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Namayengo, Faith M.; Antonides, Gerrit; Cecchi, Francesco

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Microcredit and Food Security: Evidence from Rural Households in Uganda

Faith M. Namayengo^{a,b}, Gerrit Antonides^{a,*},
and Francesco Cecchi^{c,d}

^aWageningen University, Urban Economics Group, Hollandseweg 1, Wageningen 6706 KN, The Netherlands, ^bKyambogo University, P.O. Box 1, Kyambogo, Kampala, Uganda, ^cFaculty of Economics and Business, University of Groningen, Nettelbosje 2, Groningen 9747 AE, The Netherlands, and ^dDevelopment Economics Group, Wageningen University, Hollandseweg 1, Wageningen 6706 KN, The Netherlands

*Corresponding author: Gerrit Antonides, Wageningen University, Urban Economics Group, Hollandseweg 1, Wageningen 6706 KN, The Netherlands. Telephone: +31-317-482415. E-mail: Gerrit.Antonides@wur.nl

Abstract

This study investigates the effect of participation into a microcredit program on household food security parameters of female borrowers in a rural setting in Uganda. We explore the modes of food acquisition, dietary diversity, caloric and protein intake, and qualitative food insecurity measures for different categories of respondents. We conduct a cross-sectional analysis comparing old clients to newly registered first time borrowers. Next, we compare first time borrowers and non-borrowers using a panel design. While the cross-sectional analysis allows the comparison of women that similarly self-selected into borrowing, the panel analysis complements by providing insights into changes of food security parameters. In both cases, we use Kernel matching, or difference-in-difference with Kernel matching, to control for potential bias in observables, and perform a sensitivity analysis with respect to unobservables using Rosenbaum bounds as well as an individual fixed effects panel analysis. Results show a decline in food security following the uptake of microcredit. In particular, the analysis reveals robustly lower dietary diversity among long-time borrowers than new borrowers, and larger reductions in dietary diversity scores among new borrowers, after 1 year, compared to controls. The reduction in dietary diversity was traced to a reduction in animal-source food, fruit and sugar intake. We find indicative evidence that this is partly explained by a shift from own production to reliance on food purchase by households. Other household members relegating the burden of food provision to women after borrowing may also help explain the observed result.

Key words: food security, microcredit, subsistence farming, microenterprises, women

1. Introduction

Agricultural production in Sub-Saharan Africa is mainly undertaken by smallholders, with women representing more than half the agricultural labour force in the region (Quisumbing *et al.*, 1995). According to some estimates smallholders provide over 80% of the food consumed (IFAD and UNEP, 2013). Nevertheless, food insecurity—or the lack of access to sufficient quality food (Rahman *et al.* 2013)—is still prevalent in poor rural areas, and progress in reducing undernourishment lags behind the rest of the world (FAO *et al.*, 2015). In Uganda, about 48% of the population is food-energy deficient, more than 40% of the rural population have low dietary diversity, and almost a third of the children are stunted.

Many interventions aimed at increasing food security target women in recognition of the special role they play in food security attainment. Women are involved in many agricultural and non-agricultural activities, including subsistence crop production, and in informal trade and services (Østergaard, 1992; Buvinić, 1997; Momsen, 2004). Moreover, they typically devote a higher share of their income than men to everyday subsistence and nutrition (Carloni and Goddard, 1987; Blumberg, 1989). Despite their key role, women constitute a large part of the world's poor (Fletschner, 2009). Uganda is one of the countries in the world where gender disparity is high and increasing (UNDP, 2014), with the majority women either not employed or active in unpaid and subsistence work (UBOS and UNFPA, 2014). For them, an important livelihood diversification strategy amounts to self-employment by setting up survival and maintenance microenterprises (MEs). These MEs make significant contributions to the livelihood of women and their households (Jiggins, 1989; Smith *et al.*, 2001; Schreiner and Woller, 2003). However, they usually lack access to credit, which limits their capacity to invest and expand their businesses (Østergaard, 1992; Parpart and Connelly, 2000).

Microfinance institutions can help ease this constraint by providing women with micro-loans. Female microenterprises have good loan repayment records (Kabeer, 2005; Karlan and Goldberg, 2011), and are expected to attain high returns to investment (Kaboski and Townsend, 2012). Providers of microcredit believe therefore that the provision of micro-credit to women will lead to improvements in the food security of poor households. First, borrowing is expected to have positive income effects, hence increasing the liquidity available to buy food. Second, when credit is invested in agricultural activities, it is expected to lead to increased agricultural productivity and production—hence increasing food availability. Third, credit may have consumption smoothing effects: households may overcome income and non-income shocks by using part of the credit to smoothen household food consumption expenditures over time.

However, the burden of loan repayment may also lead to a deterioration of food security in the medium and long term—possibly exacerbated by poor-performing investments or the diversion of loans to current consumption. Borrowers may allocate the meagre available resources to loan repayment, away from essential needs like food provision and other household expenditures. If the loan is used for a cash crop, increased food insecurity may also result from a shift from own-food consumption to reliance on purchased food. Finally, women's burden of food provision may increase if other households members reduce their cash transfers to them as consequence of their increased perceived liquidity. In Uganda, it is usually men meeting the households' cash needs, because of their higher involvement in the cash economy. When women borrow men may reduce the intra-household transfers and

contributions, under the assumption that women are now financially empowered and more independent.

Empirical evidence on the combined effect of these mechanisms in different contexts is scarce. Recent systematic reviews of the impact of borrowing on the welfare of the poor by [Duvendack *et al.* \(2011\)](#) and [Stewart *et al.* \(2010\)](#), reveal minimal focus of evaluations on the food security of households. Most studies focused on income and empowerment effects of borrowing. In our study we try to answer the question of whether borrowing leads to modification in food consumption among rural microcredit borrowers and the factors which may explain any observed differences. In particular we test whether participation in a microcredit program leads to changes in mode of food acquisition and household expenditure, in household food security parameters, and in the contribution of others to household food needs decreases when women access loans.

We utilise different food security indicators and two alternative study approaches to ensure consistency of our findings. In the first study approach, we utilise a quasi-experimental cross-sectional design comparing baseline food security parameters for old borrowers (OB), in the BRAC Uganda microfinance program, and incoming new borrowers (NB) into the same program, before they receive their first loan. This design ensures that both groups are self-selected into borrowing. We utilise propensity score matching (PSM) to improve the comparability of groups and to determine differences in food security outcomes of OB and NB groups. PSM results show significantly smaller dietary diversity scores, and a smaller proportion of energy from own production. OB also reveal smaller sugar- intake and fruit-intake scores and proportion of energy consumption from fat than NB. In the complementary approach, we use 2-year panel data for the NB category and a comparison group (CG), who never got a loan from BRAC or any other MFI. We employ a difference-in-difference (DID) estimation with Kernel matching to assess changes in food security parameters of the NB and CG, within the study period. We again find a decline in the food security parameters of the households after borrowing.

The remainder of the article is organised as follows. Section 2 presents the conceptual and theoretical framework, and presents an overview of findings of previous studies on microcredit and food security. Section 3 describes the study area, the BRAC microcredit program and the study design and data collection methods. Section 4 presents the results of the cross-sectional and panel studies. Section 5 concludes.

