

Does Institutional Finance Matter for Agriculture?

Evidence Using Panel Data from Uganda

Shahidur R. Khandker

Gayatri B. Koolwal

The World Bank
Development Research Group
Agriculture and Rural Development Team
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Abstract

Smallholder agriculture in many developing countries has remained largely self-financed. However, improved productivity for attaining greater food security requires better access to institutional credit. Past efforts to extend institutional credit to smaller farmers has failed for several reasons, including subsidized operation of government-aided credit schemes. Thus, recent efforts to expand credit for smallholder agriculture that rely on innovative credit delivery schemes at market prices have received much policy interest. However, thus far the impacts of these efforts are not fully understood. This study examines credit for smallholder agriculture in the context of Uganda, where agriculture is about 35 percent of gross domestic product, most farmers are smallholders, and the country has introduced policies since 2005 to extend credit access to the sector. The analysis uses newly available household panel data from Uganda for 2005–

2006 and 2009–2010 to examine (a) whether credit effectively targets agriculture, by examining determinants of borrowing across different sources; (b) agricultural and nonagricultural determinants of supply and demand credit constraints among non-borrowers; and (c) the effects of borrowing and credit constraints on household income, consumption, and agricultural outcomes. The analysis finds that although not many households report borrowing specifically for agriculture, credit is fungible and agricultural outcomes do substantially improve with institutional borrowing, particularly microcredit. Among non-borrowers, supply and demand credit constraints have fallen considerably over the period, particularly in rural areas. Access to institutions and infrastructure play a strong role in alleviating the negative effect of credit constraints on welfare outcomes, as well as determining the source of lending among borrowing households.

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Shahidur R. Khandker
Gayatri B. Koolwal

World Bank

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1. Introduction

The role of credit in supporting agriculture, including its potential to help households handle risk, and purchase inputs/technology to improve agricultural productivity, has garnered recent policy interest in many developing countries. Examining these questions has traditionally been difficult, because of limited access to credit in areas where agricultural activity is high — in Sub-Saharan Africa, for example, agriculture reaches nearly 40 percent of GDP in some countries, is heavily concentrated in smallholder activities, and access to credit in the region is among the lowest worldwide. Within Sub-Saharan Africa, recent efforts to expand credit to agriculture have received much attention (including from the World Bank's "Agriculture Action Plan" for FY2010-2012) but thus far the initial impacts of these efforts are not fully understood.

This study uses newly available panel data from Uganda, which has experienced a recent push to expand access to credit for farmers, to help address the channels by which credit can help agriculture. In Uganda, agriculture makes up about 35 percent of GDP, and the agricultural sector employs about 73 percent of the active labor force, compared to services (22.5 percent) and industry (4.2 percent) (Nuwagaba, 2012). Virtually all rural households are in farming, about 80 percent of which are smallholder farmers — as well as nearly half of households in urban areas where farming has grown rapidly in recent years due to concerns about food adequacy (see, for example, Mukwaya et. al., 2012). However, because of limited access and perceived risks of agricultural loans, agriculture receives only about 9% of total commercial bank credit annually — of which crop production receives about 3% and crop finance (or trade in agricultural output) receives the rest (Mpuga, 2004). In the past, therefore, most rural households have relied on informal sources for their borrowing needs.

Specifically, our study examines (a) whether credit effectively targets agriculture, by examining determinants of borrowing across different sources ; (b) agricultural and non-agricultural determinants of credit constraints; and (c) the effects of borrowing and credit constraints on household consumption, income, and agricultural outcomes. Our data come from the Uganda National Household Survey (UNHS), which is nationally-representative and covers a panel of about 2,600 households between 2005-06 and 2009-10. The survey allows us to examine effects across different sources of institutional (as opposed to informal) borrowing, including banks/government sources, microcredit, and cooperatives; cooperative credit in particular has expanded rapidly since 2005 as a source of borrowing by agricultural households. The UNHS also elicits supply and demand credit constraints among nonborrowers, which can allow a partial picture of factors that affect credit constraints, as well as how these constraints affect outcomes.

Our analysis uses a panel fixed-effects estimation to examine effects on household outcomes, controlling for pre-survey (2001) household and community characteristics to account for time-varying unobserved heterogeneity over the period (Jalan and Ravallion, 1998, 2002). We find that while not many households report borrowing specifically for agriculture, credit is fungible and agricultural outcomes do substantially improve with institutional borrowing, particularly from microcredit. Among nonborrowers, supply and demand credit constraints have fallen considerably over the period, and particularly in rural areas that are associated with significantly worse household outcomes across per capita expenditure, sources of income, and agricultural outcomes. Access to facilities and infrastructure play a strong role in alleviating the negative effect of credit constraints on outcomes, as well as determining the source of lending among borrowing households.

In the paper, Section 2 discusses the recent literature on access to credit and agricultural outcomes. Section 3 presents Uganda's recent efforts to expand finance to

agriculture, as well as a description of the UNHS and summary statistics. Section 4 presents the empirical methodology in greater detail. Section 5 discusses the results, and Section 6 concludes.

2. What is known about the role of institutional finance in agriculture?

Credit for smallholder agriculture has historically been limited in most developing countries; where institutional finance is available, non-farm activities have typically been targeted. Smaller farmers face a number of risks to their livelihoods, including unpredictable weather and crop price variation. These risks may also affect their investments in productivity-enhancing technologies, as well as their options for borrowing. In the presence of credit constraints, lack of access can significantly lower outcomes for agricultural households through different channels.

Using panel data from Northern Peru, Guirkinger and Boucher (2008) find that credit constraints lower the value of agricultural output substantially, whereas productivity is independent of endowments such as land and liquidity for unconstrained households. Credit-constrained farmers can also misallocate resources for agricultural production (Carter, 1989; Feder et. al., 1990; Foltz, 2004). And in a study of land tenure security reforms in Paraguay, Carter and Olinto (2003) find that without an adequate supply of credit, increased tenure security and accompanying demand for land can lead to under-investment in other capital for agriculture for liquidity-constrained farmers.

Aside from farming, agricultural households in developing countries often diversify their income across different sources, and credit constraints can hamper their ability to take up nonfarm activities (Ellis, 2000). Some caveats exist however — credit can also be fungible, and even perfect monitoring does not necessarily mean that credit for production activities cannot substituted for consumption or other purposes. Feder et al. (1990), for

example, found in a study of rural China that farmers experienced high credit constraints, but substantial amounts of borrowing for agriculture were funneled towards consumption, dampening the extent to which agricultural credit could affect incomes. The fungibility of credit could also work the other way, however, with borrowing for consumption being used for production as well. The enhanced ability to smooth consumption may also permit households to choose riskier but higher yielding contracts from among those offered in agricultural markets (Pitt and Khandker, 1999), potentially increasing as well as smoothing household consumption across seasons.

The source of borrowing also matters. Governments in many developing countries have made recent efforts to improve access to credit for farmers without large landholdings,¹ which makes the role of banks and microfinance institutions (MFIs) an interesting policy question. Pitt and Khandker (1998, 1999), for example, find in Bangladesh that consumption-poor households and those with higher than average seasonal fluctuations in consumption and labor supply would be more likely to participate in microcredit programs. Pitt (2000) also finds in Bangladesh that participating in microcredit induces a significant increase in own-cultivation through sharecropping, along with a complementary increase in male hours in field crop self-employment and a reduction in male hours in the wage agricultural labor market, consistent with presumed effects in diversifying income and smoothing consumption.

As for commercial and/or agricultural banks, most studies have found that the supply-led approach to agricultural credit that has historically been pursued in many

¹ This includes extending agricultural lines of credit directly to local banks, which then provide loans to farmers and rural entrepreneurs. Prior to the 1990s, multilateral institutions like the World Bank managed the disbursement of agricultural finance directly through project implementation units (World Bank, 2003). Some examples include the Rural Finance Projects in Vietnam and the SAGARPA program in Mexico; the Financial Services for the Poorest program in Bangladesh; as well as programs where technology upgrades and training are provided to local financial institutions (the Strengthening India's Rural Credit Cooperatives program, and the Ghana Rural Financial Services Project).

developing countries has created viable alternatives to moneylenders, albeit for households with somewhat greater assets and sources of collateral. Binswanger and Khandker (1995) find that better access to banks also spurred fertilizer use and investment in agriculture, but has been less successful in generating viable institutions, including failing to generate agricultural employment.

