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Do development projects link smallholders to markets?

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Abstract: *The objective of this paper is to understand the mechanisms by which development projects facilitate market linkage of smallholder farmers based on panel data from Nicaragua. We find that activities related to entrepreneurial practices have positive and statistically significant effect on commercialization. We also find that increased commercialization is positively correlated with total bean sales income, suggesting a positive indirect effect of the activities. Other activities demonstrate no positive and robust effect on commercialization while direct positive effects on sales income can be observed. This implies that market linkage of smallholder farmers require different sets of intervention tools than traditional farm technical assistance.*

Keywords: Central America, NGO project, Market linkage

JEL codes: O13, Q17, Q18

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1. Introduction

In the recent years, the topic of smallholder commercialization has received much attention in the development literature. Smallholders' inclusion in commercial markets can benefit them by providing premium prices (Gulati et al., 2007), reducing transaction costs (Nagaraj et al., 2008; Vieira, 2008), and providing access to credits and improved production technology (Minten et al., 2009; Nagaraj et al., 2008; Swinnen, 2007). However, such emerging market transactions can also pose challenges for smallholder farmers in developing countries. Small farmers may be excluded from these markets due to a lack of assets to meet more stringent standards required in the modern marketing chains, leading to further marginalization of the poor in the developing world (Barrett et al., 2012; Reardon et al., 2003; Reardon et al., 2009; Reardon & Timmer, 2007; Swinnen, 2007).

However, overcoming the difficulties that resource-poor farmers face is not a straightforward task. While the empirical literature has identified mechanisms that allow smallholder farmers to exploit the business opportunities of agricultural commodity markets (Hellin et al., 2009; Minten et al., 2009; Narrod et al., 2009; Whitfield, 2012), actual enforcement of such mechanisms is difficult particularly when private companies are the sole initiators of the implementation. In general, retail companies systematically prefer farmers with a good access to roads, physical assets (e.g. irrigation system), possession of relatively large land areas and high human capital (e.g. education, experience in horticultural production) among others (Barrett et al., 2012; Donovan & Poole, 2008; Michelson, 2013; Rao & Qaim, 2011). As a result, retail companies-based market linkage tends to be limited to producers who are relatively better off at the initial stage. In addition, even if smallholders are included in the marketing chains at the initial stage, many are unable to maintain participation due to both quality and quantity requirements and implicit risks (Barrett et al., 2012; Donovan & Poole, 2008).

Having identified the importance of product commercialization as well as the constraints small farmers face, many development institutions are starting to consider assisting smallholder farmers to commercialize as a catalyst for alleviation of rural poverty. A number of development projects have been launched in order to initiate better communication and increased exchange between farmers and buyers in commodity markets (Humphrey & Navas-Alemán, 2010; Barrett, 2008; Shepherd, 2007). Food and Agriculture Organization of the United Nations (FAO), International Fund for Agricultural Development (IFAD), and the Consultative Group on International Agricultural Research (CGIAR) are amongst the public institutions initiating market linkage programs for smallholder farmers throughout the world (CIAT, n.d.; FAO, n.d.-b; IFAD, 2012).

Despite the recognized potential of projects aiming at linking farmers to markets, there is a lack of empirical literature to address outcomes of intervention activities at the micro-, meso- and macro-levels (Barrett, 2008; Mithofer, 2011). To the best of our knowledge, there is no study that explicitly assesses the impacts of development projects in the context of smallholder market linkage. While many argue the importance of external support in either establishing or maintaining the industry (e.g. Bignebat & Vagneron, 2011; Carletto et al., 2011; Kersting & Wollni, 2012; Subervie & Vagneron, 2013), there is little constructive argument as to what intervention activities contribute to smallholder commercialization by how much. In addition, existing studies fail to differentiate activities in assessing effectiveness of development projects.

This is an important research gap to be addressed. The existing reports do not provide satisfactory answers as to what extent projects were successful in achieving their objectives, whether the success was due to project interventions, and if the implementation of the projects was cost effective (Humphrey & Navas-Alemán, 2010). However, such studies are difficult to assess empirically. Product participants are selected according to certain criteria. Therefore, evaluation of the impacts of project interventions has to control for potential selection biases, which is challenging (Barrett, 2008). Carrying out such studies can be costly and many organizations prefer to allocate the resources for the actual implementation of the project rather than impact evaluation (Humphrey & Navas-Alemán, 2010). Moreover, assessment of impact in a long-run requires a panel data set that allows us to control for selection bias.

This research intends to fill the aforementioned gap by investigating how an NGO intervention influences market linkage of smallholder farmers. As a case study, we refer to a development project whose focus was market linkage of smallholder farmers. The Catholic Relief Services (CRS) implemented the project[1] in rural Nicaragua over a period of five years between 2007 and 2012. We conduct our analysis on bean farmers.

