Liquidity Constraints, Access to Credit and Pro-Poor Growth in Rural Tanzania

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Abstract

Small-scale farmers in developing countries may become trapped in poverty by lack of the liquidity needed to make profitable investments. Increased access to credit could generate pro-poor economic growth if poor households are otherwise liquidity-constrained and if liquidity-constrained households benefit from the new financial services. Using household data from rural Tanzania, this paper presents evidence that increased finance for liquidity-constrained households could generate pro-poor growth, but that general expansion of financial services to households that have no access to credit would not effectively target lower income households or households whose farm activities are liquidity-constrained.

Keywords

Agriculture, Liquidity, Micro-finance, Rural finance, Tanzania.

Introduction

It has long been recognized that resource-poor people may be trapped in poverty by lack of finance needed to undertake productive investments (Von Pischke, Adams and Donald, 1983). When increased access to finance relaxes the liquidity constraint that impoverished households face, it may enable them to shift from coping strategies to activities that generate dynamic growth. Accordingly, expanded access to credit has been enthusiastically championed in the development community for its potential to generate sustainable economic growth that favours the poor (Murdoch, 2000; Robinson, 2001). While this idea is not new, the institutional context for addressing finance is rapidly changing, in sometimes contradictory ways. In much of rural Africa, for example, explosive growth in micro-finance is creating new opportunities for many households, but the decline of more centralized systems of crop-secured lending has removed other sources of liquidity. In many cases, it is not immediately clear that liquidity constraints inhibit productive investment by the poor or that increased access to credit among unserved populations would directly benefit poor households that are liquidity-constrained.

Liquidity is a particularly acute problem in farming, where the bulk of the poor in developing countries continue to make their living. The biological lag between planting seeds and harvesting crops implies a structural need for liquidity. Meanwhile, high costs of monitoring and enforcing contracts in rural areas often result in under-developed financial markets which leave many people without access to financial services. At the micro-level, farmers who lack sufficient liquidity will be unable to manage farm resources in an optimal manner, will tend to use fewer inputs, and will achieve lower yields and net revenues. In aggregate, liquidity constraints may diminish the responsiveness of the agricultural sector to improved output prices.

In many developing countries the availability of formal finance in rural areas declined in the 1990s with the collapse of centrally administered, single-channel, marketing systems (Akiyama *et al*., 2001; Kherallah *et al*., 2000). Until the mid 1990s, centrally controlled agricultural cooperatives and parastatals provided farmers throughout Africa with crop-secured loans of agricultural inputs for the production of export crops. Inputs were often distributed at village-level cooperative societies and the costs of these inputs were deducted from the value of products delivered after harvest. Because marketing controls allowed only one outlet for production, these crop-secured loans were relatively easy to administer and enforce. However, the monopsonistic, public systems tended to operate at inflated costs and have failed or contracted in their scope since being exposed to competition or increased responsibility for their own expenses. In many cases the decline of these controlled marketing systems has reduced output marketing costs, but at the same time, has removed an important source of seasonal finance (Dorward, Kydd and Poulton, 1998).

New institutions for micro-finance are emerging throughout the developing world usually with some financial support from donors, non-governmental organizations, or government budgets (World Bank, 1996; Zeller and Sharma, 1998; Robinson, 2001; Matin, Hulme, and Rutherford, 2002). Farmers also have other sources of finance including formal banks and credit unions, shop-keeper credit, loans from friends and family, and their own savings. Given the multiple and changing potential sources of finance, it is appropriate to assess the degree to which rural households are bound by liquidity constraints before investing in expanded access to financial services. Furthermore, because liquidity-constrained households may have access to credit and households without access to credit are not necessarily liquidity-constrained, it is also important to distinguish between lack of access to credit and unmet demand for liquidity.

Financial services extend beyond credit, and credit is valuable for more than productive investment. This paper examines only the need for liquidity in farm operations, ignoring many other potentially valuable functions of financial institutions. Using data from a sample of Tanzanian coffee growers, we seek to determine whether a liquidity constraint is affecting farm production and incomes; whether provision of financial services to those who lack access to credit relieves the liquidity constraint effectively; and whether relieving liquidity constraints to stimulate output is consistent with a pro-poor growth strategy. The empirical findings lead to some modest conclusions regarding the need for initiatives to develop rural financial institutions and the appropriate design of those initiatives.

