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Impact of productive associations in credit demand in small coffee farmers in Peru

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***Abstract*– Credit demand in farmers has remained low despite the increase of credit allocations and bank offices in rural areas. Low productivity and profitability could be key determinants of this low demand due to a possible poverty trap generated. There is evidence in coffee sector that productive associations could increase both factors; therefore, what is the impact of them on credit demand in small coffee farmers? Using a propensity score matching model and data from IV National Census of Agriculture the study demonstrates that small associated coffee farmers increase more than two times the odds of credit request compared to those that are not associated. This result indicates that cooperatives may have a causal effect on credit uptake.**

***Keywords*-- Credit demand, productive associations, propensity score matching, agriculture, small coffee producers**

I. Introduction

In Peru the financial system has done a great effort to expand the credit offer in the agricultural sector. Credit portfolio and micro-financial institutions have notoriously increased since 1994 [1].

However, the credit demand in the agricultural sector has remained low. Evidence shows that just 8.8% of farmers requested credit and just 4.2% responded that the reason was the lack of financial institutions. Only 3.2% of non-applicants in the coffee sector attributed their decision to the absence of financial institutions, confirming that low credit demand is primarily a demand-side rather than a supply-side problem.

These figures demonstrate that credit access is not the principal reason for the low credit request. Thus, it is suggested to analyze the problem from the demand side and investigate the factors that motivate the small farmer to ask for credit ([2], [3], [4]).

Under the assumption that the individual with low income is rational (and makes efficient decisions), a credit request will be necessary only if the small farmer has sufficient productive conditions, so that the investment is profitable given his production curve. Thus, even if the farmer is in extreme poverty, he will not take the credit [5].

Productive conditions mean having enough credit to make the farm profitable, having an interest rate that summed with the rest of marginal costs result lower or equal to marginal income, receiving training, relevant market information and financial services, and business assistance to increase productivity and profitability [6].

Productive associations (e.g. cooperatives) play an important role in the solution to the problem of the low demand credit request in small farmers. The reasons stem from the benefits given by them: training, technical assistance, better prices and cost reduction due to joint purchase of agricultural inputs ([7], [8], [9], [10]).

Moreover, some studies demonstrate that they increase the probability of requesting a credit because belonging to a cooperative serve as a guarantee or a collateral [11]. Additionally, cooperatives boost social capital, and it enhances the flow of relevant information as financial knowledge and market opportunities, increasing the probability of asking for credit [12].

This study brings information to respond to the question: Do associations have a causal effect on credit requests in small coffee farmers in Peru? We respond this question by using propensity score matching and the National Agricultural Census of Peru. In the first chapter we describe the research region, the sample, and explain some descriptive statistics of the National Census. Then, we set the econometric model and the identification strategy to finally show the results.

This demand-side problem is not unique to Peru; similar patterns have been documented across Latin America, where smallholder farmers often self-exclude from credit markets despite available supply. Studies in Mexico, Colombia, and Brazil have shown that rural households frequently perceive credit as inaccessible or unsuitable for their needs, even when financial institutions are present [13]. Understanding what activates demand—rather than simply expanding supply—has become an increasingly relevant policy question in the region.

This research contributes to the literature on credit requests in developing countries, which has traditionally focused on this study from a supply-side perspective. When we analyze the problem from the demand side, why small producers do not ask for a loan, the study engages in a dialog with the studies that have recently explored this phenomenon using impact evaluation and census data and provides empirical evidence about the causal effect of productive associations on credit demand in smallholder producers.

The underlying argument is that cooperatives improve productivity, profitability, and access to market information, shifting the conditions under which requesting credit becomes a rational decision for the small farmer. In other words, associations do not merely reduce the barriers to obtaining credit; they transform the expected returns on investment, making borrowing worthwhile for farmers who would otherwise self-exclude.

Using propensity score matching with census data from Peru, we show that associations have a causal effect on the decision to seek credit—a finding that sheds light on how farmer organizations shape financial behavior in rural households.

II. Literature Review

Linh [14] used data from the 2021 China Household Finance Survey to show that cooperatives give banks a window into farmers' activities through organized value chains—this reduces transaction costs and makes lending less risky for both sides. In practice, the cooperative acts as an intermediary that pools information about its members, so a bank no longer needs to evaluate each farmer individually.

