



Credit Constraints and Agricultural Productivity: Evidence from Rural Rwanda

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Introduction

- The potential negative impact of capital market imperfections has long been recognized at the conceptual framework (Stiglitz and Weiss 1981, Esweran and Kotwal 1986, Carter 1988, etc.)
- Conning and Udry (2007): patterns of agricultural production and resource use depends on the degree of imperfections in credit markets.
- But evidence of the relevance of credit constraints is rather scarce largely because credit constraints are hard to measure
- A few studies have used the direct elicitation methodology (DEM) to identify credit constraints and assess the implications of ill-functioning markets (Fedder et al., 1990: Northeast China; Diagne and Zeller, 2001: Malawi; Foltz, 2004: Tunisia; Guirkingner and Boucher, 2008: Peru; Ali and Deininger, 2012: Ethiopia)

→ Aim to contribute to the literature on the nature of credit

Conceptual framework

- Testable relationships derived from the standard agricultural household model that combines both consumption and production choices (De Janvry et al. 1991)
- Perfect and complete markets: separability of production and consumption decisions of the farm household
 - input use decisions are independent from initial resource endowments. Output per unit of land is therefore not affected by level of liquidity or initial endowments of the household
- Imperfect/missing markets: consumption and production decisions are made simultaneously
 - credit constraint leads to sub-optimal level of input use (since input is dependent on access to capital) and therefore lowers level of output per ha.
- **Given a binding credit constraint: we expect a non-null relationship between household endowments (labour, land) and productivity.**