A growing number of studies of Sub-Saharan Africa examine the effects of extending credit access for agriculture and helping households manage risk. Using national data from Rwanda, Ali, Deininger and Duponchel (2014) find that relieving household credit constraints would increase agricultural output by around 17 percent. They also find that access to information through media and participating in networks like farmers cooperatives can contribute significantly to reducing credit constraints. From a randomized study in Mali, Beaman et. al. (2014) find that MFI agricultural loans in randomly selected villages, compared to cash grants offered to randomly selected households in non-program villages, boosted purchases of agricultural inputs and farm profits for farmers with high returns to capital. However, take-up of the lending program was still low, indicating that constraints in addition to access are also an issue. And in a recent study of Ghana, Quartey et. al. (2012) argue that credit access alone is not sufficient to boost agricultural production; agricultural profitability also needs to be improved through better efficiency of pricing and marketing agricultural production, to ensure that loans actually boost productivity and farmers do not end up in debt. Agricultural insurance is another policy area being examined to help farmers manage production risks (Karlan, Osei, Osei-Akoto and Udry, 2014).

3. Ugandan context and data

The state of institutional credit in Uganda

More than half of Uganda's population is unserved by any kind of financial institution, formal or informal. Much of Uganda's institutional finance has been maintained by commercial banks which are typically inaccessible to higher-risk and geographically isolated households. As a result, the shortfall in lending is even more pronounced within agriculture.

In recent years, however, the Ugandan government has increased its emphasis on supplying credit to agriculture. This includes a push since 2005 to improve access to microfinance as well as cooperatives so that low-income households could have options to save and borrow, including a Microfinancing Support Centre offering loans to farmers at subsidized interest rates of around 9 percent (as well as commercial credit at 13 percent). Since 2005, the government has also encouraged and promoted Savings Credit and Cooperative Societies (SACCOs) to accelerate the accessibility of loans, which are community membership-based financial institutions that are formed and owned by their members in promotion of their economic interests. This expansion in semiformal credit has not been without problems, however, including claims of inequitable distribution of loans across areas due to limited regulation and supervision, as well as some MFIs and SACCOs raising their lending rates to market levels similar to those charged by commercial banks. In this study, we examine how take-up of MFI and cooperative credit has changed in Uganda since 2005, as well as their effects on household agricultural and other outcomes.

Other initiatives include the establishment of an Agricultural Credit Facility in 2009 across 11 banks for farmers to acquire agro-processing machinery and equipment at subsidized interest rates. Centenary Bank, one of biggest commercial banks in Uganda, and a partner with Agrifin, has the majority of its branches in rural areas and has been expanding rapidly since 2004. Compared to other banks, Centenary Bank has reached more

customers in rural areas than any other institution in the country. Direct product distribution channels such as mobile banking are other alternatives being used (including electronic point-of-sale devices run by the Uganda Microfinance Union in rural areas), as well as partnerships with market-facilitating institutions. Policy makers are being challenged to explore new ways to expand financial access effectively and sustainably, in the absence of the large-scale government agricultural subsidies of the past.

Data: Uganda National Household Survey

In this study, we use the Uganda National Household Survey (UNHS), which covers 3,123 households between 2005-06 and 2009-2010, with a panel sample of 2,607 households from both rounds. Over the survey period, economic activity in the nonfarm sector did increase, but households still remained heavily involved in agriculture. Table 1 shows that 77 percent of the population lives in rural areas, and more than 90 percent of rural households own or operate farms; almost half of urban households are also in farming activities. The survey asked details about loans taken by the household across different institutional and informal sources, presented in Table 1, as well as the purpose of borrowing across agricultural, nonfarm enterprise, consumption and other activities (Table 2).² The credit module in both survey rounds also asks about reasons for not borrowing (such as no need, inadequate collateral, or terms too expensive); summary statistics are presented in Table 3. The agricultural module of the UNHS is very detailed and asks about production and inputs used in each farming and livestock activity of the household.

Characteristics of household borrowing

² Amount of borrowing was only recorded in the 2005 round. The 2005 round also surveyed borrowing at the individual level, whereas the 2009 round aggregated these questions to the household level. The mode of questions and response categories were consistent across the two surveys, however.

Looking at Table 1, borrowing from any source increased substantially in both rural and urban areas over the 4-year period, from 27 to 42 percent in rural areas and 31 to 49 percent in urban areas. This increase is primarily attributable to the share of households borrowing from institutional sources (banks/government sources, microfinance, and cooperatives), which rose from 39 to 51 percent in rural areas, and 47 to 56 percent in urban areas. Borrowing from informal sources (family and friends, as well as local moneylenders), on the other hand, declined over the period. Within institutional sources, borrowing increased primarily from cooperatives in rural areas, and formal banks and cooperatives in urban areas. The increase in cooperative borrowing includes the recent push from SACCOs among farmers in Uganda; the data show no borrowing from cooperatives in 2005. Borrowing from cooperatives has also grown much faster compared to traditional MFIs/NGOs, reflecting interesting differences in Uganda's credit markets compared to other countries. Cooperative borrowing also appears to be making up for some part of the decline in borrowing from family and friends in both regions.

Table 2 presents households' reported reasons for taking a loan, spanning (1) agriculture, (2) nonfarm enterprises, (3) housing/building materials, (4) consumption expenditure, and (5) other purposes.³ The figures reflect shares of borrowing households, for which the breakdown is given in Table 1 as well as the bottom of Table 2. We discuss purpose of borrowing mainly to provide a context for borrowing in these areas, since credit can ultimately be fungible across different activities. To see whether reasons for borrowing vary by loans from formal versus semiformal sources, we broke up the share of borrowing households by source of institutional borrowing as well, which is why the sample sizes are

³ In the UNHS, purpose of borrowing was divided into several categories : (1) buy land ; (2) buy livestock ; (3) buy farm tools and implements ; (4) buy farm inputs such as seeds, fertilizer, pesticides ; (5) purchase inputs/working capital for non-farm enterprises ; (6) buying a house/pay for building materials ; (7) buy consumption goods and services ; (8) pay for education expenses ; (9) pay for health expenses ; (10) pay for ceremonial expenses. For ease of presentation we group together (1)-(4) under agriculture, and (7)-(10) under consumption expenditure.

quite small – reflecting the share of households taking loans for a specific reason from a specific source.⁴

Has the increase in cooperative lending, much of which was targeted towards agriculture in recent years, affected agricultural borrowing over the period? Looking at Table 2, borrowing for agriculture has certainly increased from cooperative sources in rural and urban areas, with a much greater increase in rural areas. Cooperative borrowing for other purposes has also risen, primarily for consumption and nonfarm enterprise activity in rural areas.

Agricultural borrowing from other sources such as banks and MFIs, varies by region. It fell in rural areas, indicating a substitution of agricultural borrowers towards cooperatives, but a closer look at the data revealed that the decline in MFI borrowing in rural areas was focused mainly for larger landowning households.⁵ In urban areas, agricultural borrowing from non-cooperative sources actually rose, mainly for purchasing land and livestock, and was also focused on households at the bottom end of the landowning distribution.⁶

Agricultural borrowing therefore has been on the rise, and focused on poorer households, but it depends on the source. Similarly, for other purposes of borrowing such as nonfarm activity or consumption, we find sharp differences in trends across sources of borrowing. In both urban and rural areas, for example, borrowing for nonfarm enterprises declined under MFIs, but increased from other sources, particularly cooperatives in rural areas. We found that this trend did not vary by households' position in the landholding or per capita expenditure distribution. MFI borrowing, on the other hand, seems to be

⁴ For example, in Table 2, the number of rural households borrowing from banks/government agencies in 2005 was 22. This corresponds to 0.04×544 in column 1 of Table 1.

⁵ The decline in agricultural borrowing from formal banks occurred for most farmers across the distribution. Results available upon request.

⁶ Results available upon request.

strongly associated with consumption needs, particularly in rural areas, where borrowing for consumption from these sources rose from 33 to 54 percent over the period, and fell under bank/government institutions. Expansion of cooperative credit for consumption through SACCOs is also reflected in Table 2.

