Sustaining Input on Credit Through Dynamic Incentives and Information Sharing: Lessons from a Framed Field Experiment

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Policy Paper

Synopsis:

- A Dynamic incentive model is used to develop conditions that minimize strategic default in agricultural inputs on credit to rural smallholder farmers. Hypotheses from the model are tested using data collected through a framed field experiment that simulates a market for input on credit
- The existence of an information exchange system, amongst input sellers, which mimics the role of a "credit score", can effectively deter default behavior by farmers receiving inputs on credit.
- Productivity shocks that affect the return to the use of inputs also affect the opportunity cost of repayment, and thus farmer's decision to repay

Policy implication:

Financial, technological, and institutional innovation that reduce the costs of collecting and exchanging credit information are desirable in order to resolve failures in agricultural credit markets, and thus increase farmers access to modern inputs for agricultural production.

Research question: Can input provision on credit be sustained by a market arrangement? If yes, under which conditions?

Financial constraints are cited amongst the main demand side factors limiting the use of modern inputs by farmers in SSA. Even when farmers perceive the use of inputs as profitable, they often lack the cash necessary for input purchase. Farmers' current sources of cash are mostly income from crop sales, income from agricultural and non-agricultural wages, income from non-farm enterprises, and transfers.

There has been a recent increase of government interventions, such as subsidies in the agricultural input sector in several SSA countries because the private sector has been unable to effectively interact with farmers after the withdrawal of government parastatals as part of the structural adjustment programs implemented in the 1980s and 1990s. This resurgence of government interventions can be justified partly by market failures in the rural credit market (Besley, 1994).

Market failures in the rural African credit market due to asymmetric information in the presence of risk (Doward, 1998) have prevented farmers from obtaining access to credit from financial institutions in order to finance inputs purchase. For the same reasons, input companies are not willing to provide inputs on credit to farmers and wait to collect the money after harvest, even though such arrangements could potentially benefit both parties. The market failures in input credit markets persist because institutions for contract enforcement are weak or non-existent, increasing the potential for strategic default by farmers in SSA.

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The paper uses a repeated game theoretic model to develop conditions under which input provision on credit could be sustained between poor farmers and input sellers in developing countries. The main research hypotheses derived from the theoretical model were tested using data collected through a lab-in-the field experiment also call field experiment. The experiment was conducted with a total of 200 farmers in 10 villages of Kwara state, Nigeria.

Research Hypotheses:

Theoretically, dynamic incentives, whereby farmers who default are punished in a repeated interaction by being denied input credit in subsequent periods, are likely to reduce strategic default. But when there are many input suppliers within the sector, the effectiveness of dynamic incentives requires a collective punishment, and an information exchange mechanism amongst the input sellers. This idea mimics the functioning of the *merchant guilds* that facilitated trade during the late medieval period (Greif, Milgrom et al. 1994) and the *Coalition* that enabled 11th century Maghribi traders' to benefit from employing overseas agents despite the commitment problem inherent in these relations (Greif, 1993). It is also consistent with the credit score system used in the United States and elsewhere.

The main hypotheses of this study are summarized in Box 1. If input sellers have no way of knowing farmers' past default behavior with another firm, farmers will have incentive to strategically default and then go to another firm for input credit, depending on how many firms are in the market. The result of this is the collapse of the market such that the transactions do not occur and both parties forgo the benefit from trade. Therefore, the information component is of the greatest importance for the success of a collective punishment mechanism in activating and sustaining markets for input credit in Sub Saharan Africa. Moreover, the variability of the returns to the use of the inputs can affect farmers' ability to repay. When farmers have a risk averse utility function, the utility cost of repaying the input debt after a bad harvest is higher than the cost of repaying after a good harvest.

BOX 1: RESEARCH HYPOTHESES

- **Hypothesis 1:**

  As communication and exchange of information is facilitated amongst input suppliers, the probability of the farmer being caught and ostracized increases, and therefore, the probability of default by farmers receiving inputs on credit decreases

- **Hypothesis 2:**

  In bad state of the nature (when productivity is lower), the farmer's opportunity cost of repaying for the credit increases, and the probability of default by farmers receiving such inputs on credit increases

Experimental Design:

Given that input-on-credit arrangements are not commonly observed in the setting of interest, the above hypotheses are tested using an incentivized lab-in-the-field experiment involving randomly selected farmers in 10 different villages in Kwara State, Nigeria. The experiment is designed to simulate a multiple round market for inputs-on-credit and test the above hypothesized communication and profitability shock effects. Some details of the experiments are provided in Box 2.