Credit Rationing, Access to Credit, and Liquidity Constraints

Credit rationing, access to credit, and liquidity constraints are related but distinct issues for rural finance. Because of transactions costs and asymmetric information, lenders are generally unwilling to distribute credit based on price alone (Stiglitz and Weiss, 1981). Credit markets are therefore subject to credit rationing, in which suppliers lend less than they could at the prevailing interest rates and allocate credit based on some non-price considerations. Under credit rationing, a potential borrower may be unable to borrow a desired amount, even if she is willing to pay the prevailing interest rate. A firm or household is liquidity-constrained when it lacks the finance from any source to undertake an investment that is profitable at the prevailing input, factor, and output prices. A liquidity-constrained agent may have access to some credit, but not be able to borrow as much as would be optimal under the given terms and prices or may face terms that are inconsistent in timing with the investment. Thus households with access to credit may or may not be liquidity-constrained. The same is true for households with no access to credit at all. An agent with no access to credit who also has no investment needing finance is not liquidity-

constrained, but an agent with an investment opportunity and no access to finance may be. Finally, a household that is not liquidity-constrained at prevailing prices is likely to wish to borrow at a subsidized rate. Demand for participation in a low-cost credit program does not necessarily imply that a liquidity constraint was previously binding. Reduced costs of credit with increased access will relax a liquidity constraint, but liquidity can be supplemented without improving access to credit. Improved financial services that facilitate saving, direct income transfers, and reduced costs for consumption goods could each alleviate a liquidity constraint without influencing access to credit or the cost of borrowing.

When liquidity constraints affect farm management decisions in an agrarian economy and a large share of households lack access to credit, improving access to credit can affect production and incomes. To the extent that those who are liquidity-constrained and lack access to credit are relatively low income households, pro-poor growth patterns can be promoted through initiatives to enhance credit markets. Research to assess the impact of liquidity constraints has used survey data to indicate the probability of a household being liquidity-constrained and then to measure the impacts of liquidity-constrained status on economic outcomes (Feder *et al.*, 1990; Freeman, Ehui, and Jabbar, 1998; Duong and Izumida, 2002). This paper follows a similar approach, but also explores the relationships among access to credit, liquidity constraints, and poverty.

Analytical Method

This paper applies a switching regression technique in which a probit model is used to explain which households are constrained by liquidity in their farm management practices. Using output from the probit regression we then estimate separate production functions for liquidity-constrained and non-constrained households. Because liquidity is itself an input in the production function for households that are liquidity-constrained (Feder *et al.*, 1990), we can use this

regression to estimate the impact of incremental finance on output among the constrained households. Moreover, comparison of the production function coefficients for the liquidity-constrained and non-constrained farms can indicate how complete relaxation of the constraint would be expected to influence farm management and output. If production functions differ between the constrained and unconstrained farms, programs to increase access to credit among the liquidity-constrained households are expected to enhance production. If the constrained households have lower incomes, the growth caused by increased liquidity will favour the poor. Finally, if the liquidity-constrained households are also those who lack access to credit, providing expanded access to unserved populations, without specific targeting would be an appropriate pro-poor growth strategy.

For estimation, farmers are defined as liquidity-constrained if they have excess demand for finance. This excess demand (D*) may be described by a function:

$D^* = \beta Z + \varepsilon,$

where Z is a vector of exogenous variables, β is a vector of parameters and ε is a random disturbance term with mean of 0 and variance σ^2. Although D* is not observed, farmer self-identification of being liquidity-constrained is used to indicate whether D* is greater than zero for specific growers. Following Freeman, Ehui and Jabbar (1998) and Feder *et al*. (1990), we create the dichotomous variable, D, where, D=1, if $D^* \geq 0$, and D=0, if $D^*<0$. Probit maximum likelihood methods are then used to estimate:

(1) $\text{Prob}(D=1) = 1 - F(-\beta Z) + \varepsilon,$

assuming that $\text{var}(\varepsilon)=1$.

Given (1), the production behaviour of constrained and non-constrained farmers can be

modelled in reduced form as:

(2a) $Y_1 = \alpha_1 X_1 + u_1$ iff D=1

(2b) $Y_2 = \alpha_2 X_2 + u_2$ iff D=0

Where Y_1 and Y_2 represent output from constrained and non-constrained farmers respectively, X_1 and X_2 are vectors of explanatory variables and α_1 and α_2 represent coefficients to be estimated. As Madalla (1983) demonstrates, the expected values of the error terms u_1 and u_2 are not zero, making direct OLS estimation of (2) inappropriate. This problem can be addressed by calculating the inverse Mills' ratio from (1) and including the variables $\lambda_1 = \phi(\beta'Z)/\Phi(\beta'Z)$ and $\lambda_2 = \phi(\beta'Z)/(1-\Phi(\beta'Z))$ in the X_1 and X_2 vectors, respectively. The model can then be solved using OLS, as long as the usual conditions for OLS hold and at least one variable from (1) is excluded from (2). To ensure identification, the excluded variable should be continuous and statistically significant in the probit equation (Deaton, 1997, p. 105).

Agricultural Production and Policies in Northern Tanzania

The data for this study come from a stratified random sample of 250 coffee growers from Northern Tanzania, who were surveyed between August and December 2001 and again in April 2002. Production systems in the highland areas of Northern Tanzania are based on the intercropped production of bananas and coffee with maize and beans also grown and some livestock maintained. In general, the bananas are a food staple and the coffee is grown for the export market. Farms rely heavily on household labour and use few purchased inputs.