Credit constraints among nonborrowers

In the UNHS, nonborrowers were asked in each round their reasons for not taking in a loan in the last 12 months. These were: (1) no need, (2) believed would have been refused, (3) limited collateral, (4) do not like taking debt, (5) do not know any lender/no access, and (6) too costly. Following the discussion on survey questions eliciting credit constraints in Boucher, Guirkinger and Trivelli (2009), we can construct indicators of supply-side and demand-side credit constraints among nonborrowers based on their reported reasons for not borrowing. If the reason for not borrowing was fear of being rejected or limited collateral, we designated the household as supply-side credit constrained. If their reasons for not borrowing were related to (a) risk rationing (not liking to take debt), or (b) transaction-cost rationing (too costly and/or lack of access to lenders), we designated those households as demand-side credit constrained. Because of the way responses were elicited in this question, there is no overlap between supply-constrained and demand-constrained individuals. Our analysis of credit constraints in this paper is also limited to nonborrowers, since the UNHS did not ask similar questions among borrowers.

Looking at Table 3, we find that supply and demand credit constraints among nonborrowers have broadly fallen over the period in both rural and urban areas.⁷ This includes the share of households concerned about limited collateral (supply constraint),

⁷ Because of some missing values, the sample size at the bottom of Table 3, reflecting the number of nonborrowing households, does not exactly equal the difference between the total sample and number of borrowing households (Table 1).

which fell from 23 to 14 percent in rural areas and 28 to 15 percent in urban areas, as well as the share of households with limited access to credit (demand constraint), which fell from 30 to 5 percent in rural areas, and 11 to 1 percent in urban areas. In fact, other than access, there were no large reported differences in credit constraints across rural and urban areas.

Reports of some specific credit constraints did increase over the period, such as concerns among rural households that they would be refused a loan, as well as the share of rural and urban households not liking to be in debt (risk rationed). The share that thought it was too costly to borrow also remained about the same in rural areas, even though it declined in urban areas.

Overall, access and availability of credit appear to have improved greatly — concerns about lack of access and limited collateral fell dramatically over the period. A related issue is that households might simply be better off by 2009 — despite the rise in borrowing over the period (Table 1) more households reported they did not need to borrow in 2009 compared to 2005.

4. Empirical methodology

Our main empirical strategy employs household-level fixed-effects estimation, controlling for initial (2001) household and community characteristics, to account for unobserved time-varying heterogeneity (Jalan and Ravallion, 1998, 2002). We outline this approach for each of the main questions discussed in Section 4.

Determinants of borrowing

Using the household-level panel survey, we first examine household and community-level correlates of borrowing b_{ijt} over time, among agricultural households i

living in community j . Specifically, we look at whether the household borrowed from a formal bank/government source (b_{ijt}^B), an MFI (b_{ijt}^M), or a cooperative (b_{ijt}^C), in the past 12 months. We estimate a household panel fixed-effects regression; X_{ijt} includes such household variables as gender and marital status of the household head, education of adult men and women, sex/age composition of household members. Community characteristics V_{jt} include access to schools, banks, healthcare facilities, infrastructure, and agricultural extension services. The estimation also controls for time-invariant unobserved heterogeneity at the household level (η_i) and community level (μ_j), as well as a vector of idiosyncratic errors distributed across households ϵ_{ijt} :

$$b_{ijt}^r = \beta X_{ijt} + \gamma V_{jt} + \eta_i + \mu_j + \epsilon_{ijt}, r = \{B, M, C\} \quad (1a)$$

With the panel fixed-effects approach, we can difference both sides of equation (1a) over time to remove fixed unobserved heterogeneity that may simultaneously affect borrowing as well as changes in X_{ijt} and V_{jt} :

$$\Delta b_{ijt}^r = \beta \Delta X_{ijt} + \gamma \Delta V_{jt} + \Delta \epsilon_{ijt}, r = \{B, M, C\} \quad (1b)$$

However, the above equation yields consistent estimates only if unobserved community and household heterogeneity do not vary over time. Although our panel covers a fairly short five-year time span, changes in credit access might have altered unobserved characteristics of households (such as motivation to make productivity-enhancing investments) that also affected outcomes over the period as well. In this study, given the short time span, we argue that any potential time-varying heterogeneity will be dependent mainly on initial area/community characteristics of the sample, which would affect both changes in access to credit as well as how households are able to respond to this change. Controlling for these initial conditions can therefore help account for potential time-varying unobserved

heterogeneity (Jalan and Ravallion, 1998, 2002; Ravallion, 2007). We can therefore rewrite (1b) as:

$$\Delta b_{ijt}^r = \beta \Delta X_{ijt} + \gamma \Delta V_{jt} + \beta_0 \Delta(X_{ij0} * t) + \gamma_0 \Delta(V_{j0} * t) + \Delta \epsilon_{ijt}, r = \{B, M, C\} \quad (2)$$

Above, X_{ij0} covers initial household correlates of borrowing, including ethnicity, and household inherited agricultural landownings,⁸ nonfarm assets and household construction; we also included whether the household's main source of earnings in 2005 was subsistence farming, wage work, or nonfarm enterprise work. Initial community characteristics V_{j0} come from 2001, four years prior to the 2005 survey round, and include access to facilities such as banks and infrastructure. Regional dummies across rural and urban areas were also included.⁹ Expressing changing village and household heterogeneity in terms of initial conditions X_{ij0} and V_{j0} , which are interacted with time t , we can estimate equation (2) using a simple panel fixed-effects framework. The results for determinants of borrowing are presented in Table 5.

Determinants of supply-side and demand-side credit constraints among nonborrowers

In equation (2) above, the observed pattern of borrowing is a function of both demand and supply-side factors related to credit. This includes household preferences for borrowing which may be unmeasured, as well as access to credit and the returns to investment. While the surveys do not elicit credit constraints for borrowing households, for nonborrowing households, we can use the data in the surveys to understand how household and village-level factors, including credit supply chains, affect supply or demand credit constraints ($c_{ijt}^k = 0$ if the nonborrowing household is unconstrained, and $c_{ijt}^k = 1$ if

⁸ We constructed landholding variables based on land actually owned, but ultimately focused on the effect of inherited landownings since this is more likely to be exogenous as well.

⁹ Specifically, the regional dummies covered Kampala, Central rural, Central urban, East rural, East urban, North rural, North urban, West rural and West urban regions.

constrained, $k = \{S, D\}$). For this exercise, we are interested mainly in understanding the determinants of credit constraints among nonborrowers in 2005-06 and 2009-10, as compared to the change over time (which as seen earlier, fell for a substantial number of households during the panel survey). Separate regressions are therefore estimated for each year, $t = \{2005, 2009\}$, and the results are presented in Table 6 :

$$c_{ijt}^k = \tilde{\beta}X_{ijt} + \tilde{\gamma}V_{jt} + \tilde{\beta}_0X_{ij0} + \tilde{\gamma}_0V_{j0} + \tilde{\epsilon}_{ijt} \text{ if } b_{ijt} = 0; k = \{S, D\} \quad (3)$$

How do borrowing and credit constraints affect household outcomes?

Table 4 presents the outcomes we examine in this paper, which span per capita expenditure (food/nonfood), sources of income (farm income broken down by crop and livestock income, as well as nonfarm enterprise income), and other agricultural outcomes. The agricultural questionnaire does not have questions on credit/borrowing, but is very rich in terms of agricultural outcomes related to output changes and productivity; in addition to days spent by household members and hired labor on the farm, we also examine indicators of agricultural productivity such as log quantity of agricultural output, share of land sharecropped out, crop loss, as well as concerns about land disputes and ability to cope with agricultural shocks.

There are two ways we would like to estimate impacts on outcomes. The first is to estimate a reduced-form equation of the effects of borrowing from different sources on outcomes of households y_{ijt} , including consumption, income and agricultural production:

$$\Delta y_{ijt} = \rho_1 \Delta b_{ijt}^B + \rho_2 \Delta b_{ijt}^M + \rho_3 \Delta b_{ijt}^C + \phi \Delta X_{ijt} + \pi \Delta V_{ijt} + \phi_0 \Delta (X_{ij0} * t) + \pi_0 \Delta (V_{j0} * t) + \Delta v_{ijt} \quad (4a)$$

Table 7 presents the results for equation (4a) above, separately for rural and urban areas to better understand how borrowing from different sources has affected outcomes across regions.