[1] The details of the project are discussed in a supplementary material, which is available from authors upon request.

Our paper contributes to the empirical literature in two aspects. The first contribution is to identify pathways how a development project influences smallholder commercialization by scrutinizing how interventions with unique objectives affect the volume of bean sales in non-local markets. The project of interest consists of five individual programs, each of which addresses different aspects of production and marketing of agricultural goods. Unlike other studies, this study differentiates activities to better understand what types of intervention activities have impact on product marketing in a rural setting. To the best of our knowledge, there is no study that addresses effectiveness of different NGO-based activities in the context of commercialization of smallholder farmers.

Second, we control for unobserved heterogeneity by exploiting a panel data set. Most studies to date in the smallholder commercialization literature use cross sectional data sets or reconstructed panel data based on recall interviews. While such studies can provide useful insights for policy makers, the lack of observations over time makes it impossible to control for potential unobservable heterogeneity that is individual-specific. By utilizing a panel data set, we are able to account for such shortcomings.

There are a few reasons why this particular project is chosen. First, CRS has recorded substantial amount of information at the household level over the five years. The information includes detailed data at all points of sales that approximately 10,000 producers undertook. CRS recorded the information for every sales transaction[2], which ensures the reliability of the data. In addition, information about intervention activities is also well recorded. Even though there is a lack of some critical information, such detailed data can provide us useful insights as to how farmers' behavior changed over time in response to what type of intervention activities.

Second, due to the detailed information, we are able to differentiate individual intervention activities with unique objectives. In many of the aforementioned studies, intervention activities are not separated based on categories. However, activities that address productivity increase should not be treated in the same way as those focusing on post-harvest management practices. Also, scrutinizing intervention can point out important aspects that enable small farmers' participation in commercial markets even outside the context of development project

[2] The maximum recall period is three months, one production cycle of beans.

intervention. With detailed information about what type of intervention was undertaken by whom, we are able to understand impact pathways for market linkage.

Third, studying this particular project can serve as a model for other market linkage projects that are being launched throughout the world. Linkage-focused interventions such as the Nicaraguan project have become popular amongst donors while evaluation of such programs has not been done in a satisfactory manner (Humphrey & Navas-Alemán, 2010). Therefore, understanding the effectiveness as well as limitation of such market linkage-oriented projects can help design new projects based on the learnings from this project in Nicaragua.

The rest of the paper is organized as follows. The next section presents the overview of the market linkage program. Section 3 discusses the conceptual framework, data and econometric strategy to analyze the effects of program participation on producers' market linkage. Section 4 presents the results, which is further discussed in Section 5. Finally, Section 6 summarizes and concludes.

2. Background

Our analysis focuses on activities related to "entrepreneurial practices". The project intervention is first divided into five distinct programs: production program, environmental program, gender program, post-harvest program, and market linkage program. Each program has one or two training categories with distinct themes. Namely, the production program has trainings for agricultural practices and agricultural production, and the environmental program has trainings for water and environmental management. The gender and post-harvest programs each have one category. The market linkage program is divided into two training categories: "entrepreneurial practices" and "municipality engagement". Our interest lies in eliciting effect of "entrepreneurial practices" activities.

Not all project participants received activities in all categories. Table 1 shows the number of producers who participated in activities in each program. Among the five programs, the production program was implemented most intensively, followed by the market linkage program and environmental program. Some participants took part in more than one program over time. Therefore, there is an overlap between different programs. Every year, approximately 6% of all bean producers participated in the market linkage program.

Insert Table 1 here.

In our estimation, we hold those who participated in "entrepreneurial practices" activities as the treatment group and the rest as the control group. We are aware that farmers in the control group are also participants of the NGO project. However, our purpose is to assess effectiveness of the market linkage program rather than the project as a whole. Therefore, identification of treatment effects is possible with appropriate estimation strategies. We will discuss the details in Section 3.

"Entrepreneurial practices" activities targeted to develop farmer cooperatives as credible business enterprises which provide services to the members and contribute to their livelihood improvement (CRS, 2010). Workshops and knowledge exchange activities were organized in order for individual producers to understand the importance of the roles of cooperatives. Activities covered a wide range of topics such as financial sustainability and independence, book keeping, transparency in organizational governance, providing services to members, and improving environmental sustainability. In addition, individuals participated in business meetings to build network with potential buyers. Therefore, we expect that the intervention had direct effect on commercialization unlike other activities types[3].