Descriptive statistics from the sample are provided in table 1. Farm sizes ranged from 0.25 acres to 21 acres, and scale of coffee "plantations" ranged from 20 trees to 15,000 with the median farm holding 600 trees. 25% of the households had 300 or fewer trees and 18% had over 1,200 trees. Cash income and wealth (measured as an index of various durable assets) showed

similar ranges. 70% of households reported no purchases of basic food stuffs (maize, beans and bananas) in 2000 or 2001 and 30% of the households sold surplus food crops. Of the 250 households sampled, only 61 (25%) reported non-farm income of any kind in 2000. Among the households without non-farm income, coffee earnings amounted to 83% of total cash revenues. For the sample as a whole, coffee earnings were 76% of cash income, but for those households with non-farm income, coffee sales accounted for only 25% of total earnings.

Household heads were predominately males over the age of 50. Female headed-households constituted only 10% of the sample. All respondents had grown coffee throughout their adult lives and all had knowledge of recommended practices. Yields for coffee varied widely across the sample from a low of zero to a high of about five kilograms per tree, with total harvests ranging from zero to 5,000 kgs. Prices received in 2001 ranged from Tsh 250 to Tsh1,000 per kilogram depending on timing of sale, location, and the intermediary chosen. Falling prices during the marketing season are the primary cause of intra-village price variation. Product quality is difficult to discern at the point of sale and does not appear to have influenced prices within villages. Aside from prices, transactions costs are likely to influence farm revenues and management decisions. Time required to reach the nearest market centre ranged from less than 2 minutes to 2 hours. Almost half of the coffee growers attempted to address the costs of transportation by organizing joint sales or participating in other formal associations.

In the late 1980s, the Government of Tanzania began a series of economic policy reforms aimed at stimulating production of food and export crops. Macroeconomic reforms resulted in a 50% real exchange rate depreciation between 1992 and 1999, which enhanced the incentives for export crop production proportionately (World Bank, 2001). In addition, commodity market reforms led to increased investment in coffee processing and marketing and a dramatic decline in

the marketing margin. During the three years prior to liberalization in 1995, coffee growers received about half of the export price; from 1995 to 1999 their share averaged about 90% (Market Development Bureau, 2000). Along with policy reforms to increase producer incentives, the export price of Tanzanian coffee doubled between 1991 and 1999, before taking dramatic declines in 2001 and 2002 (United Nations Food and Agriculture Organization).

The product of the export price index, the producer's share of that price, and the real exchange rate index may be taken as an index of overall production incentives for a tradable crop (World Bank, 1994). As figure 1 indicates, this index of producer incentives rose dramatically through the 1990s, but despite the improvements in incentives, production of coffee remained flat. Part of the limited supply response may be attributed to the time required to establish new coffee plantations. However, coffee yields can respond in the short run to improved management and application of fertilizers and pesticides. Yields in Tanzania remained low through the 1990s and inputs use seems to have declined. In aggregate, consumption of nitrogenous fertilizer in Tanzania fell from 46,800 MT in 1990 to only 21,000 MT in 1999 (United Nations Food and Agriculture Organization).

Failure to respond to improved output prices coupled with the decline in inputs usage suggests the possibility of a binding liquidity constraint. This suspicion is reinforced by institutional developments that tended to reduce access to seasonal credit simultaneously with the increases in output price incentives. In Tanzania, liberalization brought the end of crop-secured lending and subsidized inputs. Prior to 1995, all smallholder coffee growers could receive inputs of agro-chemicals on credit through primary cooperative societies and cooperative unions. The costs of the inputs distributed from the cooperative societies were deducted from the value of coffee delivered, with growers paying for inputs in proportion to the volume of their delivery.

Facing financial crisis in the cooperative system, the Government of Tanzania liberalized coffee marketing in 1995, allowing private traders to compete with cooperative unions. In the presence of multiple crop buyers, the cooperatives could not continue to enforce crop-secured loans. As a result, finance has not been widely available through crop-secured lending since 1995.

Survey data in table 1 suggest that alternative sources of seasonal credit have not emerged. 60% of the surveyed farmers reported that they had no access to credit for financing inputs or other farm expenditures. While 40% of the growers could name a source of credit that would be suitable for financing agricultural inputs, only one grower of the 250 surveyed had actually secured inputs on credit in the last crop season and only 14 respondents reported any receipt of gifts, grants or loans in the previous year (2000). 10% of the surveyed growers indicated that they could borrow from family members or friends to finance farm activities, but had chosen not to in 2000 and 2001. 12% indicated that they could borrow from a cooperative society or private inputs dealer, but overwhelmingly did not; and 8% indicated that they could borrow from a bank or credit union, but had not done so.

Institutional systems are in place to facilitate saving. 24% of households reported that they held either a bank or post office account. In addition, two-thirds of the surveyed coffee growers received part of their coffee payments in the form of inputs vouchers, which are redeemable for inputs at registered dealers. These vouchers effectively force coffee growers to save a share of their coffee revenues for inputs purchases. Saving through financial accounts and vouchers however has been insufficient to meet liquidity needs for many households. 56% of the surveyed growers reported that they lacked sufficient liquidity to purchase inputs or hire labour to apply them.

