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Do Credit Constraints Affect Agricultural Technology Adoption?

Evidence from Nigeria*

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Introduction

The agricultural sector in Nigeria is characterized by low productivity that is driven in part by low use of modern agricultural technologies. Poor access to credit is seen by many observers to be one of the key barriers to adoption of these technologies. Literature suggests that credit constraints impede individuals from investing in productivity enhancing agricultural technologies and, thus, poor farmers are unable to engage in high-return agricultural activities. Much policy discourse and research literature associates agricultural credit constraints with supply-side factors, such as farmers not having access to credit sources or high costs of borrowing, and, thus, recommend that such supply-side constraints be addressed to improve smallholders' access to credit. However, demand-side factors, such as borrower's risk-averse behavior, financial illiteracy, collateral requirements, or perceived high transactions costs, can also play important roles in credit-rationing for smallholder farmers.

Our study examines the nature of credit constraints among smallholder farmers – whether smallholders are credit-constrained or not, the extent to which credit constraints emanate from supply-side or demand-side factors, the factors affecting credit constraints to smallholders, and the effects of these constraints on adoption of four agricultural technologies – inorganic fertilizer, improved seed, agrochemicals, and mechanization. Data extracted from the 2018/19 Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA) for Nigeria were used for the analysis in a multinomial probit model and in a seemingly unrelated regression (SUR) model of simultaneous equations. We find that in Nigeria about 50 percent of credit-constrained smallholder farmers primarily face demand-side credit constraints.

Identification of Credit Constraint Status

To guide an empirical assessment of credit constraints and their potential effects on agricultural technology adoption, we develop a framework to identify a smallholder farm household's credit constraint status using the identification strategy depicted in Table 1. A farming household's credit

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constraint status was based on the answers household respondents gave to a series of questions in the credit module of the 2018/19 LSMS-ISA survey instrument.

- ***Unconstrained*** households consisted of either satisfied borrowers or non-borrowers who did not need loans or preferred to work with their own liquidity.
- Households with ***credit constraints from the supply-side*** consist of rejected loan applicants; unsatisfied borrowers, i.e., those who received less than the loan amount requested; or non-borrowers who perceived that any loan application they made would be rejected.
- Households with ***credit constraints from the demand-side*** combine households that are risk-averse and other non-borrowers that consider the transaction costs associated with obtaining a loan to be too high.

Table 1. Identification strategy of credit constraints status of smallholders

Unconstrained		Constrained: Supply-side		Constrained: Demand-side		
					Due to risk-aversion	Due to transaction costs
Borrowers	Obtained amount of loan requested	**Applied or attempted**	***Rejected borrowers:*** Applied or otherwise attempted to obtain a loan. Ready to pay the existing interest rate, but loan application rejected.	**Non-borrowers**	Afraid of taking risks, e.g., afraid of losing collateral	Lenders not located nearby, e.g., do not know any lenders
Non-borrowers	Do not need a loan; have enough money	**Borrowers**	***Unsatisfied borrowers:*** Obtained less than the amount of loan requested; wanted a larger loan at same interest rate	**Non-borrowers**	Afraid that cannot pay the money back	Procedure too cumbersome, too much paperwork, too expensive
Non-borrowers	Prefer working with their own liquidity, i.e., reason for not borrowing is "do not like to be in debt"	**Non-borrowers**	***Non-applicants who perceive themselves to "certainly be rejected":*** Were certain that their loan application would be rejected due to inadequate collateral; past credit history; existing outstanding loans; or irregular income	**Non-borrowers**	Do not want to be worried; afraid.	Need to pay bribes, too much politics involved

Source: Authors' representation.

Credit Constraint Status of Smallholders

About 15 percent of survey respondents applied for an agricultural loan during the 12-month period preceding the survey. Our results show that 27 percent of survey households were found to be credit-constrained – 13 percent due to supply-side factors and 14 percent due to demand-side factors (Table 2). Seventy percent of rural respondents and 61 percent of urban respondents indicated they did not need a loan, suggesting a high degree of risk-averse behavior or a lack of business aspiration among farming households in Nigeria. Significant differences were observed in the characteristics of applicants versus non-applicants and between credit-constrained and unconstrained households. A higher proportion of applicants than non-applicants had land title documents (26 versus 20 percent), had insurance coverage (6 versus 3 percent), were members of cooperatives (21 versus 8 percent), and were members of informal saving groups (58 versus 43 percent). Applicants generally have higher wealth status. Between the credit-constrained and unconstrained groups, the

mean values of certain demographic variables, such as literacy and the number of economically active household members, are statistically different. A lower proportion of credit-constrained households had land title documents, suggesting one reason for their inaccessibility to credit. Likewise, higher participation in membership association and informal saving groups were observed among the unconstrained category of households.