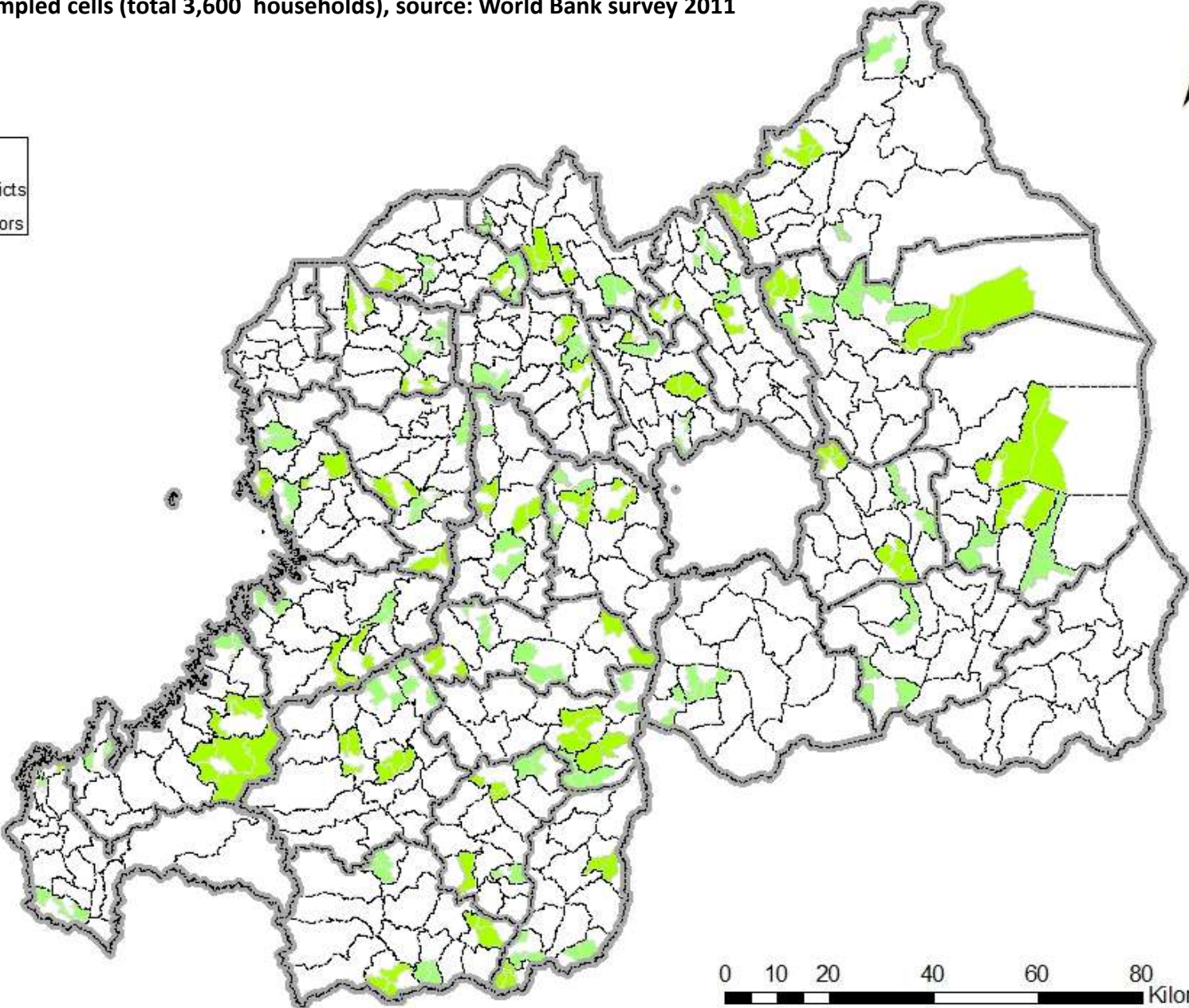
Data

- **Country characteristics:** densely populated, land scarce, largely dominated by subsistence agriculture
- **Survey:** Baseline survey of IE of the Land Tenure Regularization (LTR) program in Rwanda collected in early 2011 (World Bank)
- **Sample:** 3,600 rural households country-wide (25 districts->100 sectors-> 300 EA) – representative of 80% of the country
- **LSMS type questionnaire:** demographics, resource endowments, social networks, agricultural practice and crop production (season B) and perceptions and participation in different markets (credit, land, labour, inputs)
- **Detailed credit modules:** allow to use the direct elicitation approach to classify households by their credit constrained status by source of credit as well as the main type of constraint faced (Boucher et al. 2009).