2. Theoretical framework

2.1 Concepts and definitions of food security

There are various concepts at the core of our analysis. These include the definition of food security and its components, as well as indicators of food security used in the study including dietary diversity, and household food insecurity access scores and undernutrition. Food security has been defined in more than 200 different ways ([Maxwell, 1996](#)). We use the widely accepted World Food Summit definition, indicating that food security exists when all people at all times have physical and economic access to sufficient, safe and nutritious food, that meets their dietary needs and food preferences for an active and healthy life ([FAO, 1996](#)). Three broad concepts are encompassed in the definition of food security: food availability, food access and food utilisation. [Sen \(1981\)](#) postulates that food insecurity is not all about food availability, but rather that food access, especially economic access, is an important

component of food security. Food access encompasses the ability of households to actually access available food, usually through having the economic means to do so (Ashley, 2016). Food availability denotes the physical availability of food of adequate quantity and quality in an area, while food utilisation refers to the body's ability to utilise ingested food usually affected by the state of health of the individual (FAO, 1996). Next, we discuss the indicators of food security that we use in the study including dietary diversity (HFIAS), and measures of undernourishment based on caloric intake. Caloric intake of households can be used to classify households as food secure or food insecure (Ashley, 2016). If the caloric intake of a household is below a given minimum, the household is classified as food insecure.

While modern food economies are characterised by availability of quantity and quality foods for consumers throughout the year, the majority of people in developing economies depend on own-produced monotonous diets. These are based on starchy staples, with minimal animal-source foods, and seasonal fruits and vegetables. Starchy staple foods constitute a large percentage of the food expenditures and caloric intake for poor households (Bouis and Novenario-Reese, 1997). However, reliance on these starchy staples translates into difficulties with meeting energy and nutrient needs especially because of their being high in dietary bulk (Ljungqvist *et al.*, 1981). This makes it difficult to consume enough quantities to meet nutritional needs. Meeting nutritional and energy needs requires use of diets consisting of a variety of foods. Dietary diversity is a key element of high quality diets (Torheim *et al.*, 2004), and many nutritional guidelines recommend consumption of a variety of foods (Arimond and Ruel, 2004). Dietary diversity is considered an outcome measure of food security, for interventions that focus on food security improvement. The Dietary Diversity Score (DDS) is a simple count of the number of different food groups eaten by a household in a specified time period. A high DDS is indicative of adequacy in caloric and nutrient supply from diets, especially in developing countries (Hoddinott and Yohannes, 2002; Arimond and Ruel, 2004). When incomes of poor communities improve, they shift away from monotonous diets to richer diets, with improved quantity, quality and diversity (Swindale and Bilinsky, 2006b). Hoddinott and Yohannes (2002), found positive and strong relationship between DDS and household per-capita consumption and household per-capita daily caloric availability from staples and from non-staples. High DDS is associated with caloric and protein adequacy (Swindale and Bilinsky, 2006b; Chua *et al.*, 2012), and household income (Swindale and Bilinsky, 2006b). Interventions that empower women economically have been found to lead to improvement in the intake of animal-source foods (Colecraft *et al.*, 2006) and dietary diversity (Sraboni *et al.*, 2014). DDS is easily affected by income and non-income shocks to which households usually respond by eating less or eating less preferred, poorer quality and less diverse foods (Ashley, 2016).

Another common measure of food access is the Qualitative Household Food Insecurity Access Scale (HFIAS). HFIAS has been described and operationalised by Swindale and Bilinsky (2006a) and Coates *et al.* (2007). Based on work by the United States National Household Food Security Survey Measure (HFSSM), HFIAS comprises a series of questions that represent domains of household food insecurity (access) experiences that may be used to assign households on a continuum of severity from food secure to severely food insecure. HFIAS captures the respondents' feelings of uncertainty and or anxiety over food, perceptions that food is of insufficient quality (for adults and children), and reported reductions in food intake (for adults and children). Many researchers validated the use of HFIAS across different cultures and reported correlations between HFIAS and poverty, malnutrition and food insecurity

(Webb *et al.*, 2002; Coates *et al.*, 2003; Frongillo *et al.*, 2004). Melgar-Quinonez *et al.* (2006) found a correlation between HFIAS and household expenditures on food. In addition, Coates *et al.* (2006) conducted a study to identify the commonalities in the experience and expression of food insecurity (access), across different cultures. They found that insufficient food quantity, inadequate food quality, uncertainty and worry about food, were a significant part of the food insecurity experience across different cultures. Finally, expenditures on food may be another food security indicator because a large percentage of income of the poor goes to food (Mellor, 1983; Von Braun *et al.*, 1991). Banerjee and Duflo (2007) found that food represented 56-78% of the consumption expenditures of poor people in 13 countries.

2.2 The income effect of borrowing

Increased income is one of the major expected outcomes of borrowing, with direct bearing on food security of households. Any intervention that improves household income is expected to improve purchasing power and economic access to food. For rural agrarian communities depending on small scale farming for income and food, improvement in agricultural productivity will lead to both improvements in cash income as well as income in kind, mainly in the form of food. Microcredit thus addresses food insecurity via two major pathways: increase in productivity from agricultural and non- farm MEs, and resultant improvement in income and use of credit for consumption smoothing.

It has long been argued that poor people are credit constrained and access to credit will enable them to transform their poorly performing investments with untapped potential into productive investments. Borrowers are expected to use the social and physical capital associated with borrowing to improve enterprise output (Feder *et al.*, 1990) and thus generate more income (Zeller and Sharma, 2000). Generally, investment of credit into existing business or new production activities is expected to lead to microenterprise expansion, increased business outputs, household and business assets, profits and income improvement (Sebstad *et al.*, 1995; McKernan, 2002; Gobezie, 2004; Imai *et al.*, 2010; Karlan and Zinman, 2011; Banerjee *et al.*, 2015; Crépon *et al.*, 2015).

In the case of agricultural producers, access to credit is expected to lead to improved agricultural output (Feder *et al.*, 1990). This may happen via different pathways. Firstly, credit enables farmers to access labour-saving technologies and have better access to agricultural inputs like fertilisers and improved seeds (Zeller and Sharma, 2000; Khandker and Koolwal, 2016). Recipients may also increase their labor supply (Banerjee *et al.*, 2015; Crépon *et al.*, 2015), leading to improved productivity and income (Matin *et al.*, 2002). Some poor borrowers may utilise accessed fund to rent land for agricultural production.

Secondly, households accessing credit may manage their assets and liabilities more efficiently; they may reduce levels of assets for precautionary savings and instead acquire production assets (Matin *et al.*, 2002; Foltz, 2004). They may sacrifice short-term consumption of non-asset goods and leisure in order to acquire durable goods (Crépon *et al.*, 2011; Banerjee *et al.*, 2015). All these actions will improve their production potential. Indeed some studies have observed improvement in profits of MEs among borrowers (Copestake *et al.*, 2001).

Since agriculture is a major source of food for peasant communities, improvement in production resulting from access to credit should lead to improved household food availability and improvement in cash income, which will lead to economic access to food, especially when credit is given to women. Investment in animal production is expected to lead to improvement in production of easy-to-sell animal products including milk and other animal-source food.

One of the widely acclaimed effects of microcredit participation is the empowering effects of microcredit on women. Women who have accessed credit have been reported to have higher levels of decision making within their households (Fofana *et al.*, 2015), and improvement in societal and perceived self-worth (Hashemi *et al.*, 1996; Kabeer, 2001; Angelucci *et al.*, 2013). These may all lead to food security improvement. Any intervention that enhances women financial status and decision making will lead higher social benefits including extra expenditure on food for households (Buvinić, 1997).

