1.81)
Total Value of Household Land Owned/10000	-0.008** (-2.03)	-0.009** (-2.22)	0.698*** (2.85)	-0.01** (-2.34)	0.01 (0.01)	-0.012* (-1.72)	-1.34 (-0.89)
Age of Household Head	0.004** (2.46)	0.004** (2.11)	0.033 (1.12)	0.003* (2.16)	0.201 (1.19)	0.003** (1.97)	-0.145 (-0.30)
Age of Household Head Squared	-0.00003** (-2.06)	-0.00003* (-1.79)	-0.0002 (-0.77)	-0.00003* (-1.77)	-0.002 (-1.17)	-0.00003 (-1.60)	0.002 (0.33)
Female-Headed Household	0.001 (0.08)	0.008 (0.55)	8.65 (0.00)	0.001 (0.10)		0.005 (0.35)	
Years of Schooling of Household Head	-0.003** (-2.11)	-0.003** (-2.15)	0.842 (0.00)	-0.002 (-1.61)	0.348** (1.99)	-0.003** (-2.13)	0.939 (1.21)
Years of Schooling of Female Household Head	0.001 (0.53)	0.003 (1.03)	-0.775 (0.00)	0.002 (0.68)		0.001 (0.58)	
Dependency Ratio (population <15 and >64)/Household Size	0.029* (1.75)	0.028 (1.56)	0.004 (0.01)	0.027 (1.62)	-0.898 (-0.57)	0.025 (1.44)	2.40 (0.81)
Village Bordering Lake Malawi	-0.051*** (-6.07)	-0.048*** (-5.55)	0.275 (1.57)	-0.046*** (-4.96)	4.37** (-2.47)	-0.048*** (-5.28)	6.94 (1.43)
∂Dependent Variable/∂Credit Programme Membership	-0.031	-0.026		-0.011		0.084	
∂Dependent Variable/∂Female Household Head	-0.002	0.005		0.005		0.10	
R-Squared (or Pseudo R-Squared)	0.07	0.07	0.59	0.07	0.54	-0.14	0.28
F-stat/Chi-Squared	9.31***	8.71***	553.51***	9.10***	419.82***	-	60.04***
Observations	1131	1131	1131	1131	1131	1131	1131

Notes:

A single asterisk indicates significance at the 10 percent level, a double asterisk indicates significance at the 5 percent level, and three asterisks indicate significance at the 1 percent level. The computed t-statistics are given in parentheses. The dependent variable is the welfare indicator, *per adult equivalent food share* (*per adult equivalent food expenditure* as a percentage of *per adult equivalent total expenditure*). The reduced form equation's reported coefficients are maximum likelihood estimates.

- *Household is a Member of a Credit Programme* is a dummy variable that takes on a value of 1if the household has a credit programme member and 0 otherwise.
- *Female household head is a Member of a Credit Programme* is a dummy variable that takes on a value of 1if the household has a credit programme member and 0 otherwise.
- *Female-headed household* is a dummy variable that takes on a value of 1if the household has a female head and 0 otherwise.
- *Village bordering Lake Malawi* is a dummy variable that takes on a value of 1if the household is in a village that borders Lake Malawi and 0 otherwise.

TABLE 8: NUTRITIONAL STATUS OF PRE-SCHOOL CHILDREN ESTIMATION (PROBIT ESTIMATES – MARGINAL EFFECTS)