Ingutia and Sumelius [15] reached a not-so-different conclusion in rural Kenya, where women in cooperatives obtained credit more frequently because group lending lowered collateral requirements. Their study is worth noting because it highlights that cooperatives can be particularly effective for groups that face additional barriers to credit, such as women who rarely hold formal land titles.

Balana [16], looking at Nigerian smallholders, added that cooperative members were less likely to self-exclude from credit markets and, at the same time, faced fewer rejections from lenders. What these three studies share, despite covering very different countries, is that cooperatives seem to work on both sides of the credit problem at once: they make farmers more willing to apply and banks more willing to lend.

Cooperatives also affect credit demand through a less obvious route: they change what farmers can earn. Velandia [17] looked at coffee farmers in Mexico and found that those in cooperatives were able to obtain Fairtrade certification—something an individual smallholder simply cannot afford on his own. Fairtrade guarantees a minimum price, so these farmers are not fully exposed to the wild swings of the commodity market when they decide whether to invest.

Leiva [18] studied Costa Rica and Guatemala and found that between 2008 and 2019, the cost of producing coffee almost doubled, mostly because of rising labor costs. Many farmers could no longer cover their expenses. Those who did manage to stay profitable tended to have certification and some form of cooperative support behind them. Among the few factors that helped some of them stay above water were certification schemes and the cooperative ties needed to access them.

The Peruvian case runs along the same lines: coffee cooperatives there have been instrumental in turning the country into the world's leading organic coffee exporter, a position built on years of technical training to members, pooling of processing infrastructure, and negotiating collectively with international buyers instead of accepting whatever local intermediaries offered [19].

For credit demand, the logic is not hard to see—if a farmer expects to earn more from what he produces, a loan stops being a burden and starts being a tool. That is essentially what Banerjee and Dufflo [5] argued: the problem was never that poor farmers are irrational, but that borrowing only makes sense when the profit curve is steep enough to justify it. This connects back to the poverty trap logic of Banerjee and Duflo [5] that frames our study.

To answer our research question, we draw on two complementary perspectives: First, information asymmetries which prevent banks from assessing creditworthiness, lack of collateral, and risk in agricultural production, as well as the provision of financial services not designed for rural clients ([2], [20]). In addition, under certain conditions, low credit uptake can also be explained by low marginal returns, which make loans unattractive [5].

Second, productive associations improve market access, reduce transaction costs, and serve as collateral substitutes for their members ([11]; [7]), and the literature presents these organizations as facilitators. Our study instead argues that cooperatives enable technical assistance and training, collective bargaining power, pooling of resources, and greater market information and financial opportunities, as well as access to social capital ([12], [8]).

Through these mechanisms, associations shift the farmer's expected profit curve upward. A farmer who previously saw no benefit in borrowing may now perceive profitable investment opportunities. The decision to request credit thus reflects the farmer's assessment of whether investment will pay off.

Associativity affects credit demand through two channels: indirectly, by raising productivity and profitability via technical assistance, economies of scale, and access to higher-price markets; and directly, as cooperatives facilitate credit access and the government offers preferential loans to organized producers.

III. Data and context

A. Research Region

The research region is set on Peru, specifically in the coffee regions: Junin, San Martin, Cajamarca, Cusco, Amazonas, Huánuco, Pasco, Puno, Ucayali, Ayacucho, Piura and Lambayeque. Those regions were selected because they represent 99% of the national production [21].

This region is highly biodiverse, and it exhibits a persistent absence of state presence. Many coffee farmers develop in an informal economy and their income, in some cases, is not sufficient.

According to National Agricultural Census, 43% of small coffee farmers affirmed that income from agriculture production is not sufficient and 29.4% have another income from agriculture. Additionally, they have 1.5 HRC (Irrigated coast hectares) on average. These patterns are indicative of subsistence-oriented agriculture and suggest the possible existence of a poverty trap.

Historically, the Peruvian state has tried to diminish poverty in farmers by cooperativism. In the 1970s a dictatorial government implemented agrarian reform and cooperativism as a model of rural development. However, it did not prosper, and small farms prevailed. These phenomena generated a decrease in agriculture productivity, a reduction in the incentives to capital accumulation, a monopoly of collectors and the lack of scale economies.

In the coffee sector, the solution was met through the free organization of small farmers: productive associations. In the 1980's and 1990's the number of them grew significantly and in 1993 the "Junta Nacional del café" was created. This entity has the function to represent coffee productive cooperatives and to give training to small farmers [7].