Impacts of Liquidity Constraints

Summary statistics provide evidence that farmers who identify themselves as liquidity-constrained differ in many ways from those who do not. Moreover, they indicate that liquidity-constrained households often have some access to credit and those without any access to credit are not necessarily liquidity-constrained. The data in table 2 reveal that the liquidity-constrained farmers tend to harvest smaller amounts of coffee, to use fewer inputs in production, and to be less likely to use chemical inputs at all. There is no statistically significant difference in the mean number of trees or assets held by constrained and non-constrained households, but liquidity-constrained farms have lower total income, lower farm income, and are less likely to hold financial accounts than the non-constrained households. Basic demographic features were similar for both groups, but liquidity-constrained households were less likely to be active in local associations.

Similar shares of households identified themselves as liquidity-constrained (56%) and lacking access to credit (60%), but the two groups are distinct. Table 3 presents a cross tabulation of households based on liquidity-constrained status and access to credit. A third of the households surveyed considered themselves liquidity-constrained and without access to credit. Another 27% lacked access to credit but did not feel liquidity-constrained; presumably, these households had no unmet demand for finance for farm activities. An additional 16% of households were not constrained by liquidity and did have access to credit. Finally, 24% of households considered their farm activities to be constrained due to lack of liquidity, but reported that they had access to credit. In these cases, the households apparently considered the terms of the borrowing to be inconsistent with the farm investment or could not access as much credit as they desired.

While liquidity-constrained farm households seem systematically different from those that are not liquidity-constrained, separating farms based on access to credit does not reveal strong

patterns (table 2). Except for coffee prices received in 2001, there is no statistically significant difference in the mean value of variables for households with access to credit and those without access. Income, in particular, does not differ between the two groups. Thus, targeting households for a credit program based on their access to credit would not effectively reach lower income groups. Targeting based on a binding liquidity constraint would.

Moving beyond the discrete comparison, a switching model can be applied to analyse what characteristics tend to predict liquidity-constrained status and whether farmers who are liquidity-constrained use inputs differently from those who are not. If liquidity itself influences output, then lack of liquidity is affecting the management of labour, capital or intermediate inputs. In this case, incremental liquidity that is insufficient to alter a households liquidity-constrained status can still be expected to increase production and income by facilitating more flexible management of inputs. If liquidity constraints are reducing the use rate of an input such as fertilizer, then a higher marginal effect of fertilizer on output would be expected on liquidity-constrained farms than on others. Moving such households out of their liquidity-constrained status would be expected to alter input use levels and increase productivity and incomes.

Growers who reported that a lack of cash inhibited both purchase of inputs and the hiring of labour to apply them were considered liquidity-constrained and assigned a value of D =1 in equation 1. Explanatory variables for estimating equation 1 include factors that affect the supply or demand for liquidity. Lagged farm income is likely to be a leading source of liquidity. However, it is also likely to be a product of liquidity status. To deal with this endogeniety problem, instrumental variables were used to estimate predicted farm income in 2000, which was taken as an exogenous variable for predicting liquidity status in 2001.

Other determinants of liquidity-constrained status (with expected direction of impact in

parentheses) are: lagged coffee price (-), distance to market (+), tree count, tree age, household residents count, dependency ratio (+), non-farm income (-), age (+) and education (-) of household head, wealth (-), associational activity (-), female-headed household (+), and household with no access to credit (+). The impact of household residents count is unknown, as this variable could increase both the supply and demand for liquidity. Similarly, more and larger trees implies more coffee income and more need for inputs. Coffee price, farmer education level (in years or formal schooling) and non-farm income (including wages, salaries, remittances, gifts and business income) are each expected to raise net income and correlate to reduced probability of being liquidity-constrained. Activity in associations is expected to provide reputation and information which should reduce the likelihood of being liquidity-constrained. Associational activity was measured with a dummy variable taking the value of one if the household head was active in four or more local associations. Wealth, measured as a weighted average of durable assets, is also expected to enhance liquidity and reduce the likelihood of being liquidity constrained. Distance to market (measured in minutes required to reach the nearest market centre) raises transactions costs, reducing the effective income from farm sales and increasing the effective costs of consumption goods and inputs. Travel time is therefore expected to be positively correlated with a binding liquidity constraint. Finally female-headed households are expected to have less access to finance and therefore are more likely to be liquidity-constrained, and farmers who reported having no access to credit from any sources are also expected to be more likely to be liquidity-constrained.

The second stage regressions (equations 2a and 2b), are a production functions relating inputs to total coffee output. The inputs considered are the number and age of coffee trees, the quantity of chemical inputs, measures of labour quantity and quality, and measures of social

capital. As in Feder *et al*, (1990), liquidity is also taken as an explanatory variable for the liquidity-constrained households, but not the non-constrained households. Because social capital can provide information and better access to factors of production, it is expected to influence production (Collier, 1998). The dummy variable for associational activity is included to reflect social capital.