2.3 Borrowing and consumption smoothing

Enhancement of consumption and consumption smoothing is another pathway through which microcredit can contribute to food security. The poor do not only face challenges of low income but also their incomes are prone to shocks from risks like business failure, illness and death. Such shocks greatly influence household consumption and production decisions. Availability of credit helps the poor overcome such shocks without compromising consumption and production decisions (Morduch, 1995). Participation in microcredit programs has been observed to lead to consumption smoothing (European Communities, 2008; Angelucci *et al.*, 2013), especially for communities with production problems due to seasonality (Morduch, 1995; Zeller and Sharma, 2000; Develtere and Huybrechts, 2002). Farmers may use credit to invest in longer duration and more profitable investments (Matin *et al.*, 2002; Foltz, 2004), without worrying about current consumption. Availability of credit to address emerging shocks will enable the poor to survive without compromising food consumption. In addition, the possibility of future credit access may alter the need for savings as protection against future shocks, and clients may use acquired credit to cover current consumption (Matin *et al.*, 2002; Kaboski and Townsend, 2011).

Furthermore, the poor have needs for lump-sum consumption expenditures including life-cycle expenditures of weddings and funerals, human capital investments in health, education, and food which may be covered by borrowing (Rutherford, 1998; Matin *et al.*, 2002). Liquidity constrained borrowers may then use production loans to cover consumption expenditures they would otherwise be unable to make (Feder *et al.*, 1990). Use of credit to cover consumption expenditures which are not related to production may be considered as loan diversion. Usually, borrowers conceal from lenders the fact that a loan will be used for consumption purposes, other than food (Attanasio *et al.*, 2015), and improper expenditure of loans may lead to a reduction in food consumption (Angelucci *et al.*, 2013).

2.4 Potential negative effects of microcredit

Recently, the discourse on microcredit and its effects on households has shifted to the potentially negative effects of borrowing. Some have argued that microcredit, especially for MFIs with both social and profit motivations in their operations, may not be a silver bullet to improve income and welfare of the poor, especially women (Buckley, 1997; Morduch, 2000; Matin *et al.*, 2002). These MFIs focus on increasing their loan portfolio, profits and loan recovery, and may sometimes disregard social benefits of microcredit participation (Ghosh, 2013). Some levy high interest rates even when they have a range of prices to work within and still expand their operations (Angelucci *et al.*, 2013). Borrowers especially women end up facing limitations in making good use of accessed loans and may not benefit from borrowing. For example, a study by FAO on MFIs in Uganda (FAO, 2000b) noted

that many engendered practices are sometimes perpetrated even when women borrow; they are limited to crop and non-cash crop production, and for the case of non-farm MEs, they invest into less lucrative activities than men. Married women dependency on men on certain aspects of ME running and on ME income allocation may at times lead to negative outcomes like lack of control over ME funds and loan repayment burdens.

Studies have been commissioned to assess potential negative effects of microcredit. [Angelucci *et al.* \(2013\)](#), studied potential negative effects of microcredit on welfare and business parameters, for borrowers of Compartamos Bancos (one of the largest micro-lenders in Bolivia) and concluded that negative effects were minimal. [Goetz and Gupta \(1996\)](#) pointed to potentially negative effects of microcredit and observed that one of the most widely acclaimed outcomes of microcredit (women empowerment) is not a universal outcome. Other negative effects of borrowing reported among women have included over-indebtedness ([Rahman, 1999](#); [Ganle *et al.*, 2015](#)) and domestic violence ([Rahman, 1999](#)), loan repayment pressure and stress ([Kabeer and Rajasekhar, 1997](#)), ME-running-related stress ([Ahmed *et al.*, 2001](#)), and solidarity group loan payment pressure ([Mayoux, 2001](#)).

As such, access to credit may not lead to improvement in food security because of different factors, including: (i) no improvement in productivity of MEs leading to no improvement in cash and non-cash income and a resultant repayment burden; (ii) food security may not be a priority for households; (iii) there may be a reduction of contribution of funds towards food purchase when women join the cash economy of households.

As [Morduch \(2000\)](#) and [Buckley \(1997\)](#) argue, there may be undue optimism among proponents of microcredit that the poor demand credit at whatever cost to transform their businesses. Some MFIs charge high interest rates to poor borrowers based on the fact that the borrowers are able to pay-off loans and even come back for repeat loans. This positive picture of microcredit and automatic improvement in production ignores the many structural and societal constraints poor women face that limit their productive capacity as they try to make good of their small investments ([Ehlers and Main, 1998](#); [Brett, 2006](#)). Production improvement requires more than capital. It requires skills, information, connections and transportation which many poor people lack ([Buckley, 1997](#); [Morduch, 2000](#)). The type of MEs the women engage in also matters. Most women usually engage in low productivity, low-return activities, with limited potential to yield funds for loan repayment ([Gladwin *et al.*, 2001](#)).

Activities which the women engage in are usually those they can run within the confines of the households ([Goetz and Gupta, 1996](#)). The embeddedness of such activities within the household economic portfolio may impair separation of funds from MEs for loan repayment ([MkNelly and Lippold, 1998](#)). In addition, women may lack human, financial and social capital needed to transform their small businesses into profitable ventures ([Ehlers and Main, 1998](#)). It is no wonder that some researchers observed no improvement in ME profits among borrowers ([Banerjee *et al.*, 2015](#)). Those involved in agricultural-related MEs face production risks due to reliance on un-predictable weather patterns, which make incomes seasonal and unreliable. These risks come on top of the inevitable lag phase between investment and income ([Morvant-Roux, 2011](#)). And yet some MFIs require loan repayment to be effected within a year and for repayment to commence already in the week after loan receipt. This may not be feasible for many borrowers, for few businesses of the poor can attain the rates of return investment needed to meet such requirements ([Rutherford, 1998](#)).

The inevitable outcome of these factors is over-indebtedness and problems with loan repayment that may compromise the food security of households. [Copestake et al. \(2001\)](#) observed an increase in indebtedness of borrowers on the first loan cycle and envisaged it may have been due to rigorous loan repayment protocols that put no consideration on the risks and uncertainties of the businesses. Stuck with the burden of the repayment to save the social ties and relationships of women in group contracts, women do whatever it takes to ensure loan repayment, including compromising household consumption. They sell whatever is salable including household food items, sacrificing household expenditures to save funds for loan repayment. These may have a negative effect on household food security ([Goetz and Gupta, 1996](#)). Women may never benefit from loans if issues like market access are not part of the interventions ([Adams and Von Pischke, 1992](#)).

Some authors have explored negative effects of borrowing and found mixed results ([Angelucci et al., 2013](#)). Among the poor and less experienced borrowers some negative effects were observed.