3. Empirical estimation strategy

3.1. Conceptual framework

We define all market types except local wholesale markets as linked markets. Namely, they are farmer cooperatives, intermediaries, and private companies. The empirical literature refers to traditional markets as "wet markets" (e.g. Schipmann & Qaim, 2011) and markets where product exchange is rather "loose" (Assefa & Minten, 2015). In our research context, only local wholesales markets meet such descriptions. Private companies require stricter product quality and quantity standards while intermediaries are directly linked to private companies (e.g. supermarkets). Once producers sell their products to cooperatives, they market the collected goods to buyers including private companies. Products may be processed within cooperatives before being commercialized. Therefore, sales outside local markets involve product standards, supply agreement and product differentiation. Such economic transactions which require commitments and compliance are virtually nonexistent in local wholesale markets. For these reasons, we classify linked markets as non-local markets.

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[3] A complete list of all activities can be provided by authors upon request.

Figure 1 illustrates the possible impact pathways of the market linkage program in increasing volume of sales to alternative markets. The market linkage program provides individuals with trainings on organizational structure and the importance of providing services to cooperative members. At the same time, it also initiates negotiation between cooperatives and local governments.

Insert Figure 1 here.

As a result, cooperatives are able to provide adequate services and assist producers in product marketing. As producers benefit from improved management of cooperatives, they come to trust the organizations and sell their products to the cooperatives. Also, services provided by the cooperatives can help increase production quantity and quality, which encourages product marketing to other linked buyers. Therefore, it helps small producers to market their products outside the community.

Business exchange in linked markets was a small fraction of total sales activities and did not grow over the project intervention phase. Table 2 and Table 3 present the number of producers who sold beans to each type of markets and quantity of beans exchanged in linked and all markets in a given year, respectively. The first indicates that the majority of sales transactions occurred in local markets rather than in linked markets. On average, sales transactions in linked markets take up merely 6.24% of total sales. The figure in 2008 is the highest at 23% or 1,086 of total bean producers and the lowest is recorded in 2012 where no producer sold in linked markets.

Insert Table 2 here.

Similarly, the amount of beans sold in linked markets is small also in terms of quantity. Quantities of beans sold in linked markets range between 0% and 26% of total sales quantity between 2006 and 2012. These observations show that the fraction of economic transactions that occurred in linked markets is rather small both in terms of the number of producers and quantity exchanged.

Insert Table 3 here.

The economic transactions during 2008 and 2009 were more active in linked markets compared with other years. In 2008 and 2009, 24% and 26% of all bean producers sold at linked markets, respectively. The reason why sales activities in linked markets were less in 2010 and 2011 may be due to an informal export restriction imposed on beans during these two years (The

Economist, 2011). The Nicaraguan government implemented this policy in order to protect domestic bean consumers. Therefore, bean export during these two years decreased (FAO, n.d.-a), which may explain the significant decrease in beans sold outside local markets in our sample.

3.2. Data

We utilize the data set recorded by CRS on project participants who produce staple beans. The data set contains a total of 5,054 bean farmers and 10,194 observations on bean sales. As long as an individual farmer was part of the project, the NGO reports all sales activities s/he generated during the five years. This holds true even when individuals did not participate in any activities in a given year. In addition, the data contain all individuals who participated in the project. We exploit the full unbalanced panel data set.

Our outcome variable is defined as quantity of beans sold in linked markets. We also alternate with the fraction of bean quantity sold in linked markets with respect to total sales quantity. Variables related to individual characteristics are gender, head of household, and leadership positions in a cooperative. We also use information regarding department and villages that farmers live to control for location-fixed effects.

The production-related variables are total annual production area of beans and total annual production cost of beans. Empirical literature does not have general consensus as to how production area size affects participation in modern markets (Carletto et al., 2010; Michelson, 2013; Schipmann & Qaim, 2010). However, we expect the bigger the cultivated area is, the larger the volume of sales to linked markets is. It is because our study is concerned solely with sales volume to non-local markets and intuitively households with larger land areas are likely to produce and sell more products than those with smaller area. Production costs can affect volume of sales in either direction. Higher production cost may mean more sophisticated production technology and therefore higher product quality. In this case, households may sell the final products to linked markets which require certain quality of goods. If, on the contrary, higher cost means low efficiency, the products are less likely to enter non-local markets.

As all producers in the data set are the project's participants, they received interventions outside the market linkage program over the five years. To control for participation in different activities, we include seven dummy variables that indicate participation in the remaining activity categories. Namely, we generate dummies for good agricultural practices and production assistance (production program), water access and environmental management (environmental program), gender (gender program), post-harvest management (post-harvest program), and municipality engagement (market linkage program). In addition to the binary variables, we apply the total number of training days participated in a year and cost of trainings that farmers incurred. Frequent participation may affect the sales volume positively while paying for trainings may be associated with higher commitment and therefore, faster adoption of the lessons learned in training sessions.