DEPENDENT VARIABLES (W/A AND H/A Z-SCORES): $P(N_i=1)$	POOLED PROBIT		POOLED *S2EPM*			PANEL *S2EPM*			PANEL *S2EPM* (CBS)		
INDEPENDENT VARIABLES	W/A Nutritional Status	H/A Nutritional Status	W/A Nutritional Status	H/A Nutritional Status	Reduced Form Membership Equation	W/A Nutritional Status	H/A Nutritional Status	Reduced Form Membership Equation	W/A Nutritional Status	H/A Nutritional Status	Reduced Form Membership Equation
Household is Member of a Credit Programme	-0.012 (-0.39)	-0.005 (-0.11)	-0.127** (-2.24)	-0.115* (-1.69)		-0.017 (-1.49)	0.005 (0.32)		-0.028 (-1.49)	0.009 (0.32)	
Distance to Government Office					-0.018*** (-3.30)			-0.239*** (-6.48)			-0.144** (-3.84)
Total Household Income 1995	-0.168 (-1.58)	-0.119 (-0.87)	-0.233 (-1.60)	-0.035 (-0.22)		-0.195 (-0.99_2)	-0.035 (-0.13)		-0.195 (-0.99)	-0.035 (-0.13)	
Age of Household Head	0.003*** (3.16)	0.005*** (2.74)	0.005*** (3.97)	0.006*** (3.38)	0.012*** (4.25)	0.005*** (2.70)	0.003 (1.37)	0.098*** (6.19)	0.004*** (2.73)	0.004 (1.59)	0.042*** (3.07)
Female-Headed Household	-0.061 (-1.35)	-0.118 (-1.59)	-0.081* (-1.91)	-0.146* (-1.93)	-0.353*** (-2.62)	-0.055 (-0.74)	-0.081 (-0.88)	-0.541 (-0.75)	-0.082 (-1.05)	-0.072 (-0.74)	-1.31* (-1.85)
Years of Schooling of Household Head	0.006 (1.25)	-0.006 (0.85)	0.013** (2.26)	-0.002 (-0.28)	0.022 (1.51)	0.013* (1.65)	-0.008 (-0.75)	0.212*** (3.68)	0.014* (1.70)	-0.009 (-0.75)	0.317** (2.39)
Years of Schooling of Female Household Head	0.011 (1.15)	0.017 (1.18)	0.015 (1.53)	0.02 (1.49)	0.058** (2.08)	0.011 (0.86)	0.01 (0.57)	0.23*** (1.69)	0.016 (1.14)	0.008 (0.44)	0.168*** (2.67)
Dependency Ratio (population <15 and >64)/Household Size	-0.193** (-2.03)	-0.283* (-1.92)	-0.156 (-1.62)	-0.248 * (1.66)	0.443** (2.55)	-0.166 (-1.52)	-0.35** (-2.03)	2.16*** (3.16)	-0.164 (-1.50)	-0.352** (-2.02)	1.38** (1.97)
Household has a Latrine	-0.042 (-1.10)	-0.088* (-1.70)	0.012 (0.34)	-0.059 (-1.06)	0.334*** (3.32)	-0.03 (-0.71)	-0.082 (-1.16)	1.55*** (3.28)	-0.018 (-0.41)	-0.086 (-1.15)	1.39** (2.47)
Household uses Iodised Salt	0.012 (0.42)	0.01 (0.22)	0.026 (0.87)	0.025 (0.54)	0.16* (1.91)	0.033 (0.89)	0.011 (0.19)	1.31*** (3.78)	0.039 (1.03)	0.009 (0.14)	1.04** (2.53)
Distance to Under 5 Clinic	-0.004 (-1.04)	0.001 (0.21)	-0.009** (-1.98)	-0.002 (-0.35)	-0.013 (-1.09)	-0.009 (-1.52)	0.001 (0.11)	-0.148*** (-2.74)	-0.008 (-1.42)	0.0004 (0.06)	-0.036 (-0.57)
Village bordering Lake Malawi	-0.098*** (-3.58)	-0.16*** (-3.50)	-0.069** (-2.25)	-0.128** (-2.55)	0.336*** (3.73)	-0.083* (-1.87)	-0.164*** (-2.62)	0.411 (1.23)	-0.047 (-0.88)	-0.176** (-2.16)	1.59*** (3.66)
∂Dependent Variable/∂Female Household Head	-0.050	-0.101	-0.066	-0.126		-0.044	-0.071		-0.066	-0.064	
Pseudo R-squared	0.06	0.03	0.07	0.04	0.06	0.05	0.05	0.46	0.05	0.05	0.21
Chi-squared	32.53***	28.78***	38.43***	30.78**	94.18***	24.15***	44.88***	666.68***	24.15***	44.88***	194.75***
Observations	618	618	618	618	1131	618	618	1131	618	618	1131

Notes:

A single asterisk indicates significance at the 10 percent level, a double asterisk indicates significance at the 5 percent level, and three asterisks indicate significance at the 1 percent level. The computed t-statistics are given in parentheses. The child nutrition measures, *weight-for-age* (W/A) *Z-scores* and *height-for-age* (H/A) *Z-scores*, are the latent variables used to create the categorical nutritional status variables. Z-scores less than -2 are given a dummy value of 1 to represent a malnourished state, and Z-scores equal to and greater than -2 are given a dummy value of 0. The reported coefficients represent the marginal effects measured at the mean value of all covariates conditional upon the nutritional status indicator being set equal to 1. The reduced form equation's reported coefficients are maximum likelihood estimates.