Map of sampled cells (total 3,600 households), source: World Bank survey 2011

Legend

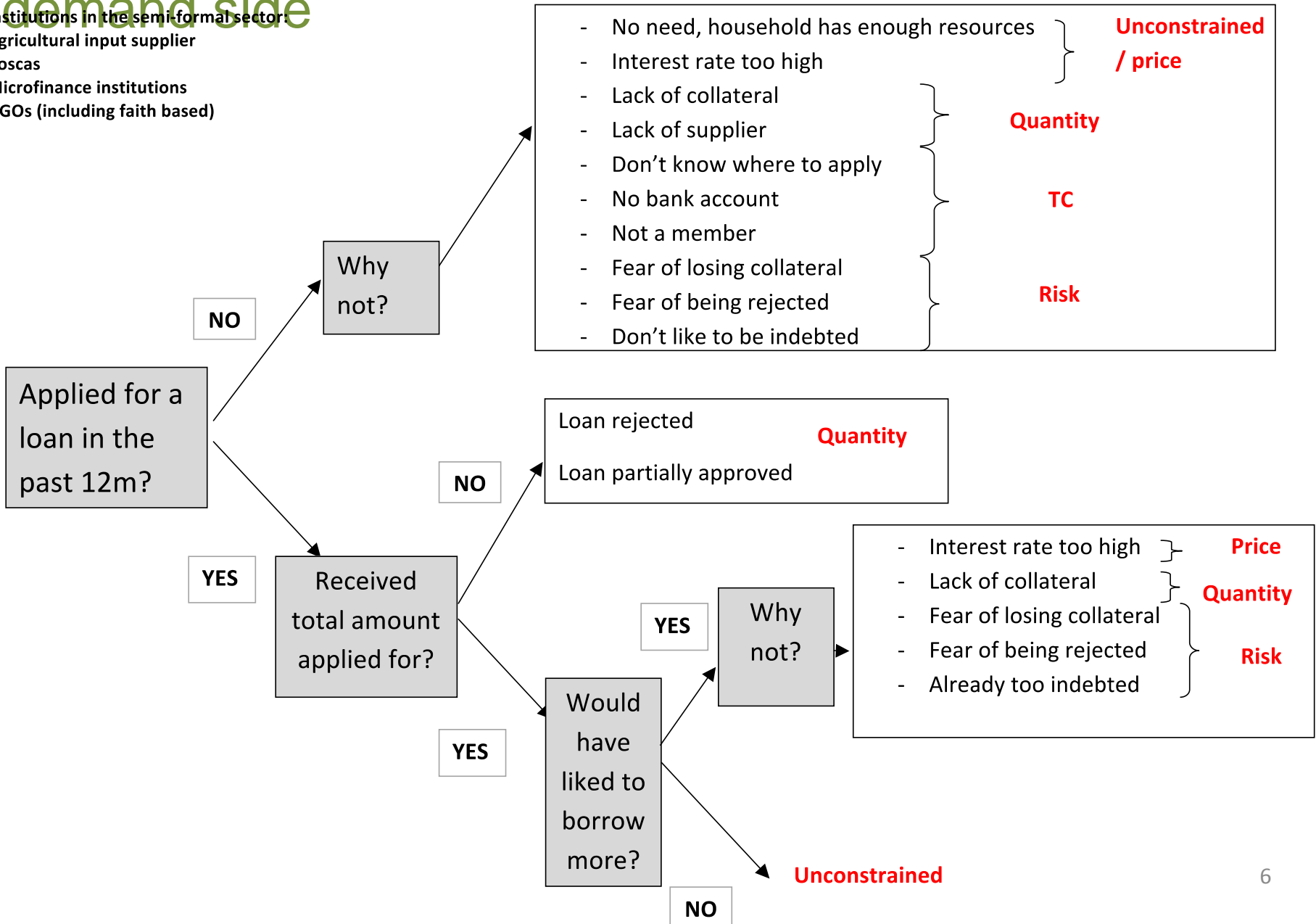
- Districts
- Sectors



0 10 20 40 60 80 Kilometers

Direct elicitation methodology (DEM): supply but also demand side

Institutions in the semi-formal sector:
 Agricultural input supplier
 Roscas
 Microfinance institutions
 NGOs (including faith based)



Descriptive statistics: access to credit

- The formal credit sector is almost inexistent. The remaining credit market is divided between the semi-formal sector and the informal sector with 1/5 of households participating in each
- Amounts borrowed in the semi-formal sector increase with wealth
- Semi-formal sector loans are more often taken for investment purposes (37 %) than informal loans (26 %).
- 71% of households are constrained in the semi-formal sector but the proportion decreases in the upper quartiles
 - 1/3 is *quantity rationed* (supply side – and most researched)
 - Almost 2/3 are *transaction cost rationed* (demand side)
 - 1/5 are *risk rationed* suggesting the presence of imperfections in

Table 2a: Credit access

	Total	Q1	Q2	Q3	Q4
Formal sector					
Applied for a loan	0.03	0.01	0.01	0.02	0.06
Semi-formal sector					
Applied for a loan	0.20	0.17	0.22 ***	0.23	0.21
Total applied for, in USD	55	28	28	57 ***	102 ***
Loan fully approved	0.98	1.00	0.98	0.98	0.96
Loan partially approved	0.01	0.00	0.01	0.02	0.01
Total received, in USD	51	27	26	54 ***	93 ***
Monthly interest rate	0.06	0.06	0.07	0.05 *	0.05
Loan length, months	5	5	5	5	5
No guarantee	0.62	0.67	0.66	0.62	0.51 **
Land as a collateral	0.31	0.31	0.29	0.29	0.37 *
<i>Loan purpose</i>					
Investment	0.37	0.29	0.36	0.44	0.41
Consumption	0.33	0.38	0.37	0.31	0.27
Health	0.14	0.18	0.16	0.14	0.09
Education	0.12	0.10	0.09	0.08	0.20 ***
Total Obs.	3600	823	824	823	824

Table 2b- Credit constrained status

	Total	Q1	Q2		Q3		Q4	
Formal sector								
Constrained	0.87	0.96	0.93	***	0.88	***	0.74	***
Quantity rationed	0.09	0.08	0.10		0.08		0.09	
Lack of collateral	0.06	0.06	0.07		0.05		0.05	
Risk rationed	0.07	0.03	0.04		0.06	*	0.14	***
Transaction costs rationed	0.69	0.82	0.76	***	0.70	***	0.49	***
Semi-formal sector								
Constrained	0.71	0.82	0.76	***	0.65	***	0.59	**
Quantity rationed	0.32	0.38	0.38		0.28	***	0.25	*
Lack of collateral	0.10	0.13	0.12		0.08	***	0.06	
Risk rationed	0.21	0.13	0.23	***	0.22		0.24	
Transaction costs rationed	0.62	0.71	0.67	*	0.58	***	0.52	**
Quantity & risk rationed	0.07	0.03	0.10	***	0.07	*	0.08	
Informal sector								
Constrained	0.58	0.74	0.63	***	0.52	***	0.42	***
Quantity rationed	0.36	0.52	0.42	***	0.31	***	0.21	***
Lack of collateral	0.05	0.09	0.07	*	0.04	**	0.03	
Risk rationed	0.24	0.22	0.25		0.25		0.23	
Transaction costs rationed	0.28	0.38	0.31	***	0.24	***	0.18	***
Quantity & risk rationed	0.09	0.11	0.11		0.09		0.06	**
Total	3600	823	824		823		824	

Descriptive statistics: by credit status

- We observed significantly higher levels of input use for unconstrained households
- Unconstrained households use on average less family labor and rely more often on hired labor
- Unconstrained households observed higher productivity (USD 481 per ha versus USD 428)

Table 3- Descriptive statistics at the household level, by credit constrained status