All program participation is treated as cumulative. For instance, if an individual received intervention in business social relationship activities during 2009, 2010 and 2012, s/he takes the value of "0" in year 2007 and 2008 and "1" in 2009, 2010, 2011 and 2012. In other words, even though this individual did not receive intervention during 2011, the cumulative value of the participation stays "1". The intuition is that capacity building is concerned with individual's change in behavior and knowledge. Once an individual undertakes training, s/he is likely to remember, and therefore may apply, the knowledge obtained from the trainings years before.

Table 4 summarizes basic characteristics of producers in the treatment and control groups. The descriptive statistics show that 21% and 19% of the farmers are female in the treatment group and control group, respectively. 52% of the farmers who participated in the market linkage program are household heads while the percentage drops by 6% in the control group. Less of treated farmers belong to a cooperative than untreated farmers. More producers in the treatment groups are in leadership positions in a cooperative than those in the control group.

Insert Table 4 here.

Program participants diversify more than non-participants. Moreover, they have larger land areas and incur higher cost of production ($15 per year more than non-participants). Also, both production quantity and production yield of program participants are larger than non-participants. Treated producers sell more to linked markets in terms of absolute quantity. The amount of beans sold to linked markets is a small fraction of total quantity sold for both groups. On average, producers in the treatment group sold 32.54qq of beans in general, 3.45qq of which was exchanged in linked markets. Producers in the control group sold 2.55qq in linked markets out of a total of 28.73qq on average. In other words, sales to linked markets take up merely 10.60% and 8.88% of total bean sales on average for the treatment group and control group, respectively.

3.3. Econometric model

This section discusses the identification strategy of the average treatment effect on the treated (ATT) of entrepreneurial practices. As an outcome variable, we select the quantity of beans sold in non-local markets. The estimation equation is specified as:

$$y_i = \beta + \alpha_i d_i + u_i \qquad (1)$$

where y_i is the outcome variable of individual i, β is the intercept, d_i is the treatment status ($d_i = 1$ if i is treated, 0 otherwise), and u_i is the error term. In the presence of selection bias into d_i, the ATT estimator, $\propto^{ATT}$, is expressed as:

$$\propto^{ATT} = E(\propto_i \mid d_i = 1)$$
$$= E(\propto_i \mid g(Z_i, v_i) \geq 0) \quad (2)$$

where the selection depends on a vector of covariates, Z_i, and the error term, v_i.

We employ the difference-in-differences (DID) approach in order to estimate the ATT. First, we tested if program participation is endogenous, following the Hausman test (Wooldridge, 2010) and Smith-Blundell test (Smith & Blundell, 1986). Both test results indicate that the linkage program participation is endogenous, suggesting that the Two-Stage Least Square approaches are suitable to obtain unbiased estimates. However, we lack appropriate instrumental variables to explain the program participation decision. Based on a common trend assumption, DID assumes that the u_i depends on unobservable individual-specific effects and macro shock. Therefore, there is no selection on untreated outcomes when first differences are taken (Blundell & Dias, 2009):

$$E\left[u_{it_1} - u_{it_{10}} \mid d_i = 1\right] = \left[u_{it_1} - u_{it_{10}} \mid d_i = 0\right] = \left[u_{it_1} - u_{it_{10}}\right] \qquad (3)$$

Thus, under the DID assumption, the estimation equation becomes:

$$E[y_{it} \mid d_i, t] = \beta + E[\alpha_i \mid d_i = 1] + E[n_i \mid d_i = 1] + m_t \quad \text{if } d_i = 1 \text{ and } t = t_i \quad (4)$$
$$= \beta + E[n_i \mid d_i = 1] + m_t \quad \text{otherwise.}$$

Therefore, the estimated ATT in Equation (2) becomes:

$$\widehat{\propto}^{DID} = \left[\bar{y}^1_{t_1} - \bar{y}^1_{t_0}\right] - \left[\bar{y}^0_{t_1} - \bar{y}^0_{t_0}\right] \qquad (5)$$

In other words, the DID estimators are the excess change in the y in the treatment group compared with that of the control group.

Since the estimation strategy mentioned above concerns with scenarios over two distinctive periods (i.e. before and after the intervention), we modify our specification model, following Wooldridge (2010). We express the model as:

$$\Delta y_{it} = \xi_t + \beta_1 \Delta P_{it} + \beta_2 I_{it} + \delta_1 T_{it} + \Delta u_{it} \quad (1)$$

y_{it}, the outcome variable, is the total volume of beans that farmer i sold in year t. ξ_t are time period intercepts to control for m_t, P_{it} is a set of production-related variables in levels (total annual production area of beans, and total annual production cost of beans), and I_{it} is a set of intervention-related variables (seven dummy variables that indicate whether or not individuals participated in intervention activities outside the market linkage program in a given year, total number of capacity building days that farmers participated in a given year, and cost of capacity building activities that farmers themselves incurred). T_{it} represents two binary variables, indicating individuals' activity participation status in year t. Therefore, the estimator, δ_1, captures the ATT of entrepreneurial practices participation, our main interest. Δ indicates that a difference was taken.