Table 2. Credit constraints status among smallholder farmers, summary statistics

		Urban	Rural
Applied or attempted to borrow agricultural credit (%)		16.0	14.9
Average amount for which applied (Naira)		362,135	187,671
Average amount received (Naira)		191,769	73,891
Supply-side constrained households: (13%)	Rejected borrowers (%)	14.6	14.5
	Unsatisfied borrowers (%)	10.8	7.2
	Perceived "certainly rejected" nonapplicants (%)	9.4	9.8
Demand-side constrained households: (14%)	Due to risk-aversion behavior (%)	8.5	3.6
	Due to high transaction cost (%)	10.2	9.1
Unconstrained households:	Received full amount wanted (%)	10.2	10.6
	Did not need a loan (%)	61.0	69.9

Source: Authors' computations from LSMS-ISA (Nigeria) panel wave 4 (2018/19) data.
Note: The percentage breakdowns for supply-side and demand-side constraints do not add up because of multiple answers from farmers on the sorts of constraints to obtaining credit that they face. However, double-counting was avoided in aggregating the grand percentages for both supply-side and demand-side constraints.

Factors Affecting Credit Constraints

Two important variables that affect the credit constraint status of both supply-side and demand-side constrained households are whether the household has a title to their land and whether the household owns livestock, both having significant negative coefficients (Table 3). Similarly, households with a greater value of assets are significantly less likely to be supply-side constrained, as such assets can be used as collateral and, hence, remove supply-side related credit constraints.

Table 3. Factors determining credit constraints. multinomial probit model results

Dependent variable: Credit constraint status Base category – Credit unconstrained households						
	Supply-side credit-constrained			Demand-side credit-constrained		
Independent variables	Coefficient	Std. err.	p-value	Coefficient	Std. err.	p-value
Members of working age, no.	0.043**	0.020	0.029	0.033	0.020	0.101
Has land title, 0/1	-0.303***	0.097	0.002	-0.343***	0.095	0.000
Log of value of assets	-0.026***	0.010	0.008	-0.003	0.010	0.727
Log of value of livestock	-0.015**	0.007	0.024	-0.024***	0.007	0.000
Access to ICT, 0/1	0.187	0.151	0.216	-0.323**	0.157	0.040
Access to agricultural extension, 0/1	-0.014	0.099	0.891	-0.173*	0.104	0.097
Has insurance, 0/1	-0.206	0.174	0.239	-0.464***	0.173	0.007
Has informal savings, 0/1	0.463***	0.064	0.000	0.317***	0.062	0.000
Rural, 0/1	-0.098	0.080	0.219	0.260***	0.075	0.001
Log of non-farm income	0.016**	0.006	0.012	0.013**	0.006	0.027
Log of remittance income	0.023*	0.014	0.096	0.004	0.014	0.782
Constant	-1.651***	0.219	0.000	-1.504***	0.221	0.000

Source: Multinomial probit regression results using data from the LSMS-ISA (Nigeria) panel wave 4 (2018/19) data.
Note: ICT = Information and communication technology. *** p<0.01, ** p<0.05, * p<0.1.

Farming households with good access to information and communication technology,[1] to extension services, and to insurance coverage are less likely to suffer demand-side credit

[1] This includes access to phone services, internet, and other information technology sources.

constraints. But these three factors are not significant in determining credit access for supply-side constrained households. Overall, we find that rural residents are more likely to suffer demand-side credit constraints compared to their urban counterparts. The greater challenges such households face in accessing information, extension services, and insurance than urban households contribute to this result.

Credit Constraints and Technology Adoption

Nearly 50 percent of respondents adopted agrochemicals and 41 percent applied inorganic fertilizer. However, only 16 percent use improved seed and 12 percent use agricultural machinery. Our main interest in this study is to examine the effect of credit constraints on the adoption of these technologies. Results from a seemingly unrelated regression (SUR) model on factors conditioning adoptions of these technologies, including credit constraint status, are reported in Table 4.