2.5 Available evidence on microcredit and food security

Studies on the relationship between microcredit and food security show mixed results. For example, whereas [Attanasio et al. \(2015\)](#) reported an increase in 7-day expenditure on food among borrowers in Mongolia, [Augsburg et al. \(2015\)](#), observed a reduction in weekly food expenditures among poor borrowers, who just started a new business, in order to supplement the loan. For borrowers who already had a business, their consumption remained unchanged. [Barnes et al. \(2001\)](#) reports a positive and significant relationship between microcredit participation and consumption of animal-source food, and others report positive relationships between borrowing and the nutrition of children ([Moseson et al., 2014](#); [Marquis et al., 2015](#)), women nutritional status ([Hamad and Fernald, 2015](#)) and food consumption for entire households ([Doocy et al., 2005](#); [Imai and Azam, 2012](#); [Moseson et al., 2014](#); [Hamad and Fernald, 2015](#)). Other studies, however, have reported a negative relationship between borrowing and feeding among women. For example, borrowers under the *Promujer* lending program in Bolivia were reported to compromise their food intake as a result of the burden of loan repayment ([Brett, 2006](#)). Women reported reducing the quantity and quality of household meals and use of all available household resources to effect the payment. [Crépon et al. \(2011\)](#) reported a reduction in overall consumption and non-durable consumption for households with a pre-existing business, as they invested more in their businesses. However, they observe that borrowers who did not have pre-existing businesses increased their food consumption expenditures after borrowing.

Microcredit participation has been associated with smoothening of consumption among women borrowers. Some studies have reported higher levels of household consumption among female borrowers ([Khandker, 2005](#); Rahman, 1986). [Pitt and Khandker \(1998\)](#) compared household consumption among female and male borrowers and found female borrower households with higher consumption expenditures than their male counterparts. Households that borrow are reported to smooth their consumption expenditure in anticipation of borrowing or after borrowing. However, a number of studies found no changes in general consumption ([Attanasio et al., 2015](#); [Banerjee et al., 2015](#); [Crépon et al., 2015](#)) after borrowing. [Coleman \(1999\)](#) found no effect of borrowing on expenditure on health and education of children. Finally, over-borrowing and bad investments may translate into

consumption decreases to cover losses on these expenditures (Angelucci *et al.*, 2013), including loan repayment.

3. Methodology

3.1 Study design

Measurements of changes among program recipients brought about by a program involves estimating the counterfactual, i.e., what would have happened to program recipients, without the program. There are methodological challenges involved, since it is not possible to both be and not be in the program at the same time. In the case of microfinance programs, there is the challenge of selecting comparison groups, i.e., non-borrowers to compare with borrowers. This is not usually easy because program placement may be endogenous. The decision to join a credit program may also be endogenous, as those who decide to join the program, may be different from those who do not join the program (Morduch, 2000; Armendáriz and Morduch, 2010) leading to self-selection bias. Different methods can be used to overcome these challenges including instrumental variables methods, double-difference methods, propensity score matching, randomised impact evaluation methods and pipe-line methods (Pitt and Khandker, 1998; Coleman, 1999). In this study, we employ some of these commonly used methods to assess the differences between borrowers and non-borrowers in selected outcome variables. Our study is structured as a panel in which we collected data on three categories of respondents. The first category of respondents was the OB group who had a running loan with BRAC. The second category consisted of incoming new borrowers into BRAC (New Borrowers= NB), before they received their first loan. The last group of respondents consisted of a group of women from the same village as NB, with a microenterprise but who never borrowed from BRAC or other MFI. The design of our study is presented in Table 1.

During the baseline we collected data on the three study groups. We used the baseline data to construct a quasi-experimental cross-sectional design in which food security parameters of the OB and NB borrowers were compared based on the methodology sometimes referred to as the USAID/AIMS comparative cross-sectional analysis design (Nelson *et al.*, 2004). The basis of this methodology in the assessment of the effect of microcredit is that, since both groups have already self-selected to participate in microcredit and one has just not received the loan, the difference between outcome measures for the two may be taken as the effect the intervention.

We also collected baseline data on women who never received a loan (Comparison group = CG). We carried out two waves of data collection for both the NB and the CG

Table 1: Study Design

Groups	Microcredit intervention	Observations (t ₁)	Microcredit intervention	Observations (t ₂)
Old borrowers (OB)	Yes	312	–	–
New borrowers (NB)	No	222	Yes	163
Comparison group (CG)	No	226	No	207

groups (Gaile and Foster, 1996). After 1 year we conducted a follow-up study in which we collected data from the NB and CG groups only. This data was used to obtain an alternative measure of the effect of microcredit using the difference-in-difference method. We did not collect follow-up information on OB; therefore we do not know if OB participants borrowed again or not and why they may have taken such decision.

3.2 Setting

We use clients of BRAC, which is considered to be the world's largest developmental organisation in terms of reach and staff scale (Economist, 2010). BRAC is one of the largest micro-lenders in Uganda with 110,000 active borrowers by the end of 2013. It operates in many rural agrarian districts of Uganda, and has an on-going expansion plan (BRAC, 2008, 2013). The BRAC microfinance program targets poor women (20–50 years) with stable businesses to enhance the performance of their self-employment activities (agricultural or non-farm microenterprises). The BRAC microcredit program uses the Grameen-like group lending model (Armendáriz and Morduch, 2010), relying on joint liability of members for loan repayments at weekly group meetings. Microloans (USD 50–700) are given in cash to individual women who are serviced in 15–20 person Village Organisations (VOs). Loans are repayable in either 20 or 40 equal weekly instalments, commencing in the week after loan access. A VO is served by a credit officer, who is in charge of explaining BRAC loan terms and processes, including 18 promises members recite in each meeting to promote desirable behavioural adaptations. The group members have to agree to joint liability for repayment of each other's loans. Joint liability helps overcome problems of information asymmetry before lending, and moral hazard after lending. In addition borrowers are required to present a loan guarantor who is required to pay back the loan in case the repayment is excessively delayed. Loan repayment is done weekly in the week following loan access. If a member fails to make her payment, the group chairperson and credit officer urge members to cover the payment in the spirit of solidarity by pooling funds together. Loan guarantors are called in when a woman neither turns up for a VO meeting nor makes prior arrangement for a payment. Women who cannot attend a VO meeting send their repayment through fellow VO members. (More details and characteristics of BRAC are presented in Namayengo *et al.*, 2016). At the time of the study BRAC charged flat interest rates of 12% and 25% for the 20 and 40-week repayment periods, respectively. Loan amounts were jointly agreed upon by members of the VOs and the BRAC credit officer, branch manager and area manager. The minimum loan size and usual amount of the first loan was at the time of the study UGX. 250,000 (about \$ 100).

The study was conducted in the districts of Mukono and Buikwe, both located in the central region of Uganda, within the Lake Victoria basin. The districts were selected based on two criteria. The first one is presence of BRAC microfinance activities among rural agrarian clients. The second was the MFI having expansion plans which was necessary for the identification of new borrowers for the study (see Table 1 for study design). Mukono district shares borders with Buikwe in the East. The relief, climate and fertile soils makes the area suitable for crop production (Mukono District Local Government, 2010).

With a population of about 599,817 people Mukono ranks seventh out of the 121 districts of Uganda, whereas Buikwe has a population of about 436,406. Most people in Mukono (73%) and Buikwe (67%) live in rural areas (UBOS, 2016). Over 80% of the population in both districts rely on agricultural production. Subsistence agriculture is

characterised by low acreage due to increasing family sizes and land fragmentation, and by low productivity per unit area because of deteriorating soil fertility. Because of the proximity to the lake and the presence of many fish landing sites and rivers, fishing is an important economic activity in the two districts. Most fish is taken by big fish processing companies for export ([Mukono District Local Government, 2010](#)). Buikwe district is located 62 km by road east of Kampala. It became a separate district in 2009 ([UBOS, 2016](#)).