- *W/A Nutritional Status* is a dummy variable that takes on a value of 1 if the household has at least one pre-schooler that is chronically malnourished.
- *H/A Nutritional Status* is a dummy variable that takes on a value of 1 if the household has at least one pre-schooler that is acutely malnourished.
- *Household is a Member of a Credit Programme* is a dummy variable that takes on a value of 1if the household has a credit programme member and 0 otherwise.
- *Female-headed household* is a dummy variable that takes on a value of 1if the household has a female head and 0 otherwise.
- *Household has a Latrine* is a dummy variable that takes on a value of 1if the household has a latrine and 0 otherwise.
- *Household uses Iodised Salt* is a dummy variable that takes on a value of 1if the household uses iodised salt and 0 otherwise.
- *Village bordering Lake Malawi* is a dummy variable that takes on a value of 1if the household is in a village that borders Lake Malawi and 0 otherwise.

TABLE 9: NUTRITIONAL STATUS OF PRE-SCHOOL CHILDREN ESTIMATION (PROBIT ESTIMATES -- MARGINAL EFFECTS)

DEPENDENT VARIABLES (W/A AND H/A Z-SCORES): $P(N_i=1)$	POOLED PROBIT		POOLED *S2EPM*			PANEL *S2EPM*			PANEL *S2EPM* (CBS)		
INDEPENDENT VARIABLES	W/A Nutritional Status	H/A Nutritional Status	W/A Nutritional Status	H/A Nutritional Status	Reduced Form Membership Equation	W/A Nutritional Status	H/A Nutritional Status	Reduced Form Membership Equation	W/A Nutritional Status	H/A Nutritional Status	Reduced Form Membership Equation
Household is Member of a Credit programme	-0.016 (-0.48)	-0.018 (-0.36)	-0.143** (-2.42)	-0.138** (-1.99)		-0.019 (-1.35)	0.002 (0.10)		-0.031 (-1.35)	0.003 (0.10)	
Female HH Head is a Member of a Credit Programme	0.021 (0.28)	0.058 (0.57)	0.109 (1.13)	0.15 (1.61)		-0.001 (-0.37)	0.001 (-0.44)		-0.007 (-0.37)	-0.014 (-0.44)	
Distance from average FHH to Government Office					-0.037*** (-3.12)			2.76*** (2.77)			0.328*** (2.90)
Total Household Income 1995	-0.169 (-1.59)	-0.124 (-0.90)	-0.234 (-1.61)	-0.034 (-0.22)		-0.195 (-0.98)	-0.035 (-0.13)		-0.195 (-0.98)	-0.035 (-0.13)	
Age of Household Head	0.003*** (3.06)	0.004*** (2.63)	0.005*** (3.81)	0.006*** (3.00)	0.016*** (2.83)	0.005** (2.44)	0.004 (1.36)	0.006 (0.13)	0.005** (1.98)	0.005 (1.32)	0.056** (1.97)
Female-Headed Household	-0.062 (-1.36)	-0.141* (-1.68)	-0.109** (-2.48)	-0.210** (-2.49)	9.06 (0.00)	-0.031 (-0.30)	-0.039 (-0.30)		-0.061 (-0.63)	-0.036 (-0.29)	
Years of Schooling of Household Head	0.006 (1.28)	-0.006 (-0.78)	0.014** (2.44)	-0.0007 (-0.08)	0.023 (0.00)	0.014 (1.62)	-0.007 (-0.62)	-0.078 (-0.27)	0.017 (1.39)	-0.004 (-0.23)	0.268 (1.48)
Years of Schooling of Female Household Head	0.01 (1.00)	0.014 (0.92)	0.009 (0.84)	0.013 (0.83)	0.042 (0.00)	0.011 (0.80)	0.009 (0.53)		0.016 (1.14)	0.009 (0.46)	
Dependency Ratio (population <15 and >64)/Household Size	-0.19** (-1.99)	-0.275* (-1.86)	-0.134 (-1.37)	-0.212 (-1.41)	0.029 (0.09)	-0.158 (-1.37)	-0.339* (-1.92)	0.371 (0.10)	-0.173 (-1.57)	-0.37** (-2.11)	-2.45 (-1.28)