Liquidity and labour were measured indirectly due to incomplete data on labour use and financial assets. The number of residents is included because household members are the main source of farm labour. The allocation of household labour over different activities is treated as a function of expected prices of outputs and available labour. The lagged coffee price reported by households is taken as the expected price which is likely to correlate positively with labour application to coffee. If growers are more removed from local markets, transactions costs will imply that on-farm food production will have a relatively high value and coffee production a lower value than otherwise (Goetz, 1992). Hence, distance to the market should negatively correlate with labour application to coffee and coffee output. The dependency ratio (the share of residents under 15 or over 65) is expected to reduce the availability of labour for coffee activities, while lower age and higher education are expected to enhance the quality of labour applied.

For the liquidity-constrained households, output should be positively correlated to available liquidity. Continuous data were not available on financial assets, so the wealth index is used to gauge liquidity in the estimation. The wealth index is a crude measure of liquidity in that it does not include financial assets and some of the included assets may not be liquid. As an alternative, predicted farm income and non-farm income for the year 2000 are summed and used as an income-based measure of liquidity in 2001. Applying these variables separately as measures of liquidity ensures identification. All data that are not dichotomous were converted into log

form. Because the error terms in these regressions were heteroskedastic, the model was solved using a robust regression technique in which the data were iteratively reweighted based on regression residuals (StataCorp, 1999).

Table 4 presents the results from the regression to predict farm income and the probit stage of the switching model. Concerning the regression to predict income, most variables are statistically insignificant, but the F-test fails to reject joint insignificance, lending support for use of predicted income as a relevant instrument for income. The results from the probit model indicate that receiving higher coffee prices, having lower travel time to markets, having higher wealth and predicted income, and belonging to associations tend to reduce the probability of being liquidity-constrained. Variables whose expected impact was ambiguous (tree count, tree age and residents count) are all statistically insignificant. The insignificance of access to credit indicates that availability of credit does not ensure sufficient finance and lack of it does not necessarily imply insufficient liquidity.

Turning to the production function estimates in table 5, the coefficient on chemical inputs expenditure is statistically significant among the liquidity-constrained farmers, using either wealth or income as the proxy for liquidity (columns A and B, respectively). The coefficient on inputs is smaller and not statistically significant among the non-constrained farmers (column C). This finding implies that a lack of finance is constraining the intensity of use of inputs in the coffee sector. The output elasticity with respect to inputs expenditure confirms that purchased inputs are underused among the liquidity-constrained growers. Based on mean levels of output and chemical inputs use for liquidity-constrained households, an increase in inputs expenditures of 10% (Tsh 540) would yield just under one kilogram of added output per farm. Reported output prices ranged from Tsh 250 to Tsh 1500 per kilogram in 2000 and 2001, suggesting positive returns to

added investment in inputs, except at very low coffee prices.

Other differences between constrained and non-constrained growers suggest a need for finance beyond that for inputs purchase. The liquidity-constrained households are less responsive to price and more negatively affected by age of household head. The limited responsiveness to price is evidence that these households are less able to mobilize labour than others and the effect of age similarly suggests that liquidity-constrained households are unable to hire wage labour when their own labour capacity diminishes. Also associational activity implies greater output among households who are not liquidity-constrained, but not among those that are constrained. Apparently, the benefits of associations are more available to those who have the funds to take advantage of the information and contracts available through them.

The differences in coefficients between the constrained and non-constrained households indicate a growth effect could arise from moving households out of the liquidity-constrained status. The coefficient on liquidity indicates that incremental finance that still leaves a household liquidity-constrained could also stimulate production. Whether it is measured through the wealth index (column A) or income (column B), liquidity has a positive and significant impact on output among the liquidity-constrained households. Taking the lower estimate of the output elasticity with respect to liquidity (0.45) and mean values for the liquidity-constrained households, the results imply that a 1% addition to household cash availability (Tsh 2,500) would yield an increase in coffee output of about 0.5 kgs, worth Tsh 125 to 500 in 2001, depending on the coffee price received. Added liquidity can also be expected to generate increased use of purchased inputs to bring use rates among the constrained households closer to those of the non-constrained households, thereby creating additional increases in farm revenues. In contrast, additional liquidity for the non-constrained households would not affect farm output.

In theory, liquidity should not be included in the production function for households that are not liquidity-constrained. However, it is possible that self-identification of a liquidity-constrained status was flawed. To determine whether the liquidity-constrained sub-set was accurately defined, the model including a liquidity proxy was estimated for the non-constrained households. As column D of table 5 reveals, coefficient values in this specification are similar to those when liquidity is excluded, and the liquidity variable is insignificant, implying that these households accurately identified themselves as not liquidity-constrained.