3.3 Sample and procedures

With the consent of the participants and after assurance of confidentiality baseline data collection was undertaken between September 2013 and March 2014. The follow-up study took place between September 2014 and April 2015, 1 year after the baseline survey. We collected data from 312 existing borrowers (Old Borrowers = OB) and 222 incoming clients (New Borrowers = NB) who had self-selected to join the microcredit program before they received their first loan. Because they had self-selected to participate in the microcredit program, the NB category was expected to have comparable characteristics to the OB category as described by [Armendáriz and Morduch \(2010\)](#). We also obtained data from 226 non-borrowers (Comparison group = CG) following a method described by [Karlán and Goldberg \(2011\)](#). The LC1 (Local Council 1) chairman of the villages in which the NB groups resided helped to identify households engaged in the informal sector (a non-farm microenterprise or agriculture as a source of income). The follow-up study had a total of 370 respondents (NB = 163 and CG = 207). The overall attrition rate is thus 17% for the panel study.

The OB and NB categories were selected from 100 VOs, from 6 BRAC branches from Buikwe and Mukono districts (Buikwe, Nkokonjeru, Lugazi, Kasawo and two from Mukono). At the start of the study, the selected BRAC branches had expansion plans, a pre-requisite for recruitment of NBs into the study. By the time of the study BRAC had about 323 women organisations in the two districts that are served under 6 branches. All BRAC branches were eligible for inclusion into the study. We purposively included BRAC branches that had expansion plans, a pre-requisite for recruitment of new borrowers (NB). We zeroed down on inclusion of VOs that had agrarian clients we defined as ‘clients who practiced agricultural production for food or as ME’. In order to balance out the effect of loan periods and loan cycles, we sampled and included VOs that had existed for more than 2 years. BRAC branch managers and loan officers used loan sheets to aid in the selection of VOs, with typically agrarian borrowers. VOs for NBs were newly formed or had new borrowers. All women in a selected VO were eligible as respondents, except NBs and OBs who previously borrowed from other MFIs. NBs were enrolled in the study during the mandatory one-month orientation period, before they accessed their first loan. OBs were selected from VOs in the same or neighbouring village as selected NBs. Drop-outs from OB groups were traced and interviewed to reduce drop-out bias as described by [Karlán \(2001\)](#).

Information about the BRAC microcredit program was obtained from focus group discussions (FDG) with the borrowers and from key-informant interviews with BRAC loan officers, branch managers and the area manager. We obtained some information from loan sheets that we were able to access and also attended some VO meetings to understand more about the program operations. Six FGD sessions were held for OB groups and two for NBs. Each focus group comprised 8–15 participants, and included persons who had not been included in the survey and from groups not included in the questionnaire survey. Detailed notes and audio recordings were used to record the interviews. A FGD guide was

used to elicit information from participants about their opinions and experiences with borrowing.

3.4 Measures

Food intake and dietary diversity were measured by asking the women to provide the number of days, amount, cost and source of food that was eaten by the households in the 7 days before the study. Measurement of food availability was obtained from data on the types, quantities, cost and sources of food (purchase versus own-production), acquired or purchased by the household in the 7 days before the study. Household measures with known weight equivalents were used to estimate the quantities of food eaten by the household. Information was obtained on household members who missed different meals in the reference time period, to account for missed meals. The energy, protein, caloric and fat intake of the households was calculated by using the respective values from 100 g of food as given by Ngulube (1989).

We calculated a household per-capita caloric intake by dividing the total calories in the different foods acquired and or consumed by the household and dividing it with the total number of adult male equivalent (AME) units for the household. AMEs were obtained from information on the household size and age composition. All adults were assigned one AME and children 0.6 AME. The total AME units of the household were the sum total of the AME units of the household. In a separate procedure, the quantities of different types of food were converted into total calories using food composition data bases and the food composition by Ngulube (1989). To obtain per-capita caloric intake for a household, the total caloric supply from the food was divided by the total household adult equivalence units (den Hartog *et al.*, 2006; Smith and Subandoro, 2007). As a robustness check, we also use a less rough proxy of caloric intake, using conversion factors for estimated calorie requirements disaggregated by age and gender (Claro *et al.*, 2010).

We calculated a household diet diversity score (DDS) as the number of food groups consumed during the previous 24 h of the study. In this study DDS was based on 12 different food groups: cereals, white roots and tubers, legumes/pulses, vegetables, fish, fruits, meat, eggs, oil, sugar and milk. This a slightly modified list from that used by Swindale and Bilinsky (2006b).

The household food insecurity access scale (HFIAS) was adopted from Swindale and Bilinsky (2006a) and Coates *et al.* (2007) to assess whether households experienced problems in access to food in the preceding 30 days. The HFIAS scale was used to obtain the following information: (i) feelings of uncertainty or anxiety over the food situation; (ii) perception that food is insufficient of quantity for adults and children; (iii) perceptions that food is insufficient in quality; (iv) reported reductions in food intake for adults and children; (v) reported consequences of reduced food intake; (vi) reported feelings of shame for resorting to socially unacceptable means to obtain food. Different questions related to the above were asked for a recall period of 4 weeks or 30 days. The respondent was first asked an occurrence question, as to whether the condition in the question happened at all in the past 4 weeks (Yes or No). If the respondent answered yes to an occurrence question, a frequency of occurrence question was asked to determine whether the condition happened rarely (once or twice), sometimes (3–10 times) or often (more than 10 times) in the past 4 weeks. We calculated a household food insecurity access score (HFIAS), for individual households, following the methods by Coates *et al.*, (2007). The maximum score for a household was 27 and the minimum was zero. The higher the HFIAS score the more food insecurity the household experienced.

Figure A1 in the Appendix presents the distribution of DDS and HFIAS measures across the whole sample at t_1 .

The quantitative survey questionnaire was also used to elicit information on socio-demographic characteristics of respondents and their households, household expenditure, as well as several personality variables. It also elicited data on the monthly household expenditure non-durable goods/ non-food goods, frequently purchased services and 7-day expenditure on food. We also used it to determine the level of monetary expenditure of other family members on food.

We used a 4-point Likert scale (1 = agree strongly; 2 = agree to some extent; 3 = disagree to some extent; 4 = disagree strongly) with different personality statements. Three time preference items were adapted from [Petrocelli \(2003\)](#): (1) I only focus on the short term; (2) I live more for the present than for the future; (3) The future will take care of itself. Four items for need for achievement were adapted from [Keinan and Kivetz \(2011\)](#), and [Ray \(1980\)](#), including: (1) I get restless and annoyed when I feel am wasting time; (2) I have always worked hard to be among the best; (3) I am an ambitious person; (4) Improving my life is important to me. Another four items for risk preference were adapted from [Blais and Weber \(2006\)](#): (1) I enjoy taking part in decisions with un-known outcomes; (2) I avoid activities whose outcomes are uncertain (reverse scored); (3) to gain high profits in business one should take decisions even when uncertain of the outcomes; (4) I would invest all my monthly profit in a new business venture. Socio-demographic and personality measures were assumed to reflect stable personality characteristics that might explain residual heterogeneity in the samples of new and old borrowers.