Finally, we also examine effects of nonborrowers' reported demand and supply-side credit constraints on outcomes:

$$\Delta y_{ijt} = \tilde{\rho}_1 \Delta c_{ijt}^S + \tilde{\rho}_2 \Delta c_{ijt}^D + \tilde{\phi} \Delta X_{ijt} + \tilde{\pi} \Delta V_{ijt} + \tilde{\phi}_0 \Delta (X_{ij0} * t) + \tilde{\pi}_0 \Delta (V_{j0} * t) + \Delta \tilde{v}_{ijt}, \quad (4b)$$

Table 8 presents the results from equation (4b), again for rural and urban areas. The effects of being supply constrained versus demand constrained are compared to the excluded category of unconstrained nonborrowers.

We also attempt to understand the extent of potential selection of either type of constrained nonborrowers for the different outcomes, using an endogenous switching regression model for panel data. Specifically, we examine the selection effect, within the nonborrowing sample, of being supply credit constrained (or demand credit constrained) versus not being credit constrained, by running a switching regression model for equation (4b):

$$\Delta y_{ijt}^k = \tilde{\alpha}^k \Delta X_{ijt} + \tilde{\theta}^k \Delta V_{ijt} + \Delta \tilde{\omega}_{ijt}^k, \text{ if } c_{ijt}^k = 1, k = \{S, D\} \quad (5a)$$

$$\Delta y_{ijt}^0 = \tilde{\alpha}^0 \Delta X_{ijt} + \tilde{\theta}^0 \Delta V_{ijt} + \Delta \tilde{\omega}_{ijt}^0, \text{ if } c_{ijt}^k = 0, \quad (5b)$$

$$\Delta c_{ijt}^{k*} = \delta \Delta Z_{ijt} + \Delta \psi_{ijt}, \quad (5c)$$

$$c_{ijt}^k = \begin{cases} 1 & \text{if } c_{ijt}^{k*} > 0 \\ 0 & \text{if } c_{ijt}^{k*} \leq 0 \end{cases} \quad (5d)$$

Above, equations (5d) and (5e) represent the process by which households are endogenously selected into either the constrained (supply/demand) or unconstrained regimes. The continuous variable c_{ijt}^{k*} is the latent propensity to be constrained for household i in period t and is modeled as a linear function of observed factors including the initial conditions affecting credit supply and demand (Z_{ijt}). The binary variable c_{ijt}^k takes the value one if c_{ijt}^{k*} exceeds a threshold value set at zero and corresponds to household i being observed as (supply/demand) constrained in period t . If the household is instead

unconstrained, c_{ijt}^k equals zero.

Related work on estimating endogenous switching regressions for panel data include a study by Guirkinger and Boucher (2008), who using a two-round panel from Peru examine the returns to productive endowments such as land, credit and savings for credit-constrained and unconstrained households. Their study differences the data to remove fixed unobserved heterogeneity, and runs a switching regression on the differenced model. Following Woutersen and Khandker (2013), we take this model further and estimate an additional selection equation for whether or not the household exhibits supply/demand credit constraints to account for the endogeneity. The selection equation is estimated as a probit model, and includes the household and village initial conditions X_{ij0} and V_{j0} as exclusion restrictions (in this exercise, these initial conditions are not included in equations (5a)-(5b) above). For each outcome equation, we estimate the inverse Mills ratio (λ). The coefficient on λ reveals whether there is selection bias, assuming the selection equation is correct. Table 9 presents the estimated coefficients on the inverse Mills ratio, for both the fixed effects switching regressions (as per Guirkinger and Boucher, 2008), as well as the endogenous switching regressions including a selection equation.

5. Results

Determinants of borrowing and credit constraints

Table 5 present determinants of the change in borrowing across bank/government sources, microcredit and cooperatives (following equation (2) above), and Table 6 presents determinants of household credit constraints in each survey round (following equation (3)).

Table 5 shows some varying effects on determinants of borrowing from different institutional sources. A few clear patterns emerge. First, as might be expected, households with better access to infrastructure (water access in 2001, and in communities that received electricity over the period) as well as higher wage income were more likely to borrow from banks or government sources ; these households were also less likely to have inherited landownings and thus be involved in farming. The picture on cooperatives also indicates that better-off households were borrowing from this source – with higher nonfarm assets and in communities that received electricity over the period, as well as in communities closer to health facilities. Households borrowing from microcredit, on the other hand, were much more likely to be in rural areas, with lower nonfarm assets. Overall, we find that nonfarm assets and infrastructure are the most important in determining the likelihood of borrowing from different institutional sources.

For the determinants of credit constraints (Table 6), we find an interesting distinction in effects on supply versus demand credit constraints. Nonborrowing households reporting either type of credit constraint did tend to be poorer. Both demand and supply constrained households had a lower likelihood of homeownership. Supply constrained households had worse educational outcomes and lower nonfarm asset holdings, and were also further away from banks in 2001. Demand constrained households were more likely to be in rural areas and involved in subsistence wage work. However, the picture is somewhat more mixed for demand constrained households. Greater nonfarm enterprise income and better housing structures also tended to be associated with demand constraints, and compared to supply constrained households, household socioeconomic determinants tended to have a much less significant effect on demand constraints by the 2009 round (with regional variables taking on a stronger role). This is consistent with our definition of supply and demand credit constraints – since supply credit constraints are

based mainly on limited perceived collateral, household socioeconomic determinants take on a stronger role and these effects are less likely to change over the period. Demand constraints, on the other hand are related to a wider range of factors including not liking to take debt, cost and access, the latter of which changed dramatically over the period (Table 2), and more likely to be related to geographic factors than socioeconomic characteristics.

Effects of borrowing and credit constraints on agricultural household income and productivity

Next, what is the role of borrowing on enhancing agricultural and non-agricultural income? Table 7 presents household panel fixed effects estimates, controlling for initial characteristics, of borrowing from different institutional sources on household per capita expenditure, income, and agricultural outcomes (equation (4a)). The table presents the separate effects of borrowing from banks, microcredit, and cooperatives, and separately for the urban and rural samples as well.

Table 7 shows that microcredit has had the broadest effect on improving outcomes for households across rural and urban areas, including agricultural outcomes such as crop income, days spent in own-farm work, and log agricultural output. Nonfarm enterprise income and months of operation are also higher for rural households borrowing from microfinance, compared to other sources (in urban areas, however, banks/government sources play the most important role for nonfarm enterprise activity). In rural areas, family time spent in own farm work was higher in households borrowing from banks and cooperatives, but borrowing from these sources did not affect other measures of agricultural activity. In urban areas, own-farm production and employment were significantly lower under cooperative borrowing, indicating large differences in how cooperative credit operates across regions.

All forms of credit did appear to help protect against vulnerability, boosting nonfood consumption expenditure and ability to cope with recent shocks in rural areas, as well as helping protect households from loss/damage of crops (rural and urban areas) and land disputes (microfinance in urban areas).

Overall, therefore, despite the evidence that not many households borrow specifically for agriculture, credit is fungible and we find that agricultural outcomes do substantially improve with institutional borrowing, particularly from microcredit. Borrowing for consumption, which Table 2 shows the most reported reason for borrowing in the sample, has increased greatly within microfinance over the period, particularly in rural areas. Since such a high share of households is involved in farming in rural as well as urban areas, our results indicate that a large part of this borrowing has been channeled into agriculture as well.

Following the same panel fixed effects specification (equation (4b)), Table 8 shows a broad negative effect of supply and demand credit constraints among nonborrowers on household outcomes. Per capita food expenditure, crop and livestock income, agricultural output, wage earnings, and wage labor supply all fall with both types of credit constraints, as well as households' confidence in rural areas on being able to handle land disputes, and also cope with recent shocks. Thus the role for policy in lowering supply and demand-side credit constraints is substantial. Interestingly, however, both types of constraints have a much stronger effect on outcomes in rural as compared to urban areas, particularly so for supply constraints. Access to facilities and infrastructure are therefore likely to play a strong role in alleviating the negative effect of credit constraints on outcomes.

Finally, Table 9 presents coefficients on the inverse Mills ratio λ from the endogenous switching regressions in equation (5) above. Table 9 shows that the extent of selection bias on how credit constraints affect outcomes is quite limited; aside from a few

significant effects (crop income and vulnerability to land disputes), the coefficients on λ are not significant. Assuming the selection equation is correctly specified, we have been able to account for potential endogeneity in these estimates.