Based on data from IV CENAGRO (National Agricultural Census), small coffee farmers affirmed that the principal benefit is to receive training and technical assistance, followed by national and international market access and supply of agricultural inputs. These self-reported benefits align with the theoretical expectation that associations improve the conditions under which credit becomes attractive.

Training and technical assistance increase productivity; market access improves expected prices; and joint input purchases reduce costs. Together, these factors shift the farmer's profit curve upward, making investment—and therefore borrowing—a more rational choice. These answers are signs that associations could generate an increase in productivity and profitability, two essential factors that can bring out the small farmers from a possible poverty trap.

B. Sample and data

The econometric analysis is based on a propensity score matching model with data taken from the IV National Agricultural Census 2012. The population are the small coffee farmers of the principal coffee regions cited before.

Based on Maletta [22], small farmers are defined as the ones that have no more than 10 HCR (Coast irrigated hectares), no more than one regular farm worker, and the legal status of a natural person. It is important to say that for the calculation of the HCRs, Maletta [22] proposed to consider not only the extension of the area of cultivation, but the geography and the number of animals a small farmer could have.

In this respect, Maletta [22] developed a table of equivalence between regions and ecological zones to account for geographical heterogeneity (Table II). Additionally, smallholder coffee production systems are diverse and not limited to coffee cultivation; farmers also raise livestock. Therefore, Maletta proposed a second equivalence table to standardize different types of livestock in terms of sheep units. Based on this approach, he determined that 40 sheep are equivalent to 1 HRC.

The Census distinguishes the extension of cultivated areas and other aspects that Maletta suggests calculating HRCs.

C. Descriptive Statistics

The population is 204 309 small coffee farmers, and the 13.4% requested formal credit. From those that did not ask for credit, 33.1% mentioned that they did not need it, 27.6% because of a high interest rate, and 20.9% because of a lack of a credit guarantee.

Following the credit constraints categorization of Guirkinger and Boucher [20], 27.6% of farmers were price rationed, 6.8% were cost transaction rationed, and 5.8% were auto excluded.

Also, the farmers affirmed that they requested a credit to obtain agricultural production inputs (62.7%), to buy

TABLE I

DESCRIPTIVE STATISTICS

Statistic	Mean	St. Dev.
Request	0.130	0.336
Association	0.130	0.336
Toilet	0.109	0.312
Electricity	0.026	0.160
Title	0.211	0.408
Irrigation	0.050	0.197
Another_income	0.294	0.456
Sufficient_income	0.432	0.495
Index_prod	0.641	0.319
Export	0.017	0.128
Hrc	1.502	1.519
Famt	1.791	1.645
Organic_certification	0.043	0.203
Education	4.001	1.635
Age	43.855	15.414

TABLE II

EQUIVALENT OF ECOLOGICAL ZONE BASED ON AVERAGE GROSS VALUE PRODUCTION PER HECTARE

Natural region	Ecological zone CENAGRO	Cultivation system	Equivalence in HRC
Coast	Coast	Irrigation-based	1
		Rainfed	2.75
	Maritime yunga region	Irrigation-based	1
		Rainfed	2.75
Highland	Maritime yunga region	Irrigation-based	1.37
		Rainfed	2.75
	Quechua, suni, puna and janca	Irrigation-based	1.37
		Rainfed	2.75
	Fluvial yunga region	Irrigation-based	1.37
		Rainfed	2.75
Rainforest	Fluvial yunga region	Irrigation-based	2.04
		Rainfed	3.05
	High and low rainforest	Irrigation-based	2.04
		Rainfed	3.05
Note: Based on production values of 2012 (Data from MINAGRI Statistics)			
Source: Maletta [22]			

agricultural tools and machines (14.8%), and product commercialization (8.5%).