We also constructed an asset index and a housing facilities index, as a proxy for wealth using principal component analysis of data on household wealth and asset ownership. We obtained two components from our analysis; component 1 which we named the household assets index; included seven count variables (number of tables, chairs, beds, mattresses, cell phones, hoes and radios). Component 2 was composed of variables related to housing and housing facilities (house ownership, TV ownership, electricity presence, type of walls of the house and the material for the floor of the houses). We used these variables to construct a household housing index.

Qualitative data collection using focus group discussions was done for groups of up to 15 women, to obtain in-depth information different aspects of the study: Reasons for borrowing; Female participation and responsibilities in the management of loans and loan-supported MEs; Decision making on loan acquisition; Control of loan funds and the running of the MEs; Changes in household welfare after borrowing (we probed for changes in lives of the respondents and their household after borrowing); Changes in community participation and respondent position in community after borrowing (we probed about loan repayment, sources of funds, difficulties, role of husbands, etc.).

All study instruments were translated into Luganda, the commonly spoken language in the study area. They were pilot tested and improved before use in the study.

3.5 Empirical strategy

We analysed cross-sectional data for 534 respondents (312 OBs and 222 NBs) from about 138 Village Organisations (VOs), from 7 BRAC branches in the Buikwe and Mukono districts. We cross-checked and ensured comparability of the OB and NB groups by use of the Propensity Score Matching (PSM) methodology. Factors which could influence self-selection

into microcredit and those which could influence microcredit outcomes were used as control variables in the PSM procedure, with weighted Kernel matching (Luellen *et al.*, 2005). These factors included respondent background characteristics, that is religion, marital status, age, years of education, time preference, risk preference and achievement motivation. In order to compare with the NBs, all age-related variables of OBs were converted to the age basis at the time of their first loan, indicated as 'corrected age', 'corrected family size' and 'corrected dependency ratio' hereafter. Principal components analysis was used to check the dimensionality of the personality characteristics. In this analysis, only the time preference items were found to have a single factor in common, hence the average item scores were used as a measure of time preference, or impatience. The need for achievement and risk preference items were not explained from common factors, so we used the individual item scores in the PSM procedure.

The control variables were used to construct propensity scores estimating the probability of being in the comparison or treatment group.

The PSM procedure was also used to estimate the effect of receiving microcredit. The rationale of PSM is to match the participants in the treatment group to those in the comparison group based on propensity scores. Therefore any remaining differences observed can be attributed to the treatment. The average treatment effect on the treated (τ_{ATT}) was defined as:

$$\tau_{ATT} = E(\tau|D = 1) = E[Y(1)|D = 1] - E[Y(0)|D = 1], \quad (1)$$

where $D = 1$ if respondent had a running loan with BRAC and $D = 0$ when they belonged to the NB category. $Y(D)$ is the outcome variable of each participant (for example dietary diversity score) while $[Y(0)|D = 1]$ is counterfactual and unobservable. According to Rosenbaum and Rubin (1983) τ_{ATT} can be expressed as:

$$\tau_{ATT} = E_{P(X)|D=1}[E[Y(1)|D = 1, P(X)] - E[Y(0)|D = 0, P(X)]], \quad (2)$$

where $P(X)$ is the propensity score, that is, the probability of an individual to participate in the microcredit program given the observed characteristics X .

Panel data analysis involved comparison of data for 222 NBs and 225 CGs respondents using: (i) the Difference-in-difference (DID) approach in combination with propensity score matching, and (ii) a Generalised Least Squares (GLS) model with fixed effect to take advantage of the panel nature of the data. The first methodology was described by Armendáriz and Labie (2011). The DID measures the impact of microcredit on borrowers by comparing treatment and comparison groups on changes in outcomes of interest over time relative to the outcomes observed in the baseline survey. The method recognises that unobserved heterogeneity in participation is present, but assumes that such factors are time-invariant (Khandker *et al.*, 2010). We obtained the difference between outcome variables between the two time periods (T1–T2) and netted out roles of measured and unmeasured individual attributes that do not change over time. Since this difference may be a reflection of differences in the broader social and economic environment, we use the comparison group baseline and follow-up control measures to obtain C1 and C2 differences. Given the two period setting, where $t = 0$ before borrowing and $t = 1$ after borrowing, letting Y_t^T and Y_t^C be the respective outcomes of treatment and control units in time t , the DID method was used to estimate the average microcredit impact as follows:

$$Food\ Security_{it} = E((Y_1^T - Y_0^T) | T_i = 1) - E((Y_1^C - Y_0^C) | T_i = 0), \quad (3)$$

where $Food\ Security_{it}$ is one of our seven measures of food security, $T_i=1$ denotes respondent accessing credit, whereas $T_i=0$ denotes the comparison group that never received or applied for microcredit. The DID estimator has the advantage of allowing for unobserved heterogeneity (the unobserved difference in mean counterfactual outcomes between treated and untreated units that could lead to select bias). We improved the DID methodology by combining it with Kernel matching (Khandker *et al.*, 2010). We used propensity scores of factors (socio-demographic and personality characteristics of NB and CG) which could influence participation into the microcredit program to match controls and borrowers on pre-program characteristics, in the baseline year. We then obtained differences between NB and CG groups within the common support, on different food security parameters.

In addition to the DID with Kernel matching we use the data in the common support region to run a standard GLS model with fixed effects. In this case each woman in the sample is traced both in the baseline and follow-up to form a panel of data. This way

$$Food\ Security_{it} = \alpha_i + T_{it} + \delta_t + \varepsilon_{it}, \quad (4)$$

where $Food\ Security_{it}$ is again one of our seven measures of food security, α_i is the individual level fixed effect term, T_{it} is once more the microcredit treatment, δ_t represents a time dummy and ε_{it} the error term.

4. Results

4.1 Cross-sectional study results

In this section we present results for 533 respondents we used in the cross-sectional comparison of old borrowers OB ($n = 312$) and New borrowers ($n = 222$). As mentioned before, propensity score matching was used to improve comparability of the two groups. It was also used to determine the average treatment effect on the treated (ATT), a measure of differences between treatment and controls, after controlling for variables that could influence taking credit, but not food security.

Descriptive characteristics of the respondents in the cross-sectional study before and after matching on factors that would influence microcredit participation are shown in Table 2. The dependency ratio defined as the ratio of dependents (aged 0–14 years and those over 65 years) to the household productive members (15–64 years), was about 1.48 for entire sample. This is lower than the national average. Respondents in the whole sample scored high on the time preference scale, indicating a moderately high future bias, and they scored around neutral on the risk measurement scale. The majority of the respondents (70%) were married. The respondents in both groups typically had limited formal education, the majority having completed 7 years of primary education. Older respondents were more likely to be in the OB group.