To test the effect of communication or exchange of information, five out of the ten study villages are randomly selected to receive a communication treatment. In those five villages information regarding individual farmer default behavior is relayed to all creditors resulting in increasing the probability that a farmer is identified as a potential future defaulter. In the five non-communication treatment villages, creditors only knew the default behavior of the farmers to whom they made loans. Comparing farmers' behavior in the communication treatment to that in the non-communication treatment tests for the hypothesized communication effect.

To test hypothesis 2 – the impact of productivity and profitability on default behavior – a round-level treatment is implemented. Specifically, in each round the weather could take on one of two states – good or bad. If the weather is good, productivity and profitability of farmers is high, and if the weather is bad productivity and profitability of farmers is low. We hypothesized lower levels of farmer default in rounds with good weather than in rounds with bad. In each round, the weather state is determined by the flip of a coin after credit decisions is made, but before repayment.

Further details about the implementation of the experiment can be found in the full paper.

BOX 2: DESCRIPTION OF THE EXPERIMENT

- Incentivized experiment
- 10 villages x 20 participants
- 16 farmers and 4 input brokers in each village
- 10-11 rounds, Random stopping point
- 2 periods in each round: pre planting and after harvest
- Farmers receive input credit offers from brokers in pre planting period
- Only ID numbers were used to avoid bias in credit allocation
- After harvest farmers decide to repay fully (100%), partially (50%), or not repay at all (0%)

Findings:

Information sharing amongst inputs sellers reduces default by farmers

Consistently with the research hypotheses, the existence of an information exchange system between inputs sellers affects positively farmers' repayment behavior. Figure 1 shows that the proportion of farmer defaulting (paying less than 100% of input debts) is lower in the communication villages than the non communication villages (57.3% versus 61.5%). Moreover, the multivariate analysis of farmers' repayment behavior as function of communication and weather treatment (Figure 2) indicates that the farmers in communication villages are more likely to repay fully than farmers in non communication villages.

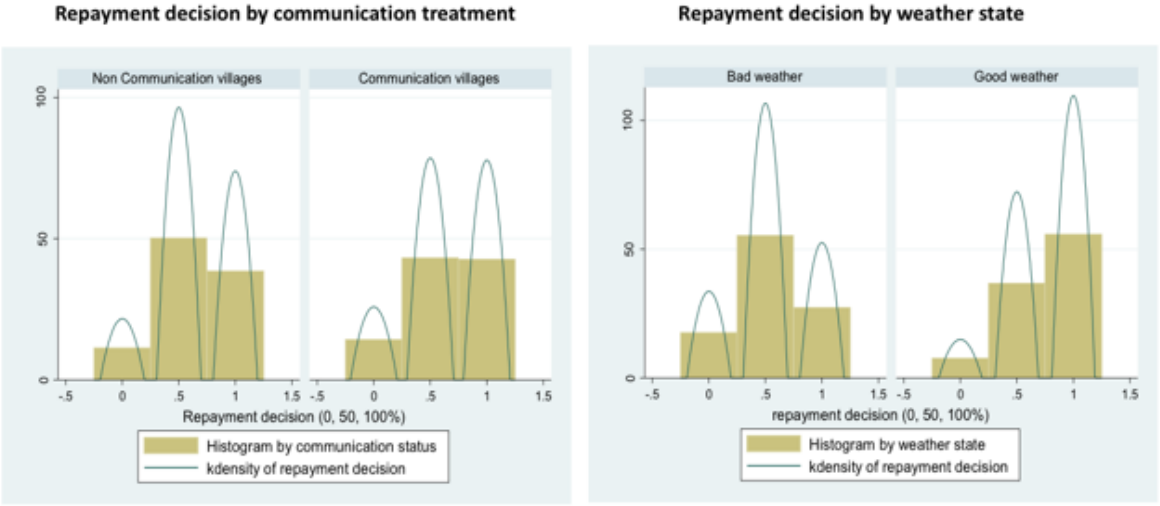
Negative productivity shocks increase default rate amongst farmers

Figure 1 shows that during bad weathers, the proportion farmers defaulting is higher than during good weather (73% versus 44%). This strong effect of weather shock on farmers' default behavior is also confirmed by the multivariate analysis reported in figure 2. The coefficient on weather state in positive and significant, indicating that farmers are more likely to repay fully when the weather is good than when they face a negative productivity shock (bad weather).