The DID estimators can be seriously biased upward in the existence of serial autocorrelation (Bertrand et al., 2004). We test for serial correlation, following Wooldridge (2010). The test result indicates that serial correlation exists in our data set. Therefore, we obtain unbiased estimators, following the two-step correction procedures suggested by Bertrand et al. (2004). For the details of the procedure, see Bertrand et al. (2004) and Michelson (2013).

For robustness check, we use lagged interventions variables to account for possible endogeneity. In addition, we control for geographical fixed effects by including dummy variables indicating individual departments and villages. Finally, we replace the outcome variable by the fraction of beans sold in linked markets. All results are presented in Table 5 and Table 6.

4. Estimation results

Table 5 presents the regression results for estimations with quantity sold in linked markets as outcome variable. All models show positive and statistically significant effect of entrepreneurial activities on the quantity sold. For instance, Column 1 indicates that those who participated in the entrepreneurial activities sold on average 2.02qq more than those who did not. Similarly, the standard serial autocorrelation-corrected model shows the magnitude of 2.78qq increase for participants. When geographical fixed effects are taken into account, the effect becomes 2.70qq and 2.91qq for department and village fixed effect, respectively (Columns 4 through 5). When lagged intervention variables are employed, participants of entrepreneurial practices show 4.18 qq and 6.73 qq higher sales volume than those who did not participate (Column 2 and 6).

Insert Table 5 here.

Another robust and positive results are the total number of days participated. The standard serial autocorrelation-corrected model shows that an additional day participated is associated with an increase in sales volume by 1.35 qq on average (Column 3). Similarly, an additional day participated would increase the sales quantity in dynamic markets by 1.15 qq and 1.12 qq with department and village fixed effects, respectively (Column 4 through 5).

When the DID estimators are corrected to account for serial autocorrelation, production variables and basic characteristic indicators are not included in the second-stage estimation. That is why the standard DID models present production variables while the SA-corrected models do not. The reason why the elicited R^2 values are low is also due to the two-stage estimation procedure. Therefore, the standard DID models explain larger variation of the observations than in SA-corrected models.

Table 6 presents results with fraction of quantity sold in linked markets with respect to total bean quantity sold in any market as an outcome variable. The results are similar to those in Table 5 in terms of the direction of effect. Standard DID model shows that entrepreneurial practices participants sold 0.2 percentage points more beans to dynamic markets than non-participants (Column 1). Likewise, SA-corrected model indicates that the difference is 0.5 percentage points.

Insert Table 6 here.

Positive influence of general participation is also confirmed. All estimation results except in those with lagged intervention variables show positive correlation between total number of days participated and percentage of beans sold in linked markets. An additional day of capacity building participated is associated with a 0.4 percentage point increase on average when estimated in a SA-corrected DID model (Column 3). With geographical fixed effects, the effect becomes 0.3 percentage point increase (Column 4 and 5).

In all estimations, we cannot find robust, positive and statistically significant effect of any other intervention activities. This may indicate that classical extension services concerning agricultural productivity increase do not have effects on market linkage. Put in another way, facilitating smallholder commercialization requires a distinct set of intervention activities in addition to activities related to productivity increase.

5. Discussion

In order to map an impact pathway, we estimate how an increase in bean sales in dynamic markets affects sales income, controlling for intervention activities undertaken by individual producers. The result is presented in Table 7. We show solely the SA-corrected estimators since the DID estimators show similar trends as to the presented results.

Insert Table 7 here.

All estimation models indicate that the higher the percentage of beans sold in dynamic markets, the higher sales income is. More specifically, a percentage point increase in bean sales to linked markets is associated with an increase in total sales income by 0.30 USD (Column 1). With department and village-level fixed effects, the effect is approximately 0.50 USD (Column 2 and 3). Such findings confirm that increased engagement in commercialization has positive effect on increasing welfare. This is consistent with findings in the empirical literature. Therefore, we can confirm that entrepreneurial practices assist alleviation of poverty through facilitating commercialization by smallholders.

It is also noteworthy that traditional intervention activities such as agricultural practices and water activities show positive correlation with sales income. Our findings confirm the positive link between farm extension services and market linkage that research suggests (e.g. Bignebat & Vagneron, 2011; Carletto et al., 2011; Kersting & Wollni, 2012; Subervie & Vagneron, 2013). While such traditional intervention activities do not show positive effect on commercialization, they play important role in contributing to household income, and therefore reduction of poverty.