6. Conclusion

Because of limited access to agricultural credit, little is yet understood about the role of credit expansion for this sector on household outcomes. This issue is particularly pronounced in Sub-Saharan Africa, which globally has among the lowest rates of access to institutional finance, as well as among the highest share of economic activity in agriculture (and in particular among smaller farmers). Using newly available household panel data from Uganda between 2005-06 and 2009-10, we estimate panel fixed effects regressions to understand the determinants of borrowing across different sources as well as supply and demand credit constraints among nonborrowers, as well as the effects of borrowing and credit constraints on household consumption, sources of income, and agricultural outcomes. Following the literature on similar studies on measuring the effects of public interventions, the regressions controlled for pre-survey (2001) household and community characteristics to account for time-varying unobserved heterogeneity over the period.

Overall, we find that nonfarm assets and infrastructure are the most important in determining the likelihood of borrowing from one institutional source versus another. Also, while not many households report borrowing specifically for agriculture, credit is fungible and agricultural outcomes do substantially improve with institutional borrowing, particularly from microcredit. Microcredit in particular has had the broadest effect on improving outcomes for households across rural and urban areas, including agricultural outcomes such as crop income, days spent in own-farm work, and log agricultural output. Since such a high share of households is involved in farming in rural as well as urban areas,

our results indicate that a large part of this borrowing has been channeled into agriculture as well. Among nonborrowers, supply and demand credit constraints have fallen considerably over the period, and are associated with significantly worse household outcomes across per capita expenditure, sources of income, and agricultural outcomes, particularly in rural areas. Access to facilities and infrastructure play a strong role in alleviating the negative effect of credit constraints on outcomes, as well as determining the source of lending among borrowing households.

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Table 1. Borrowing and agriculture in rural and urban areas, 2005-2010

	Rural		Urban	
	2005-06	2009-10	2005-06	2009-10
Anyone in HH borrowed from any source (Y=1, N=0)	0.27 [0.45]	0.42 [0.49]	0.31 [0.46]	0.49 [0.50]
Among borrowers, sources of borrowing :				
<i>Institutional sources</i>				
Banks/government	0.04 [0.20]	0.11 [0.31]	0.17 [0.38]	0.22 [0.42]
MFI	0.34 [0.47]	0.31 [0.46]	0.29 [0.46]	0.29 [0.45]
Cooperatives	0.01 [0.07]	0.10 [0.30]	0 [-]	0.04 [0.21]
Any institutional source	0.39 [0.49]	0.51 [0.50]	0.47 [0.50]	0.56 [0.50]
<i>Informal sources</i>				
Employer	0.01 [0.07]	0.004 [0.06]	0.01 [0.10]	0.03 [0.18]
Friends/relatives	0.51 [0.50]	0.46 [0.50]	0.43 [0.50]	0.37 [0.48]
Moneylenders	0.02 [0.15]	0.01 [0.09]	0.03 [0.18]	0.02 [0.13]
Sample details :				
Number of HH	2,005	2,009	602	598
Number of borrowing HH	544	838	188	289
Share of HH in farming	0.91	0.92	0.41	0.44
Share of HH in crop activities (own land only)	0.48	0.55	0.18	0.26
Share of HH in crop activities (own land+sharecropping)	0.30	0.31	0.12	0.10
Share of HH in crop activities (sharecropping only)	0.13	0.07	0.11	0.08
Share of HH raising livestock/poultry	0.76	0.80	0.29	0.35

Table 2. Purpose of borrowing by different institutional sources

	Rural						Urban					
	Banks/govt		MFI		Cooperatives		Banks/govt		MFI		Cooperatives	
	2005	2009	2005	2009	2005	2009	2005	2009	2005	2009	2005	2009
Agriculture	0.26 [0.45]	0.19 [0.40]	0.20 [0.40]	0.12 [0.33]	0 [-]	0.22 [0.42]	0.09 [0.29]	0.14 [0.35]	0 [-]	0.07 [0.26]	0 [-]	0.08 [0.27]
Non-farm enterprises	0.26 [0.45]	0.30 [0.46]	0.36 [0.48]	0.24 [0.43]	0 [-]	0.22 [0.42]	0.42 [0.50]	0.44 [0.50]	0.62 [0.49]	0.37 [0.49]	0 [-]	0.54 [0.52]
Building/construction	0.08 [0.29]	0.10 [0.30]	0.08 [0.27]	0.04 [0.19]	0 [-]	0.04 [0.19]	0.27 [0.45]	0.14 [0.35]	0.05 [0.23]	0.07 [0.26]	0 [-]	0.08 [0.27]
Consumption	0.43 [0.50]	0.35 [0.18]	0.33 [0.47]	0.54 [0.50]	0 [-]	0.45 [0.50]	0.18 [0.39]	0.22 [0.42]	0.31 [0.47]	0.37 [0.49]	0 [-]	0.23 [0.44]
Other	0 [-]	0.06 [0.23]	0.03 [0.18]	0.05 [0.22]	0 [-]	0.06 [0.24]	0 [-]	0.06 [0.24]	0.02 [0.13]	0.11 [0.31]	0 [-]	0.08 [0.27]
Number of HH borrowing from source	23	88	184	258	0	82	33	64	55	84	0	13

Notes :

(1) Borrowing from agriculture included loans for the purchase of land, livestock and other inputs.

Table 3. Supply-side and demand-side credit constraints among nonborrowers

	Rural		Urban	
	2005	2009	2005	2009
Reasons for not borrowing				
(A) No need (unconstrained)	0.17 [0.37]	0.23 [0.42]	0.22 [0.41]	0.29 [0.46]
(B) Supply-side credit constrained	0.32 [0.46]	0.28 [0.45]	0.37 [0.48]	0.24 [0.43]
Believed would have been refused	0.09 [0.28]	0.14 [0.35]	0.10 [0.31]	0.09 [0.28]
Limited collateral	0.23 [0.42]	0.14 [0.35]	0.28 [0.45]	0.15 [0.36]
(C) Demand-side credit constrained	0.57 [0.49]	0.44 [0.50]	0.50 [0.50]	0.41 [0.49]
Do not like taking debt	0.21 [0.41]	0.29 [0.45]	0.26 [0.44]	0.29 [0.45]
Do not know any lender/no access	0.30 [0.46]	0.05 [0.21]	0.11 [0.32]	0.01 [0.08]
Too costly	0.10 [0.29]	0.10 [0.32]	0.16 [0.37]	0.10 [0.32]
Number of nonborrowing households	1456	1147	412	298

Notes :

(1) If the reason for not borrowing was fear of being rejected or limited collateral, we designated the household as supply-side credit constrained. If their reasons for not borrowing were related to (a) risk rationing (not liking to take debt), (b) transaction-cost rationing (too costly and/or lack of access to lenders), we designated those households as demand-side credit constrained.

(2) The sample size at the bottom does not exactly equal the difference between the total sample and number of borrowing households (see Table 1) because of some missing values.

(3) In 2005, households could select multiple reasons for not borrowing, which is why the shares add up to more than 1 for that year.

Table 4. Outcomes, by whether HH borrowed from an institutional source (banks, MFIs, cooperatives)

Outcomes	Borrowers				Non-borrowers			
	2005-06		2009-10		2005-06		2009-10	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
<i>Log yearly per capita expenditure (1000s Sh)</i>								
Food	5.4	[3.7]	4.7	[3.2]	4.6	[3.6]	4.7	[3.7]
Nonfood	43.3	[11.6]	39.4	[14.6]	33.2	[16.6]	32.4	[17.3]
<i>Log yearly per capita self-employed income (1000s Sh)</i>								
Crops	11.7	[12.6]	8.5	[11.1]	10.2	[12.2]	6.6	[10.5]
Livestock	6.0	[13.0]	5.5	[12.2]	3.8	[10.4]	4.7	[11.7]
Nonfarm enterprises	12.0	[14.7]	8.4	[12.2]	5.6	[10.6]	5.1	[9.9]
<i>Time spent in self-employment</i>								
Number of months the enterprise has been operating in past year	6.30	[5.64]	6.12	[5.55]	3.97	[5.22]	4.45	[5.37]
Log days in past year in own-farm work (HH members)	130.40	[121.38]	176.18	[131.47]	125.08	[118.33]	154.54	[129.35]
Log days in past year in own-farm work (hired labor)	28.79	[62.34]	35.93	[65.38]	17.62	[49.35]	21.18	[51.28]
<i>Other agricultural outcomes : past year</i>								
Log agricultural output (kg)	247.53	[265.16]	276.84	[291.08]	222.86	[249.22]	224.95	[265.85]
Share of land sharecropped out	0.12	[0.29]	0.06	[0.21]	0.15	[0.33]	0.09	[0.25]
Share of harvest that was lost/damaged	0.02	[0.11]	0.04	[0.15]	0.02	[0.09]	0.04	[0.16]
HH has concerns about land disputes	0.25	[0.43]	0.11	[0.31]	0.21	[0.41]	0.13	[0.33]
HH was able to cope with a recent shock	0.09	[0.29]	0.11	[0.32]	0.05	[0.22]	0.03	[0.16]
Number of HH	299		603		2308		2004	

Notes :

(1) Monetary values in Ugandan Shillings, and are CPI-adjusted to account for inflation over the period.