The PSM method is useful to reduce differences in observable characteristics between borrowers and non-borrowers. Matching is expected to balance the distribution of explanatory variables across OB and NB groups. Table 3 contains covariate after-matching balancing test results for the two-sample *t*-test of mean differences between OB and NB women. The major observation from Table 3 is that all covariates are balanced since differences

Table 2: Socio-demographic Characteristics of OB and NB in Unmatched Cross-sectional Samples

Variables	Pooled mean	Min	Max	OB mean	NB mean	t-test (OB-NB)
Age at borrowing	34.27 (10.12)	19	72.05	35.39 (10.6)	32.86 (9.3)	-2.77**
Education	7.31 (3.30)	0	14	7.27 (3.34)	7.31 (3.39)	0.13
Dependency ratio	1.45 (1.28)	0	9	1.47 (1.3)	1.43 (1.2)	-0.38
Time preference scores	3.41 (0.80)	1	4	3.44 (0.80)	3.40 (0.80)	-0.57
Achievement motivation score	1.06 (0.19)	0.33	2	1.05 (0.19)	1.05 (0.19)	-0.10
Risk preference	2.30 (1.00)	1	4.33	2.32 (1.05)	2.27 (0.96)	-0.56
Anglican (%)	0.3 (0.45)	0	1	0.32 (0.47)	0.26 (0.44)	(2.39) ¹
Pentecostal (%)	0.14 (0.35)	0	1	0.12 (0.33)	0.16 (0.37)	(1.78) ¹
Muslim (%)	0.23 (0.41)	0	1	0.25 (0.43)	0.19 (0.4)	(2.07) ¹
Marital status (%)	0.70 (0.46)	0	1	0.70 (0.46)	0.71 (0.46)	(0.01) ¹
Household asset index	2.16 (0.83)	0.22	6.22	2.23 (0.82)	2.07 (0.83)	-2.06**
Housing facilities index	0.46 (0.35)	0	1.25	0.47 (0.36)	0.46 (0.34)	-0.44

**Significant $p < 0.05$.
¹Pearsons Chi-square values.

between the OB and NB samples are not significant after matching. Hence the matched groups can be considered similar with respect to matching variables.

Results of the PSM analysis (Table 4) found borrowers with running loans (OB), with significantly smaller dietary diversity scores and proportion of energy from own production, than incoming borrowers (NB). OB dietary diversity scores were 0.64 points smaller than NB. They also took 2% smaller proportion of energy from fat and 8% smaller proportion of energy consumption from own production than NB. We disaggregated the household dietary diversity components further and found OB to have smaller fruit-intake and sugar-intake scores than NB (see Table A1 in the Appendix). Also, Table 4 shows that total food expenditure was similar across the two groups but that the expenditures of other household members on food were significantly lower in OB. The average caloric intake values we find is similar to that given in the 2006 Uganda Demographic and Health Survey. The baseline figure for the Ugandan population is 2,220 Kcal, according to the Uganda Nutrition Action Plan (UNAP, 2011), not too far from our estimates. Also, the Uganda Food Consumption Survey (Harvey *et al.*, 2010) found the average calories intake of women of reproductive age to be over 2,000 Kcal per day (the 50th percentile ranges

Table 3: T-tests for Equality of Means for Matched Samples (Common Support)

Variables	OB	NB	t-test	% Bias
Dependency ratio	1.59	1.64	−0.19	−4.2
Age at borrowing	35.07	34.72	0.83	3.5
Education	7.36	7.23	0.44	4.0
Time preference score	3.46	3.43	0.39	3.4
Achievement motivation score	1.06	1.06	0.42	3.8
Risk preference	2.30	2.27	0.09	1.7
Anglican (%)	0.32	0.31	0.20	1.9
Pentecostal (%)	0.14	0.13	−0.12	−1.1
Muslim (%)	0.22	0.23	−0.38	−0.31
Marital status (%)	0.70	0.72	−0.53	−4.8
Household asset index	2.21	2.23	0.14	1.3
Housing facilities index	0.47	0.46	0.73	−1.2

Note: $**p < 0.05$, $*p < 0.10$. The standardised % bias is the percentage difference of the sample means in the OB and NB samples, as a percentage of the square root of the average of the sample variances in the respective groups.

Table 4: Differences Between OB and NB Food Security Parameters, Kernel Matching

	OB		NB		Difference ATT	t
	N	Mean	N	Mean		
Caloric intake ¹	250	2,351.31	206	2,393.40	−42.07 (104.56)	−0.40
Dietary diversity score	250	6.16	205	6.81	−0.64 (0.21)	−3.02
HFIAS score ²	257	4.72	212	4.00	0.72 (0.44)	1.62
Proportion of energy from fat	246	0.14	210	0.16	0.02 (0.01)	−2.51
Proportion of own-food production ³	228	0.47	195	0.55	−0.08 (0.03)	−3.05
Log of 7-day per-capita food expense	199	8.48	170	8.64	−0.15 (0.29)	−0.38
Log of monthly food expenditure by others	250	6.90	209	8.14	−1.2 (0.5)	−2.49

Note: Figures in parentheses in the Difference column are standard errors. $**p < 0.05$, $*p < 0.10$.

¹Adult Male Equivalent.

²30-Day Household Food Insecurity Access Scale score.

³Energy from own-food production proportion.

from 2,100 of Northern Uganda to 2,800 of the South-West). Our figure may therefore not be considered unusual. Since we found no difference in caloric intake, we conducted a robustness check by replacing the standard Adult Male Equivalent measure with one that disaggregates better for age and gender (Claro *et al.*, 2010)—results did not change. As an additional robustness check for our result we conducted the PSM procedure using Radius matching and nearest neighbour matching (see Table A1 in the Appendix).

4.2 Sensitivity analysis using R-bounds

We conducted a sensitivity analysis of our matching procedure to obtain information about possible hidden bias or bias from unobserved respondent characteristics with potential to

influence self-selection into microcredit program. Such unobservable variables might bias our conclusions about the effects of microcredit and we tested this by conducting a Rosenbaum sensitivity analysis as described by Rosenbaum (2010) and DiPrete and Gangl, 2004). Appendix A2 provides p -values for Wilcoxon signed rank tests for different levels of gamma (Γ), the odds ratio of differential treatment assignment due to unobservable attributes. At each Γ a critical p -value is shown, indicating the limit of significance level of the treatment effect due to endogenous selection into treatment. We present results for up to $\Gamma = 3$, for weekly household food cost and for dietary diversity scores, some of the major outcomes of our study. Results indicate that unobservable covariates would need to change the odds of treatment assignment by factors beyond 3 (we obtained results to as high as 56 and the significance did not change) to conclude that the observed treatment effects from propensity score matching were due to non-random assignment. Given the results of the sensitivity analysis for PSM, and the lack of suitable instruments explaining group membership, we refrained from conducting an instrumental variables regression on our data. To check if our result holds even across different analytical techniques, we conduct DID analysis on 2-year panel data, as described below.

4.3 Panel study results

The panel data analysis was conducted on a total of 448 respondents. The treatment group in the panel study were 222 new borrowers (NB) who at baseline were just about to get their first loan. The comparison group (CG), were 226 women from the same village as NB but who never got a loan from BRAC or other MFI. We cluster standard errors at the village level (138).

Table 5 shows that the unmatched samples. Respondents in the comparison group were older, less educated and more risk averse than the NB category. That the two groups were different is not surprising, since the NB category had self-selected to participate in the microcredit program and the CG had not. We incorporated Kernel matching, in our DID analysis, to improve comparability of the two groups, based on observable variables including two wealth indices (housing index and asset index) and demographic and personality characteristics that would influence the decision to take credit. Once Kernel matching is performed, and data outside the common support region is excluded, the panel shows strongly balanced treatment and comparison groups with respect to the selected variables. Once again, we cannot exclude that some unobserved characteristics may be driving our results. Yet, making use of a panel setting and a GLS fixed effects ensures that all time-invariant unobservables are taken care of.