6. Conclusions

Commercialization of agricultural commodities has been seen essential for economic development and alleviation of poverty. Recognizing the importance and potential of market linkage, a number of development agencies are launching on projects that focus on smallholder commercialization. However, empirical research to date lacks evidences to show whether such projects have effect on commercialization and by how much. Corresponding to such shortcomings, our research scrutinizes one NGO-based project in order to understand impact pathways how donor-funded interventions can influence smallholder commercialization. As a case study, we select an NGO-project undertaken in rural Nicaragua between 2007 and 2012. We conduct our analysis on staple bean farmers.

Using an unbalanced panel data set recorded by the NGO, we test whether training farmers regarding entrepreneurial practices has positive effect on commercialization outside local wholesales markets. In our analysis, we define linked markets as sales directed to farmer cooperatives, intermediaries and private companies. We measure commercialization with absolute quantity and share of beans sold in linked markets. In order to draw causal links, we employ the difference-in-differences approach and account for unobserved heterogeneity. The DID estimators suffer from serial autocorrelation. Thus, we solve this problem by applying a two-stage estimation procedure suggested by Bertrand et al. (2004).

The results indicate that activities regarding entrepreneurial practices have positive and statistically significant effect on commercialization. We also find that increased commercialization is positively correlated with total bean sales income, suggesting a positive indirect effect of the activities. Other activities demonstrate no positive and robust effect on commercialization while direct positive effects on sales income can be observed. This implies that market linkage of smallholder farmers require different sets of intervention tools than traditional farm technical assistance.

We recognize limitations in our study. There is no information available outside project participants in our data set. While the DID approach eliminates unobserved heterogeneity, future studies must account for selection bias into intervention activities by applying different estimation methods (e.g. instrumental variables approach, matching). Another untouched aspect is sustainability of donor-funded effort to link small farmers to commercial markets. While effect of donor-based interventions are not always maintained by smallholders (Holzapfel & Wollni, 2014), we are not able to test long-term effects of market linkage-related projects. Studies in the future may address this question by further developing longitudinal data which include information after the duration of projects.

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8. Tables and Figures

Table 1. Number of producers who participated in intervention activities: 2007-2012

Year/Activity	2007	2008	2009	2010	2011	2012
Production program						
Agricultural Practices	0	0	0	22	93	5
Agricultural Production	40	849	136	162	82	88
Environmental program						
Water	0	0	247	100	165	42
Environmental Manag.	0	0	0	35	115	20
Gender program	0	0	4	78	56	21
Post-harvest program	0	0	0	48	97	54
Market linkage program						
Entrepreneurial practices	30	217	99	66	133	71
Municipality eng.	0	197	86	33	74	246
Total # producers	1,128	3,191	1,539	1,071	1,541	1,367
% participation in Entrepreneurial practices	3%	7%	6%	6%	9%	5%

Source: CRS data base modified by authors

Table 2. Number of bean producers who sold in different markets: 2006-2012

	Local		Linked markets			
Year	market	Farmer org.	Intermediary	Private comp.	Total	%
2006	518	-	-	10	10	1.89%
2007	2,144	-	-	53	53	2.41%
2008	2,827	34	590	462	1,086	27.75%
2009	1,695	-	-	32	32	1.85%
2010	1,862	-	-	181	181	8.86%
2011	2,121	-	-	19	19	0.89%
2012	1,415	-	-	-	-	0.00%
Total	12,582	34	590	757	1,381	6.24%

Source: CRS data base modified by authors

Table 3. Quantity of bean sales (qq) to linked and local markets: 2006-2012

Year	Total	Linked	% Linked
2006	6,026	123	2.03%
2007	29,647	672	2.27%
2008	94,215	22,133	23.49%
2009	52,668	13,827	26.25%
2010	33,611	3,144	9.35%
2011	46,700	419	0.90%
2012	31,041	-	0.00%
Total	293,907	40,318	-

Source: CRS data base modified by authors

Table 4. Comparison between market linkage program participants and non-participants

	Participants (1)	Non-part. (2)	Differences (1) – (2)
Characteristics variables			
Sex (= 1, if female)	0.21	0.19	0.02
Household head (= 1, if household head)	0.52	0.46	0.06*
Cooperative membership (= 1, if member)	0.94	0.87	0.06**
Leadership (=1, if in a leadership position)	0.65	0.37	0.28***
Marketing and production variables			
Production diversification (=1, if sell other crops besides beans)	0.27	0.17	0.10***
Area (Ha)	1.50	1.20	0.30***
Total production cost (USD)	58.34	42.98	15.35***
Total quantity of beans sold (qq)	38.53	27.42	11.11***
Bean yield (qq/Ha)	32.54	28.73	3.81**
Quantity sold to linked markets (qq)	3.45	2.55	0.89**
% of beans sold to linked markets	0.10	0.09	0.01
Observations	1,302	8,892	