**Table 5. Source of institutional borrowing,
HH panel fixed-effects estimates controlling for initial conditions**

	Banks/government		Microcredit		Cooperatives	
	Coeff.	T-stat	Coeff.	T-stat	Coeff.	T-stat
<u>HH characteristics</u>						
Year	-0.061	[-0.89]	0.200**	[2.01]	-0.067	[-1.62]
HH is in rural area (Y=1 N=0)	-0.001	[-0.03]	0.125	[1.27]	-0.063	[-1.21]
HH head is female	0.001	[0.03]	-0.018	[-0.68]	0.016	[1.03]
HH head is div/widowed	-0.003	[-0.17]	0.033	[1.49]	-0.021*	[-1.97]
HH is polygamous	-0.001	[-0.13]	-0.033	[-1.41]	-0.018	[-1.44]
Max yrs of schooling : men 15+	0.001	[0.32]	0.001	[1.13]	0.001	[1.14]
Max yrs of schooling : women 15+	-0.001	[-0.88]	0.003*	[1.92]	0	[0.49]
HH size	0.002	[0.82]	0.002	[0.60]	0.002	[0.95]
Share of HH members ≤ 50 yrs	0.007	[0.24]	0.092**	[2.12]	-0.015	[-0.87]
Share of HH members ≥ 10 yrs	0.014	[0.58]	0	[0.01]	-0.024	[-1.27]
Log inherited landownings (2005)	-0.003*	[-1.77]	0.001	[0.44]	-0.001	[-0.47]
Log value of nonfarm assets (2001)	0.004	[1.33]	-0.011**	[-2.32]	0.004**	[2.13]
House made of bricks/concrete (2001)	0.008	[0.45]	-0.022	[-0.83]	-0.003	[-0.27]
HH dwelling : independent house (2001)	0.012	[0.89]	0.016	[0.83]	0.007	[0.81]
HH main income source : subsistence farming (2005)	0.006	[0.32]	0.034	[1.25]	0.012	[1.06]
HH main income source : wages (2005)	0.043**	[2.15]	0.016	[0.57]	0.011	[0.96]
HH main income source : nonfarm enterprise (2005)	0.011	[0.54]	-0.034	[-1.26]	0.018	[1.54]
<u>Ethnic groups (excluded: other smaller groups)</u>						
HH ethnicity : Baganda	0.008	[0.38]	0.04	[1.48]	-0.019	[-1.37]
HH ethnicity : Bakiga	0.019	[0.88]	0.078	[1.53]	0.021	[0.83]
HH ethnicity : Banyakole	-0.003	[-0.18]	0.042	[1.18]	0.038*	[1.91]
HH ethnicity : Basoga	-0.030*	[-1.89]	0.039	[1.22]	0.004	[0.47]
HH ethnicity : Iteso	0.028	[1.06]	0.048	[1.59]	0.023	[1.20]
HH ethnicity : Langi	0.032	[1.13]	-0.078**	[-2.13]	-0.021	[-1.07]
HH ethnicity : Lugbara	-0.004	[-0.15]	-0.009	[-0.19]	-0.024	[-1.22]
<u>Community variables (change variables)</u>						
Distance (km) to nearest secondary school	0	[0.43]	-0.003	[-1.06]	0	[-0.13]
Distance (km) to nearest health facility	-0.001	[-0.72]	0.002	[0.51]	-0.003*	[-1.85]
Distance (km) to nearest bank	0	[-0.79]	-0.001	[-1.19]	0	[-0.29]
Share of HH in village with electricity	0.076*	[1.85]	-0.102	[-1.20]	0.069**	[2.09]
Share of HH in village with water in the home	0.038	[1.09]	-0.026	[-0.47]	-0.058**	[-2.07]
<u>Community variables (initial conditions)</u>						
Distance (km) to nearest secondary school (2001)	0	[-0.29]	-0.003	[-1.24]	0.001	[0.86]
Distance (km) to nearest health facility (2001)	0.001	[0.38]	0.004	[0.75]	-0.002	[-1.57]
Distance (km) to nearest bank (2001)	0	[-0.50]	-0.002*	[-1.67]	0	[0.07]
Share of HH in village with electricity (2001)	-0.069	[-1.56]	0.114	[1.36]	-0.005	[-0.18]
Share of HH in village with water in the home (2001)	0.140***	[3.20]	-0.06	[-0.75]	-0.01	[-0.30]
# farming groups formed under NAADS (2005)	0.003	[1.23]	-0.01	[-1.38]	0.003	[0.72]
<u>Regional dummies (excluded area : Kampala)</u>						
Central rural	-0.012	[-0.45]	-0.029	[-0.63]	-0.012	[-0.85]
Central urban	-0.012	[-0.25]	0.048	[0.91]	-0.016	[-1.36]
East rural	-0.004	[-0.11]	0.003	[0.06]	-0.005	[-0.23]
East urban	-0.063*	[-1.68]	0.043	[0.65]	-0.01	[-0.56]
North rural	0.004	[0.10]	0.106*	[1.75]	0.015	[0.57]
North urban	-0.036	[-0.92]	0.098*	[1.72]	0.043	[1.52]
West rural	-0.038	[-1.16]	0.038	[0.66]	0.056**	[2.43]
West urban	-0.056*	[-1.75]	-0.005	[-0.09]	0.029	[1.11]
Number of HH	2493		2493		2493	
R-squared	0.048		0.041		0.083	

Notes : (1) Standard errors corrected for clustering at the village level. *** p<0.01, ** p< 0.05, * p<0.10.