Table 6 shows the mean at time 0 and time 1 for the seven different food security parameters. The last two columns show respectively the outcomes of the difference-in-difference with Kernel matching and Generalised least squares with individual fixed effects models. In both cases there is strong evidence that microcredit uptake resulted in a robustly significant reduction in dietary diversity at the household level. Table A3 in the Appendix shows that this can be traced down to a reduction in the diversity of consumption of animal and sugar intake, and to a lesser extent of fruits, starchy staples and vegetables. Once again, this result refutes the argument that households may be switching to more nutrient-dense food, and thus experiencing a decline in calories while maintaining their nutrition levels. While the result from the cross-sectional analysis regarding lower proportion of own-food production

Table 5: T-tests for Equality of Means for Unmatched and Matched Panel Samples (Common Support)

Variables	Unmatched sample			Matched sample			% Bias
	NB (=163)	CG (=207)	<i>t</i> -test	NB (=160)	CG (=173)	<i>t</i> -test	
Dependency ratio	1.43	1.49	−0.53	1.43	1.51	−0.71	−6.80
Age at borrowing	32.94	35.70	−2.72**	32.94	33.31	−0.39	−3.50
Education	7.35	6.47	2.56**	7.35	7.36	−0.04	−0.40
Time preference score	3.38	3.30	0.99	3.38	3.40	−0.23	−2.10
Achievement motivation score	1.06	1.13	−2.51**	1.06	1.06	0.02	0.20
Risk preference	2.28	2.05	2.52**	2.28	2.32	−0.42	−4.30
Anglican (%)	0.27	0.26	0.08	0.27	0.28	−0.44	−4.30
Pentecostal (%)	0.15	0.15	−0.24	0.16	0.17	−0.55	−5.40
Muslim (%)	0.20	0.17	0.84	0.20	0.19	0.28	2.80
Marital status (%)	0.70	0.71	−0.21	0.70	0.70	0.14	1.30
Household asset index	2.09	2.09	−0.10	2.09	2.10	−0.13	−1.20
Housing facilities index	0.46	0.35	3.39**	0.46	0.44	0.57	5.60

Note: ***p* < 0.05. Matched sample on common support region only. The standardised % bias is the percentage difference of the sample means as a percentage of the square root of the average of the sample variances in the respective groups.

Table 6: Panel Differences: Diff-in-Diff with Kernel Matching and GLS Fixed Effects

		T0		T1		Diff-in-Diff	GLS (fe)
		Mean	Diff	Mean	Diff		
Caloric intake	CG	2119.3	256.38	2449.4	78.09	−178.29	−278.96*
	NB	2375.7	(112.94)	2527.4	(126.24)	(169.38)	(148.38)
Dietary diversity score	CG	5.22	0.22	4.81	−0.64	−0.86**	−1.03***
	NB	5.44	(0.21)	4.17	(0.21)	(0.30)	(0.28)
HFIAS score	CG	7.48	−3.40	7.00	−3.17	0.23	0.72
	NB	4.08	(0.54)	3.83	(0.59)	(0.80)	(0.59)
Proportion of energy from fat	CG	0.15	0.01	0.14	0.01	0.01	0.01
	NB	0.16	(0.01)	0.15	(0.01)	(0.01)	(0.01)
Proportion of own-food consumption	CG	0.51	0.03	0.59	0.00	−0.03	−0.01
	NB	0.54	(0.03)	0.60	(0.03)	(0.04)	(0.03)
Log 7-day per- capita food expense	CG	8.22	0.01	8.06	0.11	0.02	0.05
	NB	8.31	(0.09)	8.17	(0.10)	(0.14)	(0.10)
Log of monthly food expenditure by others	CG	6.69	1.65	7.05	0.63	−1.02	−0.99*
	NB	8.35	(0.62)	7.68	(0.58)	(0.78)	(0.57)

Note: Standard errors clustered at the village level in parenthesis. ****p* < 0.01, ***p* < 0.05, **p* < 0.10. Diff-in-Diff and GLS performed on the common support region using Kernel matching. GLS model also controls for time effects.

over the total food consumed seems instead not to be confirmed by the panel analysis, we find that caloric intake is significantly lower at the 10% level, as is the reduction in food expenditures by other household members.

5. Discussion and conclusions

We assess the effects of microcredit on the food security of households in Uganda, using a variety of indicators and assessment methods. We conduct a cross-sectional analysis comparing old clients to newly registered first time borrowers. Next, we compare first time borrowers and non-borrowers using a panel design. Overall, we reject the hypothesis of improvement in food security of households through microcredit. We find robustly lower dietary diversity among long-time borrowers than new borrowers, and larger reductions in dietary diversity scores among new borrowers, after 1 year, compared to controls. The reduction in dietary diversity was traced to a reduction in animal-source food, fruit and sugar intake. variety in consumed starchy food also goes down, pointing to increased expenditure to maintain a basic monotonous diets based on maize, supplemented with beans. This may be particularly damaging especially to younger members of the household (i.e., children below the age of 5), as the quality of calories absorbed may go down, even at equal caloric intake levels.

While we find indicative evidence that these changes are partly explained by a shift from own production to reliance on food purchase by households, the mechanism behind such negative shift remains unclear. It is possible that microcredit acts as ‘a commitment mechanism’ to invest in MEs—even to the point of eating less. It is also possible that clients lack the knowledge or understanding to make accurate estimates of the potential benefits of borrowing. If so, borrowing may represent an additional risk, which may not pay-off in specific years, even on aggregate. In fact, our study presents some limitations, especially with respect to the extent to which we can draw definitive conclusion about the effect of microcredit on food security. Firstly, even in the panel setting, it only covers a 1-year period of data. It is possible that investments have longer-term returns, and that the benefits with respect to food security are therefore only postponed. Secondly, we focus on aggregate household level outcomes, with limits exploration of intra-household and gender dynamics, and only look at food security outcomes at the household level. Thirdly, groups of borrowers that select into borrowing several years apart do not necessarily have the same expected return to borrowing. Finally, it is possible that households opt into the microcredit program when they anticipate future shocks, essentially treating the microcredit groups as an informal insurance scheme. Thus, borrowers look worse after participating in the program, but this is due to a pre-existing trend or expectations that are not observable to the surveyor.

In general, FGD participants commended BRAC as a steady and reliable source of short-term loans, to meet family needs, which they would otherwise not be able to access (Namayengo *et al.*, 2016). Yet, the rigors and burden of loan repayment may well be the single most important cause of the declining food security level among the borrowers’ households. In the absence of substantial income increases these may be exacerbated by the need to repay the loan. Some women in our focus groups indicated they would rather not eat, in order to have funds for loan repayment. More likely, women perform an imperfect substitution of the calories consumed, focusing on an easier to access yet less diverse diet. Moreover, we find evidence that other household members reduce their contribution to the household’s food expenditures once the microcredit is disbursed. Focus group discussions indicated that this may be a consequence of increased perception of financial independence by women, even if their income has not factually increased.

As Adams and Von Pischke (1992) indicated, women need more than credit to improve their own welfare and that of their households. Eradication of food insecurity will require improvement in agricultural production, improvement in quality of education and health as well as infrastructure improvement (FAO, 2000a). Yet these long-term improvements should be matched with greater efforts by policy makers to contrast short-term effects of the increased engagement of women in microenterprises and income generation, especially in relatively poorer rural communities.

Supplementary material

Supplementary material is available at *Journal of African Economies* online.

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