Household has a Latrine	-0.041 (-1.09)	-0.086* (-1.66)	-0.012 (-0.32)	-0.06 (-1.08)	0.302 (1.53)	-0.024 (-0.53)	-0.07 (-0.94)	3.23 (1.14)	-0.005 (-0.08)	-0.062 (-0.67)	1.20 (0.89)
Household uses Iodised Salt	0.012 (0.39)	0.008 (0.18)	0.019 (0.64)	-0.015 (-0.32)	0.672*** (3.66)	0.044 (0.93)	0.034 (0.43	13.60*** (2.60)	0.053 (1.00)	0.035 (0.41)	1.74 (1.54)
Distance to Under 5 Clinic	-0.005 (-1.06)	0.001 (0.16)	-0.01** (-2.18)	-0.004 (-0.65)	0.071*** (3.00)	-0.01 (-1.39)	-0.0003 (-0.03)	-0.448 (-0.96)	-0.01 (-1.16)	-0.002 (-0.25)	-0.211 (-1.21)
Village bordering Lake Malawi	-0.098*** (-3.58)	-0.16*** (-3.50)	-0.071*** (-2.33)	-0.132*** (-2.63)	0.746*** (3.92)	-0.071 (-1.31)	-0.142* (-1.76)	14.40*** (2.99)	-0.022 (-0.26)	-0.133 (-1.03)	2.80** (2.21)
∂Dependent Variable/∂Credit Programme Membership	0.037	0.04	-0.034	0.012		-0.02	0.003		-0.038	-0.011	
∂Dependent Variable/∂Female Household Head	-0.041	-0.083	0	-0.06		-0.032	-0.038		-0.068	-0.05	
Pseudo R-squared	0.06	0.03	0.08	0.04	0.61	0.07	0.03	0.57	0.05	0.05	0.23
Chi-squared	32.62***	29.11***	40.14***	33.19***	569.02***	35.57***	28.74***	418.64***	24.28***	44.54***	76.55***
Observations	618	618	618	618	1131	618	618	1131	618	618	1131

Notes:

A single asterisk indicates significance at the 10 percent level, a double asterisk indicates significance at the 5 percent level, and three asterisks indicate significance at the 1 percent level. The computed t-statistics are given in parentheses. The child nutrition measures, *weight-for-age* (W/A) *Z-scores* and *height-for-age* (H/A) *Z-scores*, are the latent variables used to create the categorical nutritional status variables. Z-scores less than -2 are given a dummy value of 1 to represent a malnourished state, and Z-scores equal to and greater than -2 are given a dummy value of 0. The reported coefficients represent the marginal effects measured at the mean value of all covariates conditional upon the nutritional status indicator being set equal to 1. The reduced form equation's reported coefficients are maximum likelihood estimates.

- *W/A Nutritional Status* is a dummy variable that takes on a value of 1 if the household has at least one pre-schooler that is chronically malnourished.
- *H/A Nutritional Status* is a dummy variable that takes on a value of 1 if the household has at least one pre-schooler that is acutely malnourished.
- *Household is a Member of a Credit Programme* is a dummy variable that takes on a value of 1if the household has a credit programme member and 0 otherwise.
- *Female-headed household* is a dummy variable that takes on a value of 1if the household has a female head and 0 otherwise.
- *Household has a Latrine* is a dummy variable that takes on a value of 1if the household has a latrine and 0 otherwise.
- *Household uses Iodised Salt* is a dummy variable that takes on a value of 1if the household uses iodised salt and 0 otherwise.
- *Village bordering Lake Malawi* is a dummy variable that takes on a value of 1if the household is in a village that borders Lake Malawi and 0 otherwise.