Table 4. Credit constraints and agricultural technology

	Used Inorganic Fertilizer		Used Improved Seed		Used Agrochemicals		Used Agricultural Machinery	
Independent variables	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Supply-side constrained, 0/1	-0.0473**	0.0214	-0.0523***	0.0169	0.0232	0.0226	0.0164	0.0151
Demand-side constrained, 0/1	-0.0458**	0.0215	-0.0522***	0.0170	0.0068	0.0227	-0.0253*	0.0152
Age of household head, yrs.	-0.0014***	0.0004	0.0000	0.0004	-0.0025***	0.0005	-0.0007**	0.0003
Literate household head, 0/1	0.0766***	0.0167	0.0563***	0.0132	-0.0310*	0.0176	0.0214*	0.0118
Male household head, 0/1	-0.0178	0.0283	-0.0314	0.0224	0.0950***	0.0300	0.0100	0.0200
Members of working age, no.	0.0156***	0.0048	0.0051	0.0038	0.0073	0.0051	0.0048	0.0034
Landholding size, ha	0.0224***	0.0081	-0.0047	0.0064	-0.0003	0.0086	-0.0005	0.0057
Has land title, 0/1	0.0048	0.0036	-0.0089***	0.0028	0.0263***	0.0038	0.0145***	0.0025
Log of value of assets	0.0039	0.0215	0.0079	0.0170	-0.0720***	0.0228	8.0035	0.0152
Log of value of livestock	0.0073***	0.0021	0.0024	0.0017	-0.0039*	0.0023	-0.0019	0.0015
Access to ICT, 0/1	0.0042***	0.0014	-0.0002	0.0011	-0.0034**	0.0015	-0.0007	0.0010
Has insurance, 0/1	0.0672***	0.0209	0.0332**	0.0165	0.0333	0.0221	0.0827***	0.0147
Has informal savings, 0/1	-0.0366**	0.0173	0.0133	0.0136	-0.0103	0.0182	0.0083	0.0121
Log of farm income	0.0316***	0.0020	0.0081***	0.0014	0.0422***	0.0019	0.0084***	0.0014
Log of non-farm income	0.0024	0.0016	0.0043***	0.0013	-0.0011	0.0017	-0.0007	0.0012
Log of remittance income	-0.0033	0.0037	0.0060**	0.0029	-0.0037	0.0039	-0.0047*	0.0027
Use organic fertilizer, 0/1	0.2701***	0.0018	-	-	-	-	-	-
Soil quality is good, 0/1	-0.0314**	0.0155	-	-	-	-	-	-
Use hired labor, 0/1	-	-	-	-	-	-	-0.0306***	0.0111
Constant	-0.1004**	0.0463	-0.0288	0.0365	-0.0287	0.0365	0.0567*	0.0326

Source: Seemingly unrelated regression (SUR) estimation results using LSMS-ISA (Nigeria) panel wave 4 (2018/19) data.
Note: Observations: 3,427. *** p<0.01, ** p<0.05, * p<0.1

- Credit constraints from both the demand-side and the supply-side significantly affect adoption of inorganic fertilizer and improved seed.
- The use of agrochemicals is not affected by constraints to credit access, neither from the supply-side nor the demand-side. This likely is due to the lower total costs of agrochemicals per hectare relative to the costs of the other three technologies analyzed – credit constraints are not as binding on the use of agrochemicals as they are on use of the other technologies.
- Use of agricultural machines is affected only by demand-side credit constraints, implying that, while agricultural machines may be available for hiring from the supply-side (in-kind credit), a majority of smallholders may prefer to continue their traditional manual farm operations rather than mechanizing their farm operations. This lack of demand for mechanized operations may

be associated with risk-averse behavior, the subsistence nature of most farming in Nigeria, or a lack of entrepreneurial capacity and low business aspirations.

Conclusions and Policy Recommendations

While improving credit access of smallholder farmers in Nigeria through mitigating supply-side constraints has been recommended as an effective policy for boosting agricultural technology adoption, our findings show that credit constraints for smallholders result not only from supply-side factors but from demand-side factors as well. In our data, the demand-side factors appear somewhat stronger than the supply-side factors. Thus, improving credit access via easing supply-side constraints may not necessarily address the problem of credit access for all Nigerian smallholders. Demand-side constraint factors must equally be addressed. The reason some non-borrowers do not participate in the credit market may not necessarily be because they cannot obtain credit, but, rather, because they may be risk-averse or do not have access to adequate information on potential sources of credit or on the terms of the credit that is available. Addressing demand-side factors, such as access to information, extension services, and insurance cover, will mitigate the credit constraints faced by many smallholders, increase their adoption of modern agricultural technologies, and improve their productivity.

Based on these findings, we suggest the following policy changes:

- Improving credit access via easing supply-side constraints alone may not necessarily boost agricultural credit use and increase adoption of modern agricultural technologies by smallholder farmers in Nigeria. Demand-side factors should equally be addressed.
- The key supply-side constraints are related to lack of adequate collateral. Policies should focus on mechanisms for enhancing smallholders' capacity to possess bankable collateral, such as land titles or assets.
- Policy needs to pay attention to improving the access of rural farming households to information, extension services, and insurance coverage to mitigate key demand-side factors hindering smallholders' access to credit.
- Inorganic fertilizer and improved seed are considered to be two key modern agricultural inputs required to increase agricultural productivity. Unfortunately, adoption of these technologies by farmers in Nigeria is significantly affected by credit constraints. We suggest targeted policy interventions to improve smallholders' access to credit to finance adoption these key agricultural inputs.

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