21.1% have a property title registered. On the other hand,

TABLE III
LOGIT RESULTS

Independent variables	Dependent variable
	Association
Gender (sexo)	0.304***
	(0.022)
Spanish (spanish)	-0.048*
	(0.026)
Toilet (sshh)	0.161***
	(0.026)
Electricity (luz)	0.480***
	(0.041)
Title (titulo)	0.371***
	(0.020)
Irrigation (riego)	1.448***
	(0.043)
Another_income (otro_i)	0.293***
	(0.018)
Sufficient_income (suf_i)	0.091***
	(0.017)
Index_prod (index_prod)	0.214***
	(0.030)
Export (export)	1.686***
	(0.061)
Hrc (hrc)	0.197***
	(0.005)
Famt (famt)	0.105***
	(0.005)
Organic_certification (P057)	3.123***
	(0.030)
Education (WP114)	0.136***
	(0.005)
Age (WP112)	0.010***
	(0.001)
Constant	-19.949
	(719.193)
Observations	204,309
Log Likelihood	-57,631.290
Akaike Inf. Crit.	116,036.600
Note:*p<0.1; **p<0.05; ***p<0.01. "District" variable was taken as a fixed effect.	
Source: IV CENAGRO; Author's own calculations.	

in respect to sociodemographic variables, the 80.3% are male, the 80.3% have Spanish as their native language, on average they are 44 years old, and their level of education is complete primary school (Table I).

IV. Limitations of the Study

This study relies on census data with a cross-sectional structure; therefore, it is not possible to measure effects over time.

In addition, the data correspond to the year 2012; however, there are several reasons for their use. First, the IV National Agricultural Census is the most recent census currently available, as the V Census has been postponed several times, and no alternative dataset offers the same level of detail and national representativeness.

Second, the objective of this research is to identify a structural pattern—namely, the mechanism through which producer associations generate a positive effect on credit demand via social capital formation and improved productive conditions—which does not depend on a specific period.

Third, the Peruvian coffee sector has not undergone substantial structural changes and continues to be predominantly characterized by small-scale producers. Fourth, this analysis may serve as a baseline for future research once data from the next National Census become available.

Finally, although the study focuses exclusively on small coffee producers, this sector represents a relative success case, as it is one of the most organized productive sectors in Peru. Additionally, our research treats all forms of productive associations in a similar way, when they have heterogeneous forms of organization. A cooperative that offers technical assistance, market linkages, and financial services may have a stronger effect than a committee that only facilitates input purchases. Also, it doesn't assess if the credit had a positive impact on the farmers' welfare. Finally, the census captures active farmers, not the ones who left the sector.

V. Econometric Model and Identification Strategy

The objective of the study is to analyze the causal effect of productive associations in credit requests. This suggests the use of a propensity score matching (PSM) model where the association could be taken as the treatment ([23], [24], [25]). Therefore, the control group would be the coffee farmers that are not associated with while the treatment group would be the ones that belong to a type of productive association (e.g. cooperatives).

The study can be modelled by the following equation:

$$Y_i^T = F_i^T(X_i) + \varepsilon_i^T; T = 0, 1 \quad (1)$$

$$T_i = G(W_i) + \mu_i \quad (2)$$

Where X are the observable variables that affect belonging to an association and the credit request; Y is a dichotomic variable that represents whether the farmer requests a credit and T whether he belongs to an association.

The impact can be estimated following this equation:

$$E(Y_i(1)|T_i = 1) - E(Y_i(0)|T_i = 0) \quad (3)$$

This method belongs to the category of non-experimental methods where the data available is not assigned randomly. In this respect, it is necessary to set some identification assumptions that allow to solve the auto selection [26].

After adding and substracting the contrafactual: $(E(Y_i(0)|\ T_i = 1)$ (4)

the equation becomes like this:

$$E(Y_i(1)|T_i = 1) + (E(Y_i(0)|T_i = 1) - (E(Y_i(0)|\ T_i = 1) - E(Y_i(0)|T_i = 0) \quad (5)$$

The difference between the first two terms is the average treatment effect on treated (ATT) and the following two represent the selection bias. The last one would be zero if the

assignment were completely random. Nevertheless, this study is not experimental, therefore the assumption is that:

$$(E(Y_i(0)|T_i = 1) - E(Y_i(0)|T_i = 0) = 0 \quad (6)$$

However, it cannot be proved. To solve this issue, it could be conducted a sensitivity test through simulations to demonstrate that there are no observed variables that affect both variables of interest. In this case, Rosenbaum was used to deduce this assumption.

Firstly, the observable variables were identified essentially based on the microeconomic model of Carranza [27]. Then, some other context variables that can affect both variables of interest were added ([28]; [29]). With a propensity score, using a logit model, everyone was assigned a probability to receive the treatment (belong to an association) [30].