Information sharing is more effective in reducing default in presence of negative productivity shocks

The multivariate analysis also includes the interaction between the weather and the communication treatments. The results in figure 2 indicate a negative and significant effect of the interaction term. This indicates that, in the communication villages, the negative effect of weather shock on farmers' repayment behavior is mitigated by the communication treatment. This result is important in the sense that though weather shocks cannot be controlled directly through policy actions, their effects can still be mitigated by designing institutions that facilitate the exchange of information about credit behavior.

Figure 1: Repayment decision by treatment status



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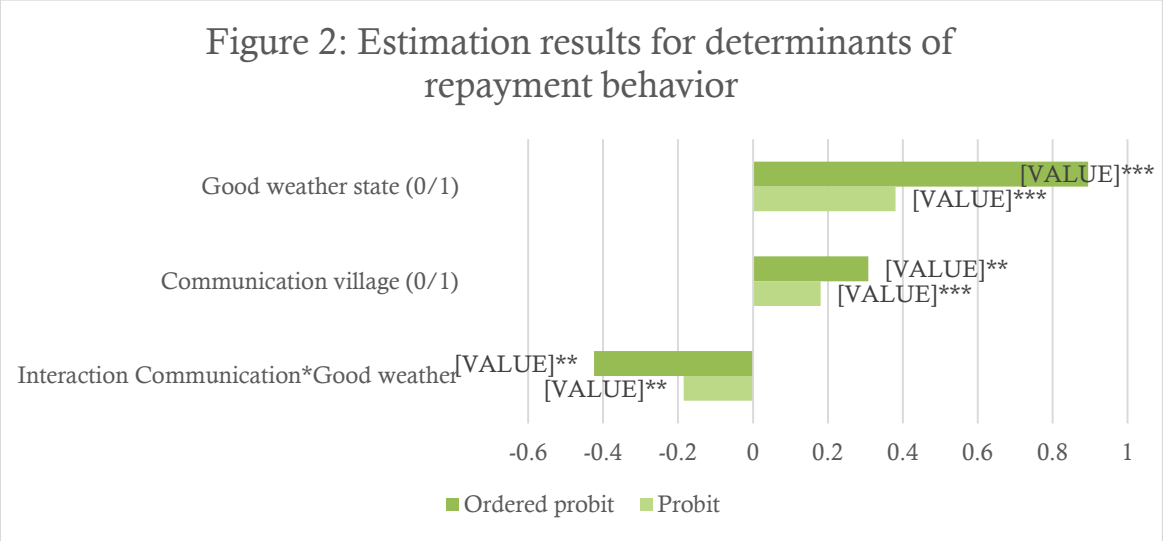

Information exchange affects positively the effectiveness of dynamic incentive mechanism

The theory behind the role of information exchange is that, it allows credit suppliers to identify farmers with bad repayment history, and punish them by denying them access to further loans (dynamic incentives). Without information sharing, the dynamic incentive cannot be effectively implemented given that a farmer with bad credit history can still get loan from credit suppliers who are not aware of the outcome of their past credit transactions. We use a Probit regression to test if the existence of credit information affected the effectiveness of dynamic incentives. The results presented in table 1 indicates that the information exchange does sustain the effectiveness of dynamic incentive. Indeed, in communication villages, farmers credit scores in each round, computed as a combined measure of they repayment behaviors in all previous round, has a positive and significant effect on the likelihood of getting offered input loans in current round. However, in non communication villages, credit score is not significant determinant of likelihood of farmers being offers input loans. This implies that when the credit information is available, input suppliers do use it to punish and reward past credit behavior, leading to a better outcome for the market as whole because the bad creditor get excluded or converted, leaving space for beneficial and profitable transactions between good credit farmers and inputs sellers.