Table 6. Determinants of credit constraints for nonborrowers, OLS

	HH is supply credit-constrained (Y=1, N=0)				HH is demand credit-constrained (Y=1, N=0)			
	2005-06		2009-10		2005-06		2009-10	
	Coeff.	T-stat	Coeff.	T-stat	Coeff.	T-stat	Coeff.	T-stat
<u>HH characteristics</u>								
HH is in rural area (Y=1 N=0)	-0.158	[-1.41]	0.056	[0.58]	0.241**	[2.06]	-0.076	[-0.71]
HH head is female	0.003	[0.10]	-0.031	[-0.89]	0.011	[0.32]	0.051	[1.21]
HH head is div/widowed	-0.011	[-0.29]	0.062	[1.51]	-0.048	[-1.25]	-0.092**	[-2.05]
HH is polygamous	0.018	[0.55]	-0.076**	[-2.39]	-0.006	[-0.18]	0.023	[0.60]
Max yrs of schooling : men 15+	-0.004**	[-2.36]	-0.007*	[-1.77]	-0.001	[-0.58]	0.001	[0.21]
Max yrs of schooling : women 15+	-0.004*	[-1.96]	-0.007*	[-1.75]	0.001	[0.25]	0	[-0.09]
HH size	-0.009**	[-2.14]	0.008*	[1.83]	0.011**	[2.07]	0.003	[0.57]
Share of HH members ≤ 50 yrs	-0.033	[-0.54]	0.09	[1.31]	-0.101	[-1.53]	-0.139*	[-1.89]
Share of HH members ≥ 10 yrs	0.067	[1.16]	0.003	[0.04]	-0.078	[-1.25]	0.012	[0.16]
Log inherited landownings (2005)	-0.005	[-1.37]	-0.002	[-0.49]	0.001	[0.32]	0.007*	[1.76]
Log value of nonfarm assets (2001)	-0.012*	[-1.76]	-0.006	[-0.82]	0.001	[0.15]	0	[0.03]
House made of bricks/concrete (2001)	-0.058	[-1.58]	0.005	[0.12]	0.071*	[1.91]	-0.044	[-1.03]
HH dwelling : independent house (2001)	-0.024	[-0.90]	-0.059*	[-1.91]	-0.066**	[-2.19]	0.008	[0.23]
HH main income source : subsistence farming (2005)	-0.026	[-0.70]	0.012	[0.30]	0.080**	[2.05]	0.042	[0.95]
HH main income source : wages (2005)	0.059	[1.56]	0.031	[0.72]	-0.048	[-1.22]	-0.035	[-0.72]
HH main income source : nonfarm enterprise (2005)	-0.025	[-0.67]	0.057	[1.41]	0.074*	[1.87]	-0.019	[-0.45]
<u>Ethnic groups (excluded: other smaller groups)</u>								
HH ethnicity : Baganda	-0.001	[-0.02]	-0.015	[-0.33]	-0.057	[-1.36]	-0.035	[-0.75]
HH ethnicity : Bakiga	-0.039	[-0.89]	-0.005	[-0.09]	0.029	[0.62]	0.034	[0.45]
HH ethnicity : Banyakole	-0.093**	[-2.45]	0.01	[0.23]	-0.043	[-0.97]	-0.056	[-1.02]
HH ethnicity : Basoga	0.056	[1.23]	-0.065	[-1.47]	-0.122***	[-2.67]	-0.06	[-1.21]
HH ethnicity : Iteso	-0.113**	[-2.16]	-0.033	[-0.66]	-0.024	[-0.53]	-0.09	[-1.40]
HH ethnicity : Langi	0.018	[0.32]	-0.156**	[-2.26]	0.110**	[2.02]	0.061	[0.98]
HH ethnicity : Lugbara	0.091	[1.63]	-0.019	[-0.30]	-0.056	[-0.98]	0.011	[0.15]
<u>Community variables (change variables)</u>								
Distance (km) to nearest secondary school	-0.005	[-0.67]	-0.008**	[-2.51]	0.004	[0.72]	0.002	[0.59]
Distance (km) to nearest health facility	-0.008*	[-1.90]	0	[-0.06]	-0.001	[-0.16]	-0.002	[-0.31]
Distance (km) to nearest bank	-0.007	[-0.63]	0	[0.16]	-0.003	[-0.20]	0	[-0.21]
Share of HH in village with electricity	0.03	[0.20]	-0.031	[-0.27]	-0.12	[-0.78]	0.07	[0.58]
Share of HH in village with water in the home	-0.125	[-0.89]	0.04	[0.43]	0.189	[1.19]	-0.003	[-0.03]
<u>Community variables (initial conditions)</u>								
Distance (km) to nearest secondary school (2001)	0.003	[0.43]	0	[0.13]	-0.002	[-0.35]	-0.003	[-1.38]
Distance (km) to nearest health facility (2001)	0.004	[1.03]	-0.004	[-1.17]	0	[-0.04]	0.003	[0.48]
Distance (km) to nearest bank (2001)	0.006	[0.57]	0.001*	[1.67]	0.003	[0.26]	0	[0.14]
Share of HH in village with electricity (2001)	-0.114	[-0.72]	-0.208	[-1.55]	0.161	[1.00]	0.031	[0.19]
Share of HH in village with water in the home (2001)	-0.043	[-0.27]	0.139	[1.12]	-0.053	[-0.28]	0.167	[1.31]
# farming groups formed under NAADS (2005)	0.001	[0.15]	-0.009	[-1.30]	-0.005	[-0.89]	-0.002	[-0.20]
<u>Regional dummies (excluded area : Kampala)</u>								
Central rural	0.08	[0.68]	-0.167**	[-2.29]	-0.167	[-1.30]	0.230***	[3.38]
Central urban	-0.005	[-0.08]	-0.089	[-1.22]	0.027	[0.38]	0.109	[1.19]
East rural	0.106	[0.86]	-0.101	[-1.50]	-0.148	[-1.07]	0.293***	[4.55]
East urban	0.05	[0.60]	-0.064	[-0.67]	0.001	[0.01]	0.126	[1.20]
North rural	0.044	[0.36]	0	[.]	-0.229*	[-1.73]	0	[.]
North urban	0.054	[0.56]	-0.08	[-0.68]	-0.089	[-1.02]	-0.003	[-0.02]
West rural	0.16	[1.33]	-0.164**	[-2.44]	-0.295**	[-2.19]	0.285***	[4.14]
West urban	0.034	[0.48]	-0.177**	[-1.98]	-0.06	[-0.70]	0.213*	[1.95]
Constant	0.676***	[6.13]	0.471***	[3.51]	0.467***	[4.02]	0.347**	[2.11]
Observations	1777		1271		1777		1271	
R-squared	0.061		0.063		0.052		0.059	

Notes : (1) Standard errors corrected for clustering at the village level. *** p<0.01, ** p< 0.05, * p<0.10.

Table 7. Effects of institutional borrowing on household outcomes, household panel fixed-effects controlling for initial conditions

	(1) Rural areas, coefficient estimates on borrowing from:			(2) Urban areas, coefficient estimates on :		
	Banks	MFIs	Cooperatives	Banks	MFIs	Cooperatives
Outcomes						
<i>Log per capita expenditure</i>						
Food	0.112* [1.77]	0.014 [0.35]	0.133* [1.80]	0.001 [0.00]	0.114 [1.18]	-0.096 [-0.60]
Nonfood	0.224*** [2.72]	0.191*** [2.69]	0.165* [1.68]	0.494* [1.93]	0.258 [1.28]	0.229 [1.18]
<i>Log per capita self-employed income</i>						
Crops	0.262 [0.93]	0.400** [1.97]	0.259 [0.75]	0.919* [1.70]	0.856* [1.73]	-0.008 [-0.01]
Livestock	0.31 [0.40]	0.468 [1.18]	-1.065 [-1.23]	-0.209 [-0.34]	0.74 [1.31]	-0.22 [-0.29]
Nonfarm enterprises	0.538 [1.06]	0.603** [2.08]	0.164 [0.26]	2.398*** [3.68]	0.875 [1.29]	0.709 [0.43]
<i>Time spent in self-employment</i>						
Number of months the enterprise has been operating in past year	0.237 [0.37]	0.993*** [3.12]	0.473 [0.62]	2.859*** [4.19]	1.07 [1.43]	0.165 [0.09]
Log days in past year in own-farm work (HH members)	0.273* [1.96]	0.169*** [2.61]	0.353** [2.24]	-0.076 [-0.37]	0.684*** [3.42]	-0.762** [-2.01]
Log days in past year in own-farm work (hired labor)	0.285 [1.33]	0.221* [1.91]	0.419 [1.60]	0.067 [0.25]	0.317 [1.40]	-0.896 [-1.13]
<i>Other agricultural outcomes</i>						
Log agricultural output (kg)	-0.036 [-0.19]	0.194** [2.05]	0.221 [1.22]	-0.063 [-0.22]	0.624** [2.04]	-1.356** [-2.17]
Share of land sharecropped out	-0.016 [-0.51]	-0.023 [-1.22]	0.039 [1.45]	0.004 [0.15]	0.060* [1.79]	-0.015 [-0.19]
Share of harvest that was lost/damaged	-0.023* [-1.67]	-0.002 [-0.19]	-0.050* [-1.82]	-0.007 [-0.74]	-0.008 [-0.77]	-0.051** [-2.00]
HH has concerns about land disputes	-0.048 [-0.93]	0.003 [0.12]	0.055 [0.93]	0.005 [0.08]	-0.085** [-2.18]	-0.025 [-0.21]
HH was able to cope with a recent shock	0.095** [2.39]	0.074*** [3.14]	0.117** [2.09]	0.06 [1.61]	0.045 [0.92]	0.051* [1.69]

Notes :

(1) Standard errors corrected for clustering at the village level. *** p<0.01, ** p< 0.05, * p<0.10.

(2) Regressions control for the same set of explanatory variables described in Tables 5 and 6.