After evaluating the common support condition, it will be developed two methods of matching (Nearest neighbor (NB) and maximum distance) and it will be calculated the Average Treatment Effect on Treated (ATT) for each method and their variations (with and without replacement). The method and variation with the lowest standardized bias will be selected. At last, the Rosenbaum test will be taken.

Formally, the method of Nearest Neighbors is defined as follows:

$$C_i = \{j \in D = 0|argmin_j P_i(X) - P_j(X)\} \quad (7)$$

Where j is a farmer of the control group and i from the treatment group, and $P(X)$ is the propensity score. Then, the ATT under NB method is the following:

$$\tau_{ATT}^{PSM-NB}|_{T=1} = \frac{1}{|N|}\sum_{i=1}^{i}\{Y_i - \frac{1}{|J|}\sum_{j=1}^{j} Y_j\} \quad (8)$$

Where $|N|$ is the number of farmers of the treatment group and $|J|$ is the number of farmers of the control group that are matched. This equation is a general form of NB where the number of neighbors can be more than one. If so, the equation applies to a factor of pondering.

VI. Estimation and Results

It was estimated the causal effect of productive associations in credit requests using a propensity score matching model. Table III shows logit results to calculate the propensity score. All covariates were statistically significant ($p < 0.01$), with organic certification and export-oriented production showing the strongest association with cooperative membership.

Table IV shows the ATT estimation for each of the methods and variations. Among the tested methods, the Nearest Neighbor approach with four neighbors and replacement showed the smallest mean differences across the largest number of variables (Fig. 1). Therefore, it was selected as the most appropriate method to estimate the ATT more precisely. After matching, the standardized bias for all covariates fell below 0.05 standard deviations, confirming adequate balance between treatment and control groups.

TABLE IV
ATT ESTIMATION

Matching method	Without replacement		With replacement	
Number of nearest neighbors	ATT[1]	Confidence interval[2]	ATT[1]	Confidence interval[2]
1	2.55	2.44-2.66	2.27	2.18-2.37
2	2.68	2.61-2.77	2.26	2.19-2.33
4	3.11	3.05-3.19	**2.21**	**2.16-2.25**
Maximum distance (sd)				
0.2	2.90	2.77-3.05	2.22	2.13-2.32
0.05	2.88	2.74-3.03	2.23	2.14-2.32

Note: [1] Calculated in odds ratio
[2] Confidence interval of 95% (2.5%-97.5%)
[3] All ATT results have a p-value lower than 0.001
Source: IV CENAGRO; Author's own calculations.

A Rosenbaum sensitivity test (Table V) was conducted to assess the potential influence of unobserved variables on the results. The test indicated no evidence to suspect the presence of such variables.

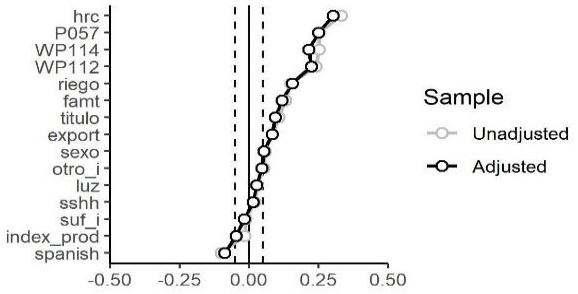

Fig. 1 Post-Matching Analysis of NN with 4 neighbours with replacement.
Note: 'Adjusted' denotes the treatment group, and 'Unadjusted' denotes the control group. The variable names are listed in Table 2.

The results show that the small coffee farmers that are associated increase the odds of demanding credit by 2.21 times compared to those with similar characteristics that are not associated. This finding is consistent with the theoretical expectation that associations improve productive conditions and market information, making credit a rational choice for farmers who would otherwise see no benefit in borrowing.

VII. Conclusions

As well as in other countries, in Peru exists a demand-side problem of credit access. Most farmers obtain credit, but more than 90% do not request it. While most of the studies focus this problem on credit restrictions like quantity, transaction cost and risk aversion, this study also considers the existence of a poverty trap. In this article, a basic model was developed to explain that credit requests depend on productivity and profitability of small coffee farmers.

Following the study approach given by Banerjee and Duflo [5], small farmers with low income would not ask for a credit because they are in poverty trap. Low-income farmers' profit will not grow as expected, even though they obtain credit, because their profit curve is flat. Therefore, not asking for it is a rational decision.