Conclusions

Though overdue in many respects, the demise of single-channel crop marketing has left a gap in the provision of seasonal finance in Tanzania. The analysis presented here supports claims that additional rural finance can enhance farm productivity among lower income coffee growers, thus contributing to pro-poor growth. The results of the switching regression imply that there would be a substantial production impact from providing incremental liquidity to the liquidity-constrained growers and from removing the constraint through access to sufficient finance. Regression results indicate that greater liquidity among these growers would result in greater production impact from current levels of inputs as well as increased use of purchased inputs.

The growth effect is only achieved if finance reaches those households whose farm activities are actually liquidity-constrained. Non-constrained households may also demand additional credit for purposes including consumption, investment in human capital, or investment in non-farm activities. Incremental liquidity to those households would have no impact on farm production and may or may not contribute to growth. Since many households lacking access to formal credit are not liquidity-constrained, expanded access to credit must target those households with both investment opportunity and insufficient finance, if it is to generate growth.

This analysis further suggests that targeting for a growth impact can alleviate poverty. In this sample, the liquidity-constrained households showed greater potential for growth and were lower in income than others. Thus incremental finance targeted to liquidity-constrained growers or complete relaxation of liquidity constraints would contribute to growth and poverty alleviation, in this case. The generalizability of this outcome is questionable. Mosley and Hulme (1998) reveal a tendency for poverty alleviation and growth to emerge as conflicting goals in micro-finance schemes, except when finance is used for investments that do not increase risk. Investment in agrochemicals for coffee production reduces yield risk and therefore falls into this special category. Since many other crop-secured credit schemes that faded with liberalization had financed risk-neutral technologies, the potential for new financial institutions to contribute to agricultural growth and fight poverty is probably large.

New financial institutions can alleviate poverty and enhance economic growth if they target low income households who are constrained from productive activities by lack of liquidity. Reduced availability of crop-secured loans has probably created many such households in rural Africa. This research reveals that they are common among the coffee growers of Tanzania, but they can only be reached with careful targeting. The challenge is not simply to provide financial services to those who have no access to credit, but to serve poor households who are liquidity-constrained. Despite the growth in micro-finance, the opportunities for this in rural Tanzania remain substantial.

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Table 1. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std.
Farm size (acres)	250	0.25	21	3	2.43
Tree count (mature trees only)	247	20	15000	857	1189.14
Average age of trees (years)	243	2	100	31.5	16.82
Wealth index [a]	249	0	14.45	2.24	1.98
Total household income, 2000 (Tsh)	247	0	3550000	328686	485220
Farm income, 2000 (Tsh)	247	0	2500000	210025	310888
Age of household head (years)	248	26	90	55	12.97
Education of household head (years)	248	0	20	6.38	3.44
Household size (headcount)	247	1	7	4	1.51
Female-Headed Household (0/1)	250	0	1	0.09	0.29
Coffee yield, 2000 (kg/tree)	247	0	5	0.41	0.65
Coffee yield, 2001 (kg/tree)	247	0	4.5	0.2	0.42
Total coffee sales 2000 (kg)	246	0	5000	246	412.56
Total coffee sales 2001 (kg)	247	0	4000	141	357.75
Coffee price 2000 (Tsh/kg)	223	350	1500	660	225.84
Coffee price 2001 (Tsh/kg)	186	250	1000	533	130.04
Travel time to market (minutes)	241	0	120	31	23.75
Distance to coffee buyer (km)	219	0	125	2.69	10.69
Joint sales (0/1)	250	0	1	0.47	0.5
Associational activity (0/1)	249	0	1	0.16	0.37
Liquidity constrained (0/1)	250	0	1	0.56	0.5
No access to credit (0/1)	250	0	1	0.6	0.49
Hold financial account (0/1)	250	0	1	0.24	0.43
Used purchased inputs, 2001 (0/1)	250	0	1	0.36	0.48
Chemical inputs used [b], 2001 (Tsh)	250	0	125000	7510	18259

Source: Survey data.
a) Wealth index is a weighted average of the number of motor vehicles, donkeys, oxen, dairy cows, goats and sheep, and radios owned by household members.
b) Total expenditures on pesticides and chemical fertilizers. All growers reported similar inputs prices.

Table 2. Descriptive Statistics (Mean with standard deviations in parentheses)