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Source: Authors' calculation

Table 5. Regression results: Y = Quantity (qq) sold in linked markets (t-value in brackets)

	Standard DID		Serial autocorrelation corrected			
	DID (1)	Interventions lagged (2)	SA corrected (3)	Department fixed effect (4)	Village fixed effect (5)	Interventions lagged (6)
Production area	6.48 (5.14)***	6.34 (22.18)***				
Production cost	-0.00 (0.06)	0.00 (0.03)				
Entrepreneurial practices	2.02 (2.13)**	4.18 (3.55)***	2.78 (5.94)***	2.70 (5.81)***	2.91 (6.30)***	6.73 (7.88)***
Municipality training	-1.69 (2.32)**	-0.89 (0.66)	-2.81 (6.03)***	-3.18 (6.81)***	-3.30 (6.92)***	-2.20 (2.24)**
Agricultural practices	2.33 (1.54)	4.91 (1.44)	-0.12 (0.10)	-0.35 (0.31)	0.01 (0.01)	0.32 (0.13)
Agricultural production	-1.98 (3.18)***	-5.64 (6.04)***	-0.39 (1.12)	-0.25 (0.71)	-0.58 (1.67)*	-2.25 (3.41)***
Water	-0.28 (0.32)	-5.07 (3.97)***	-0.67 (1.34)	-0.50 (1.01)	-0.04 (0.09)	-1.75 (1.92)*
Environmental management	-0.10 (0.09)	5.50 (2.37)**	0.22 (0.24)	-0.18 (0.20)	-2.02 (2.28)**	0.06 (0.04)
Gender	-3.33 (1.40)	2.24 (0.90)	-3.71 (3.89)***	-3.52 (3.70)***	-1.66 (1.76)*	-1.61 (0.89)
Post-harvest program	-0.25 (0.14)	2.86 (1.02)	-1.16 (1.28)	-0.74 (0.82)	-1.16 (1.30)	-1.09 (0.53)
Days participated	0.39 (1.74)*	-0.10 (0.34)	1.35 (7.46)***	1.15 (6.37)***	1.12 (6.30)***	-0.32 (1.52)
Cost for farmers	-0.03 (2.21)**	-0.02 (0.96)	-0.06 (4.29)***	-0.06 (4.11)***	-0.05 (3.88)***	0.04 (2.32)**
R^2	0.21	0.22	0.01	0.04	0.09	0.02
N	5,149	5,149	10,194	10,194	10,194	5,149

* p<0.1; ** p<0.05; *** p<0.01
Source: Authors' calculation

Table 6. Regression results: Y = Fraction (%) of quantity sold in linked markets (t-value in brackets)

	Standard DID			Serial autocorrelation corrected		
	DID (1)	Interventions lagged (2)	SA corrected (3)	Department fixed effect (4)	Village fixed effect (5)	Interventions lagged (6)
Production area	0.02	0.02				
	(3.29)***	(3.78)***				
Production cost	-0.00	-0.00				
	(1.57)	(1.49)				0.06
Entrepreneurial	0.03	-0.00	0.05	0.04	0.04	(4.56)***
practices	(2.45)**	(0.26)	(4.89)***	(4.45)***	(5.32)***	-0.07
Municipality	-0.04	-0.00	-0.07	-0.07	-0.08	(4.72)***
training	(2.84)***	(0.08)	(7.19)***	(8.24)***	(9.49)***	-0.01
Agricultural	0.04	0.18	-0.03	-0.03	-0.02	(0.28)
practices	(1.15)	(3.30)***	(1.34)	(1.38)	(1.11)	-0.03
Agricultural	-0.05	-0.10	-0.00	-0.00	-0.03	(2.96)***
production	(4.50)***	(6.64)***	(0.63)	(0.14)	(4.53)***	-0.00
Water	0.02	-0.08	0.01	0.02	0.03	(0.32)
	(1.52)	(3.85)***	(1.27)	(2.04)**	(3.09)***	0.02
Environmental	-0.01	0.23	0.01	-0.00	-0.05	(0.82)
management	(0.29)	(6.24)***	(0.34)	(0.05)	(3.52)***	-0.06
Gender	0.02	0.07	-0.09	-0.07	-0.00	(1.98)**
	(0.86)	(1.81)*	(4.91)***	(3.94)***	(0.29)	-0.03
Post-harvest	0.07	0.11	-0.04	-0.01	0.01	(1.09)
program	(2.89)***	(2.43)**	(2.01)**	(0.69)	(0.55)	
Days	0.01	0.00	0.04	0.03	0.03	-0.01
participated	(1.85)*	(0.09)	(10.00)***	(7.72)***	(8.87)***	(4.20)***
Cost for	-0.00	-0.00	-0.00	-0.00	-0.00	0.00
farmers	(2.70)***	(1.92)*	(5.60)***	(5.35)***	(5.52)***	(3.26)***
R^2	0.15	0.16	0.02	0.08	0.28	0.01
N	5,148	5,148	10,124	10,124	10,124	5,149