TABLE V
ROSENBAUM SENSITIVITY TEST

Gamma	Low bound	Upper bound
1	0	0
1.1	0	0
1.2	0	0
1.3	0	0
1.4	0	0
1.5	0	0
1.6	0	0
1.7	0	0
1.8	0	0
1.9	0	0
2	0	0
2.1	0	0
2.2	0	0.03769
2.3	0	0.9888
2.4	0	1
2.5	0	1
2.6	0	1
2.7	0	1
2.8	0	1
2.9	0	1
3	0	1
Note: Gamma is the odds ratio of being associated and not being associated due to not observable variables		
Source: IV CENAGRO, Keele [31]; Author's own calculations.		

However, cooperatives could help them overcome this obstacle by obtaining social capital. This means compensating better prices by having collective negotiation with traders and coffee collectors, receiving training, more information about the market and credits.

Just with a better profit curve, more productivity and profitability, small coffee farmers would request credit. In this respect, in Peru, cooperatives are also benefited with preference credits from "Agrobanco" following a Legislative Decree.

Having set this theoretical statement it was proved empirically that coffee associations could have a causal effect on credit requests by developing a propensity score matching model. It was estimated that associated farmers have more than two times probability of asking for a credit compared to those that do not belong to an association.

From this analysis and this result some policy conclusions can be elaborated. First, the results suggest that an association has a causal effect on credit requests—associated farmers are 2.21 times more likely to request credit than non-associated ones with similar characteristics. In this respect, this study brings empirical support to the strategic action of the Ministry of Agriculture (Midagri) that plans to give access to credit by the articulation and the organization of small farmers [32].

These findings also shed light on why this strategy works: associations do more than connect farmers to banks—they help create the conditions that make borrowing a sensible choice in the first place.

Second, there should be planned incentive mechanisms to make small farmers get organized to form a productive association. Concerning this point, it should be motivated, but not forced, due to historical reasons: forced cooperatives were implemented by a dictatorial government in the 1970s in Peru without success. Some options worth exploring include giving organized groups priority access to technical assistance programs, reducing paperwork for registered associations, or offering seed funding to help new cooperatives get started. What matters most is that farmers see clear, immediate benefits from joining.

Third, this study focuses on the demand-side problem of credit access, having a broader analysis of it. Following the survey structure of the National Agricultural Census of Peru, there are two phases before obtaining a credit: the need of credit and the request of it.

Descriptive statistics show that more than 90 percent of farmers obtained credit once they asked for it. This result implies that the problem is not a selection problem, but a lack of need or an auto exclusion, that is why a poverty trap was thought of as an explanation to this phenomenon.

This suggests that rural credit policy may need to shift focus. Expanding bank branches or lowering interest rates addresses the supply side, but that may not be where the real obstacle lies. A more effective approach would tackle the reasons farmers exclude themselves in the first place: low productivity, limited access to market information, and few profitable investment options.

Fourth, the research is focused on the coffee sector, which is one of the most organized productive sectors in Peru. Even though this aspect could be taken as an obstacle to infer for other sectors, it could also be taken as a success case to imitate. Sectors with weaker organizational traditions—potatoes, rice, livestock—might learn from what worked in coffee.

The Junta Nacional del Café gave cooperatives a national voice and helped coordinate what would otherwise have been scattered local efforts. Export markets that pay a premium for quality certifications gave farmers a concrete reason to stay organized. And early support from development programs provided the initial push that many cooperatives needed before they could stand on their own. Whether those same conditions can be replicated elsewhere is an open question, but the coffee experience at least suggests where to start.

This study opens new avenues for future research. First, an analysis of micro-level factors could uncover if the impact associations have on credit demand varies across geographical areas or farmer characteristics, such as income level, farm size, or education, or by the type of association they are members of.

Second, it is still unclear what types of mechanisms these associations activate to increase credit demand. Is the effect

driven primarily by improved information, by higher expected productivity, by reduced risk perception, or by the collateral function of group membership? Further analysis could illuminate these questions more.

Third, a longitudinal analysis could provide greater insights on the evolution of the relationship between associations and farmers; for instance, we know little about whether credit demand has strengthened, weakened, or stayed stable over time.

Fourth, moving beyond the coffee sector would test the generalizability of our results, for instance, examining other crops or even other sectors.

Finally, looking into the impact those credits have on productivity, income, and welfare would provide a more comprehensive picture of the role associations play in rural areas.

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