	Full Sample	Liquidity Constrained Yes	Liquidity Constrained No	Access to Credit Yes	Access to Credit No
Volume of coffee, 2001 (kg)	141.00 (357.75)	101.50 ** (182.09)	193.40 (497.26)	140.76 (366.99)	142.46 (345.25)
Used chemical inputs, 2000 (0/1)	0.608 (0.489)	0.546 ** (0.500)	0.688 (0.465)	0.680 (0.469)	.560 (.498)
Used chemical inputs, 2001 (0/1)	0.360 (0.481)	0.270 *** (0.445)	0.477 (0.501)	0.380 (0.488)	.347 (.477)
Chemical inputs expenditure, 2001 (Tsh)	7511 (18259)	5382 ** (16138)	10263 (20433)	7130 (18942)	7764 (17849)
Inputs expenditure per tree 2001 (Tsh)	12.072 (26.516)	7.074 *** (19.09)	18.537 (32.77)	11.61 (26.86)	12.38 (26.37)
Tree count	860 (1190.3)	755.80 (648.73)	992.62 (1631.46)	791.23 (874.50)	900.44 (1359.69)
Wealth index	2.244 (1.982)	2.106 (2.189)	2.425 (1.666)	2.18 (1.861)	2.288 (2.064)
Farm income, 2000 (Tsh)	210025.5 (310888.6)	147113.7*** (193844.9)	290995 (402476.5)	204486 (350646)	213729 (282384)
Total income, 2000 (Tsh)	328686.6 (485227)	256631.7 *** (437890.6)	421424.1 (527804.4)	365533.3 (587542.6)	304039 (402922)
Age of household head (years)	54.72 (12.98)	54.78 (13.75)	54.65 (11.98)	55.54 (13.68)	54.17 (12.49)
Education of household head (years)	6.564 (3.317)	6.203 (3.137)	7.038 (3.500)	6.717 (3.139)	6.441 (3.441)
Female household head (0/1)	0.092 (0.289)	0.092 (0.290)	0.092 (0.290)	0.090 (0.288)	0.093 (0.291)
Residents count 4.008	3.93 (1.514)	4.10 (1.567)	3.77 (1.446)	4.16 (1.589)	(1.448)
Associations (0/1)	0.164 (0.372)	0.114 *** (0.319)	0.229 (0.422)	0.170 (0.377)	0.161 (0.369)
Hold financial account (0/1)	0.240 (0.469)	0.184 ** (0.389)	0.321 (0.469)	.300 (.460)	.207 (.406)

Travel time to market (minutes)	31.14 (23.73)	33.03 (24.35)	28.70 (22.78)	31.12 (25.53)	31.16 (22.50)
Coffee price, 2000 (Tsh/kg)	659.61 (225.83)	622.52 (212.26)	710.51 (571.36)	628.85 (238.74)	678.92 (216.01)
Coffee price, 2001 (Tsh/kg)	532.74 (129.90)	502.94 ** (49.84)	571.37 (181.98)	504.97 ** (77.73)	552.35 (154.00)
Sample size	250	141	109	100	150

*,** and *** indicate that the mean values of subgroups are significantly different at 10%, 5% and 1%, respectively.

Source: Survey data.

Table 3. Liquidity Constraints and Access to Credit

Share of respondents (n=250)

	Liquidity-Constrained	Not Liquidity-Constrained	Total
No Access to Credit	32.8%	27.2%	60%
Access to Credit	23.6%	16.4%	40%
Total	56.4%	43.6%	100%

Source: Survey results

Table 4. Predicting liquidity-constrained status of coffee growers

	Farm Income OLS	Liquidity Constrained ML Probit Estimate	
		Coefficient	dF/dx
Coffee price	0.810**	-1.050**	-0.41
	(2.05)	(2.42)	
Travel time to market	0.052	0.315**	0.12
	(0.39)	(2.18)	
Tree count	0.395*	-0.003	0.00
	(1.71)	(0.03)	
Tree age	0.617**	0.084	0.03
	(2.57)	(0.42)	
Residents count 0.595		0.434	0.17
	(1.50)	(1.15)	
Dependency ratio	-0.177	-0.181	-0.07
	(0.26)	(0.36)	
Farmer age	0.275	0.676	0.26
	(0.31)	(1.44)	
Farmer education	0.314	0.223	0.09
	(1.20)	(1.16)	
Female headed	-0.401	0.088	–
	(0.63)	(0.24)	
Wealth index	0.244	-0.403*	-0.16
	(0.86)	(1.75)	
Predicted farm income	–	-0.271	-0.11
		(1.45)	
Non-farm income	0.024	0.030	0.01
	(0.82)	(1.42)	
No credit	0.157	-0.115	–
	(0.47)	(0.61)	
Associations	-0.008	-0.488*	–
	(0.02)	(1.75)	
Joint sales	0.186	–	
	(0.63)		
Used chemical inputs, 2000	1.092**	–	
	(2.58)		
Log Likelihood	-388.25	-113.55	
N	203	203	
F	6.54	–	
R-square	0.33	–	
Correctly predicted	–	70%	
Wald chi2	–	44.05	

dF/dx represents the effect on the probability of being liquidity constrained from a marginal change in a continuous variable. *, **, *** represent significance at 10%, 5% and 1%, respectively. A constant and dummy variables for three regions were included in regressions but are not reported here. Robust Huber-White t-statistics are in parentheses. All variables except dummy variables have been converted into log form. In each regression, joint insignificance is rejected at 1%.