* p<0.1; ** p<0.05; *** p<0.01

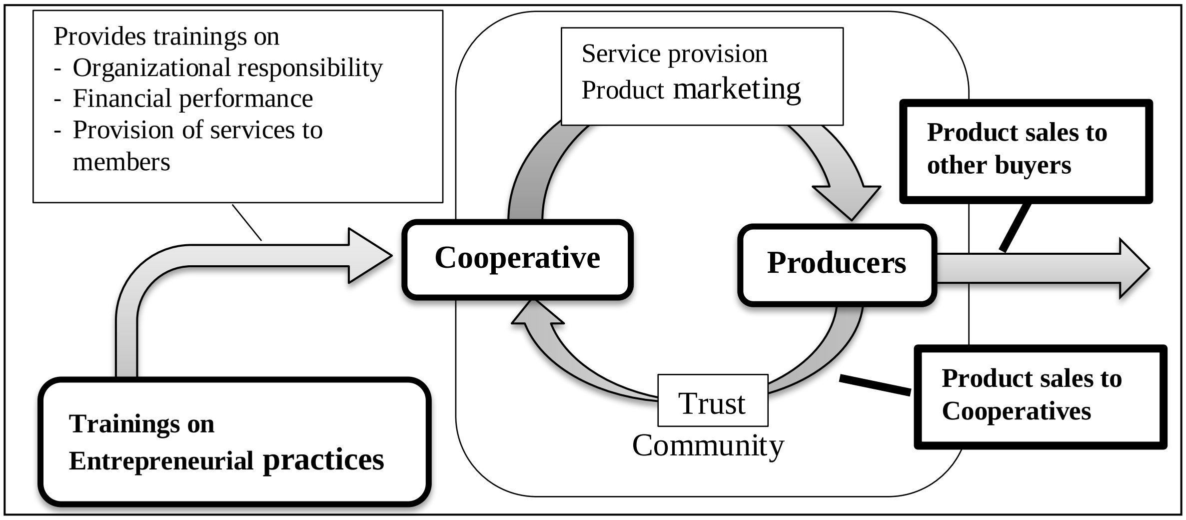
Source: Authors' calculation

Table 7. Regression results: Y = total bean sales income (USD) (t-value in brackets)

	SA corrected	Department fixed effect	Village fixed effect	Interventions lagged
	(1)	(2)	(3)	(4)
% bean sales to	0.30	0.50	0.51	0.32
linked markets	(6.36)***	(10.22)***	(10.19)***	(6.84)***
Entrepreneurial	0.09	0.12	0.06	0.17
practices	(2.55)**	(3.54)***	(1.75)*	(3.53)***
Municipality	-0.06	0.00	-0.00	-0.13
training	(1.88)*	(0.12)	(0.09)	(2.49)**
Agricultural	0.08	0.14	0.19	0.24
practices	(0.98)	(1.73)*	(2.34)**	(1.68)*
Agricultural	-0.05	0.00	0.03	-0.21
production	(1.71)*	(0.10)	(1.24)	(6.30)***
Water	0.14	0.11	0.09	0.09
	(3.92)***	(3.16)***	(2.39)**	(1.84)*
Environmental	-0.08	0.01	0.08	-0.06
management	(1.37)	(0.16)	(1.40)	(0.68)
Gender	0.16	0.20	0.10	0.12
	(2.35)**	(2.91)***	(1.53)	(1.14)
Post-harvest	-0.05	-0.04	0.05	-0.12
program	(0.72)	(0.53)	(0.73)	(1.03)
Days participated	0.01	0.00	0.00	0.01
	(0.53)	(0.24)	(0.15)	(0.44)
Cost for farmers	-0.00	0.00	0.00	0.00
	(0.45)	(0.25)	(0.11)	(0.24)
R^2	0.02	0.08	0.12	0.02
N	5,148	5,148	5,148	5,148

* p<0.1; ** p<0.05; *** p<0.01
Source: Author's calculation

Figure 1. Possible impact pathway of the market linkage program



Source: Authors