	Total	Semi-formal sector		
		Cst.	Uncst.	
<i>Input use and agricultural productivity</i>				
Use chemical fertilizer	0.17	0.13	0.25	***
Used manure	0.73	0.70	0.81	***
Use pesticides	0.13	0.11	0.17	***
Used improved seed	0.26	0.24	0.30	***
Used extension advice	0.19	0.16	0.26	***
Male family labor days	136	143	117	***
Female family labor days	326	333	307	
Used hired labor	0.43	0.38	0.56	***
Hired labor days	146	144	148	
Total labor days	488	493	480	
Yield per ha in USD	444	428	481	**
Total Obs.	3600	2542	1058	

Empirical results: Switching model determinants of credit constrained status

- Endogeneous switching regression model to test the relationship between credit constraints and agricultural productivity (Lockshin and Sajaia 2004)
- Regime selection equation includes 1/ variables from the productivity regression, 2/ set of instruments capturing:
 - (i) economic status (unproductive assets) → wealthier hhd in need of liquidity would have the resources to secure a loan
 - (ii) social network and access to information → strong socio-political networks and better access to information should relax the credit constraint as loans in the semi-formal sector are often channeled through local institutions

Table 4a: Impact of credit constraint on productivity – selection results

	Quantity constraints	All constraints
VPU program in village	-0.035 (-0.558)	-0.065 (-1.072)
Sale value of hhd assets, in USD1000	-0.444 (-1.310)	-0.415 (-1.433)
Sale value of livestock, in USD1000	-0.292*** (-2.701)	-0.240** (-2.202)
No. adult children in village	-0.033 (-1.049)	-0.062* (-1.819)
Hd born in the village=1	-0.019 (-0.331)	-0.112 (-1.604)
Hd was displaced=1	0.011 (0.192)	0.028 (0.487)
Listen to the news at least once a week	-0.137** (-2.561)	-0.262*** (-4.226)
Head/spouse holds political office	-0.199** (-2.517)	-0.240*** (-2.987)
Relatives holds political office	-0.201*** (-3.399)	-0.232*** (-3.641)
Distance to MFI, min	0.000 (0.321)	0.000 (0.158)
Number of observations	3,119	3,119

Empirical results

- **The likelihood test of independence is rejected**, providing evidence for the validity of the endogenous sample separation
- For constrained households 1 extra unit of liquidity and family labor increase yield per ha, underlying a sub-optimal level of input use

Endowments	Unconstrained households	Constrained households
Total liquidity	No effect	+
Labor (male)	No effect	+
Land	-	-

- The negative relationship between land size and yield however stands independently of the credit regime (Byiringiro and Reardon 1990) – preliminary investigations on ag profits point towards labor market imperfections
- Estimation of the treatment effect suggests that removing

Table 4a: Impact of credit constraint on productivity

	quantity constrained		all constraints	
	unconstr.	constr.	unconstr.	constr.
Total borrowed, USD1000	0.028 (0.149)	0.885*** (3.461)	0.035 (0.190)	0.644** (2.329)
Total land owned, in ha.	-0.265*** (-8.354)	-0.339*** (-4.679)	-0.171*** (-5.197)	-0.347*** (-7.686)
No. of children (0-14)	0.001 (0.073)	0.042* (1.835)	-0.014 (-0.620)	0.021 (1.364)
No. of female adult	-0.016 (-0.691)	-0.044 (-0.973)	-0.007 (-0.175)	-0.030 (-1.132)
No. of male adult	0.031 (1.174)	0.090** (2.209)	-0.009 (-0.243)	0.052** (2.132)
Cons.	6.004*** (41.122)	5.247*** (18.194)	5.749*** (16.776)	5.470*** (38.721)
Sigma	1.082**	0.990**	0.987**	0.985**
Rho	0.607*	0.281	0.081	0.276*
Log-Likelihood	-6,142.22		-5,996.69	
Chi2	269.896		175.465	
Chi2_c	33.868		7.282	
Number of observations	3,119		3,119	

Conclusions

- Using a switching regression approach, the findings underline that the presence of credit market imperfections have a negative impact on agricultural productivity
- There is large positive impact of removing credit constrained in the semi-formal credit market on ag. productivity (+17%)
- The LTR program that will deliver 10 million land titles by 2013 has the potential to increase access to credit (in the formal and semi-formal sector) by facilitating households to meet collateral requirements.
- While titles could significantly reduce quantity rationing, risk aversion could remain/become a binding constraint to take loans (Boucher et al. 2008).
- The IE should provide some information on a potential increase in (voluntary) risk rationing. If this is observed, a more comprehensive policy package to address imperfections would be required (insurance)