Table 8. Effects of credit constraints among nonborrowers on household outcomes, household panel fixed-effects controlling for initial conditions

	(1) Rural areas, coefficient estimates on :		(2) Urban areas, coefficient estimates on :	
	HH is supply-credit constrained	HH is demand- credit constrained	HH is supply-credit constrained	HH is demand- credit constrained
Outcomes				
<i>Log per capita expenditure</i>				
Food	-0.050*	-0.062**	-0.087	-0.099*
	[-1.72]	[-2.49]	[-1.57]	[-1.76]
Nonfood	0.013	0.061	0.192	0.199
	[0.24]	[1.07]	[1.28]	[1.50]
<i>Log per capita self-employed income</i>				
Crops	-0.321*	-0.155	-0.257	-0.497*
	[-1.82]	[-0.94]	[-0.93]	[-1.68]
Livestock	-0.820***	-0.496**	-0.152	-0.627*
	[-3.18]	[-2.33]	[-0.68]	[-1.97]
Nonfarm enterprises	0.021	-0.178	0.054	0.337
	[0.11]	[-1.00]	[0.11]	[0.85]
<i>Time spent in self-employment</i>				
Number of months the enterprise has been operating in past year	0.268	-0.23	-0.151	-0.349
	[1.20]	[-1.09]	[-0.29]	[-0.80]
Log days in past year in own-farm work (HH members)	-0.036	0.017	0.075	0.092
	[-0.66]	[0.28]	[0.54]	[0.63]
Log days in past year in own-farm work (hired labor)	-0.048	0.06	-0.081	0.11
	[-0.57]	[0.79]	[-0.67]	[0.88]
<i>Other agricultural outcomes</i>				
Log agricultural output (kg)	-0.164**	0.052	0.064	0.141
	[-2.19]	[0.71]	[0.39]	[0.85]
Share of land sharecropped out	0.023	-0.013	-0.002	-0.003
	[1.54]	[-0.97]	[-0.10]	[-0.15]
Share of harvest that was lost/damaged	-0.001	-0.016*	0.007	0.008
	[-0.06]	[-1.81]	[0.49]	[0.72]
HH has concerns about land disputes	0.074***	0.003	-0.005	-0.061**
	[3.26]	[0.18]	[-0.19]	[-2.41]
HH was able to cope with a recent shock	-0.034***	-0.054***	-0.025	-0.03
	[-2.83]	[-4.34]	[-1.03]	[-1.64]

Notes :

(1) Standard errors corrected for clustering at the village level. *** = significant at 0.01, ** = significant at 0.05, * = significant at 0.10.
(2) Regressions control for the same set of explanatory variables described in Tables 5 and 6.

Table 9. Coefficients on inverse mills ratio, fixed-effects and endogenous switching regressions

	Endogenous switching			
	Supply constrained		Demand constrained	
	C	NC	C	NC
Outcomes				
<i>Log per capita expenditure</i>				
Food	-0.147 [-1.02]	-0.27* [-1.75]	0.030 [0.29]	-0.12 [-0.72]
Nonfood	0.237 [1.28]	0.018 [0.12]	0.117 [0.91]	0.081 [0.52]
<i>Log per capita self-employed income</i>				
Crops	2.39** [2.29]	2.15** [2.24]	1.95*** [2.67]	2.37** [2.44]
Livestock	0.87 [0.90]	-0.13 [-0.12]	0.093 [0.11]	-0.031 [-0.03]
Nonfarm enterprises	-0.44 [-0.57]	-0.17 [-0.15]	-0.47 [-0.60]	-0.65 [-0.52]
<i>Time spent in self-employment</i>				
Number of months the enterprise has been operating in past year	-0.87 [-0.93]	-1.76 [-1.27]	-0.77 [-0.81]	-2.07 [-1.38]
Log days in past year in own-farm work (HH members)	-0.19 [-0.62]	0.11 [0.33]	-0.29 [-1.12]	0.067 [0.19]
Log days in past year in own-farm work (hired labor)	-0.36 [-1.19]	-0.34 [-0.98]	-0.243 [-0.80]	-0.213 [0.49]
<i>Other agricultural outcomes</i>				
Log agricultural output (kg)	0.46 [1.19]	0.53 [1.26]	-0.007 [-0.02]	0.66 [1.53]
Share of land sharecropped out	0.02 [0.37]	0.11 [1.23]	0.103* [1.79]	0.139 [1.63]
Share of harvest that was lost/damaged	-0.007 [-0.30]	-0.014 [-0.41]	-0.023 [-0.93]	-0.058 [-1.44]
HH has concerns about land disputes	0.13* [1.72]	0.13 [1.29]	0.243*** [3.02]	0.143 [1.36]
HH was able to cope with a recent shock	0.040 [1.15]	0.07 [1.51]	0.049 [1.36]	0.070 [1.52]

Notes :

- (1) T-statistics in brackets. Standard errors corrected for clustering at the village level. *** = significant at 0.01, ** = significant at 0.05, * = significant at 0.10.
(2) Regressions control for the same set of explanatory variables described in Tables 5 and 6.

Appendix
Table A1. Means of explanatory variables in regressions

	Rural areas				Urban areas			
	2005-06		2009-10		2005-06		2009-10	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
HH head is female	0.26	[0.44]	0.28	[0.45]	0.30	[0.46]	0.32	[0.47]
HH head is div/widowed	0.19	[0.40]	0.24	[0.43]	0.19	[0.39]	0.27	[0.44]
HH is polygamous	0.22	[0.41]	0.21	[0.41]	0.15	[0.36]	0.15	[0.36]
Max yrs of schooling : men 15+	5.21	[4.38]	5.17	[3.88]	9.32	[11.12]	7.50	[4.99]
Max yrs of schooling : women 15+	4.27	[4.25]	4.28	[3.60]	7.78	[9.75]	7.12	[4.80]
HH size	5.75	[2.99]	6.59	[3.27]	5.59	[3.33]	6.19	[3.49]
Share of HH members ≤ 50 yrs	0.11	[0.21]	0.13	[0.22]	0.07	[0.17]	0.09	[0.20]
Share of HH members ≥ 10 yrs	0.35	[0.23]	0.33	[0.22]	0.28	[0.22]	0.25	[0.21]
Inherited landownings, acres (2005)	1.65	[3.5]			0.22	[1.32]		
Value of nonfarm assets (2001)	2.6E+05	[5.6E+05]			9.7E+05	[1.3 E+06]		
House made of bricks/concrete (2001)	0.14	[0.35]			0.48	[0.50]		
HH dwelling : independent house (2001)	0.59	[0.49]			0.47	[0.50]		
HH main income source : subsistence farming (2005)	0.71	[0.45]			0.17	[0.38]		
HH main income source : wages (2005)	0.16	[0.37]			0.44	[0.50]		
HH main income source : nonfarm enterprise (2005)	0.16	[0.37]			0.38	[0.49]		
HH ethnicity : Baganda	0.18	[0.38]			0.40	[0.49]		
HH ethnicity : Bakiga	0.09	[0.28]			0.07	[0.25]		
HH ethnicity : Banyakole	0.13	[0.33]			0.11	[0.31]		
HH ethnicity : Basoga	0.09	[0.28]			0.11	[0.31]		
HH ethnicity : Iteso	0.08	[0.28]			0.05	[0.22]		
HH ethnicity : Langi	0.10	[0.30]			0.05	[0.21]		
HH ethnicity : Lugbara	0.06	[0.24]			0.04	[0.19]		
<u>Community variables</u>								
Distance (km) to nearest secondary school	5.21	[5.85]	4.84	[4.60]	1.10	[3.50]	1.02	[1.09]
Distance (km) to nearest health facility	4.27	[3.61]	2.98	[3.08]	1.20	[1.20]	0.69	[0.81]
Distance (km) to nearest bank	31.11	[21.82]	14.84	[12.10]	7.13	[16.50]	3.37	[9.67]
Share of HH in village with electricity	0.02	[0.09]	0.04	[0.12]	0.38	[0.29]	0.38	[0.31]
Share of HH in village with water in the home	0.06	[0.12]	0.11	[0.15]	0.33	[0.23]	0.42	[0.25]
# farming groups formed under NAADS (2005)	0.77	[2.02]			0.15	[0.82]		
<u>Regional dummies</u>								
Kampala	0	[-]			0.32	[0.47]		
Central rural	0.24	[0.43]			0	[-]		
Central urban	0	[-]			0.19	[0.39]		
East rural	0.25	[0.44]			0	[-]		
East urban	0	[-]			0.15	[0.36]		
North rural	0.26	[0.44]			0	[-]		
North urban	0	[-]			0.17	[0.38]		
West rural	0.24	[0.43]			0	[-]		
West urban	0	[-]			0.16	[0.37]		
Number of HH	2005		2009		602		598	

Notes :

(1) Means not presented for 2009 for initial (2001/2005) characteristics, since these would be the same across both rounds. The excluded category for HH ethnicity is other smaller groups.

(2) All monetary values are scaled by the national CPI.