Table: Determinants of receiving input loan offer as function of past repayment by communication treatment

$$Credit\ Score_t = SCORE_{t-1}/1 + SCORE_{t-2}/2 + SCORE_{t-3}/3 + \ldots + SCORE_{t-11}/11$$

VARIABLES	Coefficients [P-values]		
	Non Communication Villages	Communication Villages	All
Credit score	0.009	0.026***	0.009
	[0.144]	[0.001]	[0.129]
Communication			0.013
			[0.875]
Credit score * Communication			0.017*
			[0.101]
Round dummies		INCLUDED	
Constant	-0.063	0.221	0.072
	[0.657]	[0.120]	[0.506]
Observations	800	848	1,648

*** p<0.01, ** p<0.05, * p<0.1

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Next Steps:

Overall the results of this study indicate that input credit arrangements may be possible and could potentially be sustained between farmers and input suppliers in developing countries provided that there exists an information exchange system (playing the role of a credit score) through which information on farmer's repayment history is made available to all the inputs sellers. In addition, insurance mechanisms that mitigate the effects of productivity shocks on farmers' ability to repay input loans, are essential for sustaining input credit markets.

Questions on how input on credit arrangements could be implemented in practice are legitimate. The costs and other potential issues related to sharing information between input suppliers are important to take into consideration. If the cost of information exchange is too high, this will increase the cost of the loan to the farmers. Therefore, it might be difficult to sustain this input on credit arrangement without some external subsidies (e.g., from governments or development NGOs) unless the input is so profitable for farmers that they are willing to pay a high enough price for the input loan.

However, it may be possible to leverage the microfinance experience. Information sharing is already being incorporated as part of microfinance best practices. The establishment of credit bureaus by microfinance institutions in several regions of the globe serve as evidence (Campion and Valenzuela 2001, de Janvry, McIntosh et al., 2010). Input suppliers might also benefit from establishing "input credit bureaus" that collect repayment history information about farmers to whom they provide input loans. Such information can then be shared within the network of input suppliers and play the same role as consumer credit scores in developed countries.

Moreover, the increasing rate of penetration of digital technological advancement in SSA is now allowing the development of innovative financial instruments to support farmers' access to credit. A prime example is the Zambia National Farmers Union (ZNFU) who is now piloting the use of Visa cards to facilitate inputs transactions. This offers the potential for gathering costlessly credit information about cardholders which would then facilitate enforcement of dynamic incentives in input credit arrangements. The ZNFU serves as the central institution that connects farmers to a network of input suppliers. With the introduction of these ZNFU Visa cards, they are thinking about collecting information about credit repayment history of farmers and share it with input companies, so they can implement the collective punishment mechanism necessary to sustain input on credit arrangement with farmers. Other countries with similar technological capabilities in SSA should be encouraged to follow in Zambia's footsteps in order to achieve widespread access to inputs by cash constrained farmers in SSA. Other digital technologies such as fingerprinting are also promoted by the world Bank for the same purpose and more generally for promoting financial inclusion in developing countries.

Alternatively, for areas with less technological capabilities, input suppliers can rely on local village level retailers to distribute their product to farmers in very remote areas. Given that credit bureaus cannot be established everywhere, village level retailers, with the necessary social capital, can be a potential solution since they have information about the farmers living in their communities. Also, they can easily exchange information about repayment history with local retailers in neighboring villages to ensure defaulters do not get input loans from nearby villages. This is possible because people in very remote rural areas usually know each other – they typically go to the same markets, health care facilities and places of worship. Also, with the promotion of Information and Communication Technology (ICT) use in rural areas, this communication and exchange of information between local retailers from different villages could be facilitated to ensure effectiveness of dynamic incentives and solve strategic default issues.

Finally, it is important to combine input credit arrangements with agricultural insurance schemes so that farmers who are unable to repay due to negative economic shocks do not automatically face harsh punishment from input suppliers. Given the very strong effect of productivity shocks in our analysis, the ability of the farmers to managed negative productivity shocks is essential for the sustainability of any input credit arrangement with them.

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