Table 5. Impact of liquidity on coffee production: Based on self-identified financial constraint

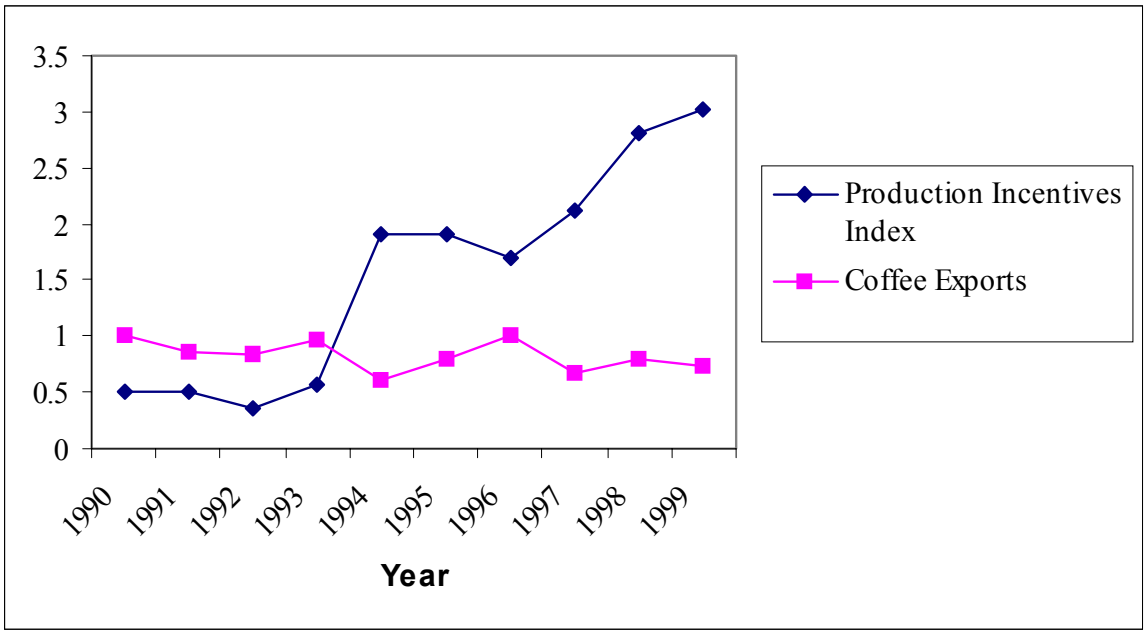
	Liquidity-Constrained		Not Liquidity- Constrained	
	A	B	C	D
Chemical inputs expenditure [a]	0.069*	0.089**	0.051	0.048
	(1.81)	(2.06)	(1.13)	(1.00)
Output price	1.497*	1.257	1.553**	1.597**
	(1.83)	(1.58)	(1.99)	(2.00)
Travel time	-0.464*	-0.379	-0.397	-0.363
	(1.79)	(1.39)	(1.29)	(1.16)
Tree count	1.170***	0.778***	0.813***	0.810***
	(6.60)	(3.52)	(4.31)	(4.19)
Tree age	0.353	0.062	0.273	0.230
	(1.40)	(0.21)	(0.77)	(0.64)
Residents count	0.086	0.026	0.863	0.912
	(0.15)	(0.04)	(1.30)	(1.29)
Dependency ratio	-0.019	-0.753	-0.745	-0.788
	(0.02)	(0.86)	(0.68)	(0.70)
Farmer age	-1.416**	-1.164	-0.342	-0.242
	(2.00)	(1.54)	(0.36)	(0.24)
Farmer education	0.365	-0.065	-0.212	-0.219
	(1.37)	(0.21)	(0.59)	(0.60)
Female headed	0.466	0.131	-0.524	-0.502
	(0.83)	(0.21)	(0.75)	(0.70)
Associations	-0.602	-0.694	1.626***	1.645***
	(1.10)	(1.23)	(3.13)	(3.13)
Liquidity/Wealth	1.098***	–	–	-0.970
	(2.72)			(0.19)
Liquidity/Income [b]	–	0.454**	–	–
		(2.30)		
λ_1	-1.536*	-0.995	–	–
	(1.91)	(1.40)		
λ_2	–		2.41***	2.314***
			(3.46)	(3.03)
N	117	117	86	86
F	6.63	4.21	3.93	3.55
R^2	0.46	0.35	0.39	0.39

*, **, *** represent significance at 10%, 5% and 1%, respectively. A constant was included in regressions but is not reported here. Robust Huber-White t-statistics are in parentheses. All variables except dummy variables have been converted into log form. In each regression, joint insignificance is rejected at 1%.

a) Because all growers faced the same inputs prices, this variable measures the aggregate volume of agrochemicals used.

b)Income is predicted farm income plus non-farm income including gifts etc. For the 203 observations, mean income is Tsh 281,358 (standard deviation = 435937.6).

Figure 1. Coffee Production: Incentives and Volume



Sources: Export data are from UNFAO (2002). Production incentives index calculated from data in UNFAO (2002), World Bank (2001), and Market Development Bureau (2000).