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Access to Dynamic Markets for Small Commercial Farmers: The Case of Potato Production in the Peruvian Andes

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ABSTRACT

The purpose of this study is twofold. On one hand, the objective is to assess the impact of new and more complex contracting schemes, as opposed to traditional marketing channels, on small farmers' welfare. On the other hand, the study explores which may be the critical factors that determine the small farmers' participation in these institutional arrangements. In this context, two critical factors are stressed. The first one has to do with access to credit and the second one is the size of the agricultural plot.

In order to examine the decision of farmers to access the dynamic markets, the paper follows the study of Lapar et al (2003). The paper also follows impact evaluation techniques to identify the differences in the performance of farmers with access to dynamic markets and those without access. As it can be seen, in all cases, the difference between farmers with access and those without access is positive. This implies that having access to dynamic markets has positive impacts on the welfare of farmers. The results show that the farmers linked to the dynamic markets gain two cents of a dollar more per kilogram of potato.

Although, in average potato producers in the Sierra need about 7,500 US$ additional credit to access dynamic markets, the variance between producers is huge. Some farmers, for example, are extremely close to gaining access the market and just a small increase on the credit line would allow them to achieve that. On the other hand, an important group of small farmers —more than half of them — are much further away from accessing the market; about 25,000 soles (US$ 7,500). In this case the amount needed to access the market is almost three times higher than the average sales of a

farmer selling to the traditional market. Moreover, 10% of the formers in the sample need over 15,150 US$ to ensure access to the market, which is the maximum credit line registered in the sample of farmers with access to dynamic markets. On the other hand the lack of scale of the producers is another major bottleneck. Our simulations showed that increase of their plot size to a minimum of five hectares (optimal size according to the industry) increases their sales to dynamic markets in 16%.

However, the impact of new and more complex contracting schemes, as opposed to traditional marketing channels, could reduce significantly the access gap to dynamic markets by reducing transaction costs, increasing productivity, and increasing scale production through coordination of smallholders.

ACCESS TO DYNAMIC MARKETS FOR SMALL COMMERCIAL FARMERS: THE CASE OF POTATO PRODUCTION IN THE PERUVIAN ANDES[1]

Javier Escobal[2] and Maximo Torero[3]

1. INTRODUCTION

Supply chain management is a recent significant institutional change affecting smallholder agriculture in the domestic markets of developing countries. Martin Christopher (1998) defines supply chain management as "the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole." In addition, transaction cost economics provides a theoretical framework for understanding the governance structure of the supply chain. Many authors point out that there is a continuum of vertical coordination, with the spot market on one end and the vertical integration on the other. Between the two extremes are hybrid forms, which can be divided into specification contracts, relation-based alliances, and equity-based alliances with different coordination characteristics relating to interdependence, information sharing, and duration of relationship (Peterson et al., 2001).

Relationships in supply chains ranges from an "arm's length" relationship — based on vertical restriction — to vertical integration. According to Phil R. Kaufman

[1] The survey on which the study is based was carry-over by GRADE (Group of Analysis for Development) within the framework of a study on Transaction Costs in Peruvian Small Scale Agriculture financed by FAO.
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(1999), however, there are four major goals that retailers pursue through the use of supply chain management. These goals have to do with ensuring lower costs for: (1) operations, (2) procurement, (3) marketing, and (4) distribution.

Supply chain management is beneficial to poor farmers as it provides them with information on new products, input, credit and extension services, marketing services, and it brings them closer to consumers. In turn, this can ease the resource constraints and reduce the production and marketing risks that farmers usually face. Changes in procurement systems toward integrated supply chains may have important implications for the rural producers' bargaining power and the level of product quality demanded from them.

The purpose of this paper is twofold. Its first objective is to assess the impact of new and more complex contracting schemes, as opposed to traditional marketing channels, on small farmers' welfare. Second, the paper seeks to identify critical factors that determine small farmers' integration in the new institutional arrangements. In this context, two critical factors are stressed: (1) access to credit and (2) the size of the agricultural plot.

The paper analyzes a stratified sample of over 300 small potato farmers (with less than five hectares of land) in the Mantaro Valley in the central highlands (Sierra region) of Peru. Around 100 of these farmers have adopted key farming and/or marketing innovations that allow them to access two dynamic markets[4]: (a) producing high quality

[4] For the purpose of this study, "dynamic market" refers to those markets able to absorb increasing levels of farm output due to their size or rapidly increasing demand.

seeds, and (b) producing high quality potatoes for the potato chips industry. The rest of the sample covers relatively similar producers, with similar ecological setting and land holding, which have chosen to sell their potatoes through traditional marketing channels. These producers can be used as a potential control group to evaluate the overall impact and determinants of accessing dynamic markets.

Thus, in line with its objectives, this study analyzes the determinants of dynamic market access of small commercial farmers in Peru; it also assesses factors critical to enhancing market linkages that can increase productivity and income growth for this type of producers. The paper is divided into seven sections, including this introduction. Section 2 provides an overview of potato production in Peru, whereas section 3 focuses on potato production in the Mantaro Valley and the role played by NGOs (non-governmental organizations) providing technical assistance for potato production there. Section 4 explores in detail the relationship between small farmers and the potato processing agro industry, specifically the role of the FOVIDA — an NGO linking small farmers with the potato processing industry. Section 5 provides a thorough description of the database used in this study. The following section deals with the methodological framework employed to determine the likelihood of dynamic market access of those producers who use traditional marketing channels. In addition, this section provides major empirical findings. Finally, last section offers concluding remarks and policy implications

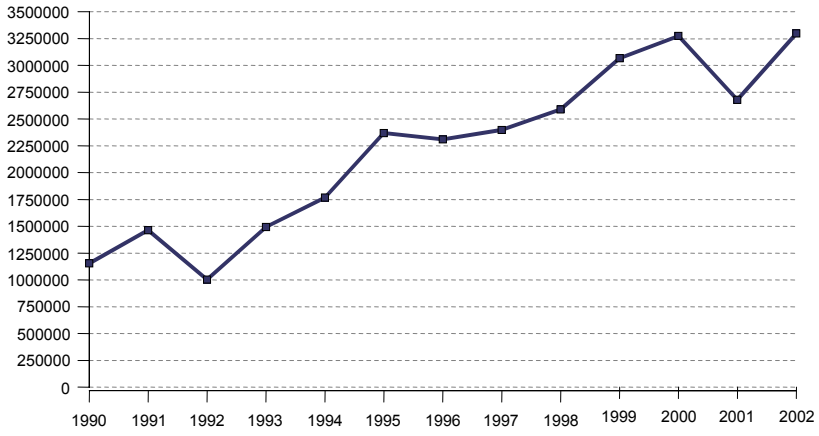
2. THE SMALL COMMERCIAL POTATO PRODUCTION IN PERU

Potato is a very important product in the Peruvian food system. It is harvested in almost every region of the country, although its production is concentrated in the Andes, given the lower temperatures that favor the growth of the crop there. The production of potato is intended mainly for domestic consumption.

In the last three years, potato production levels have been rising continuously thanks to yield improvements (Figure 1). While in 1990 the national average yield reached 7.800 tons per hectare, it came close to 14.000 tons in 2003.

Figure 1—Annual production of potatoes, 1990-2002

(metric tons)



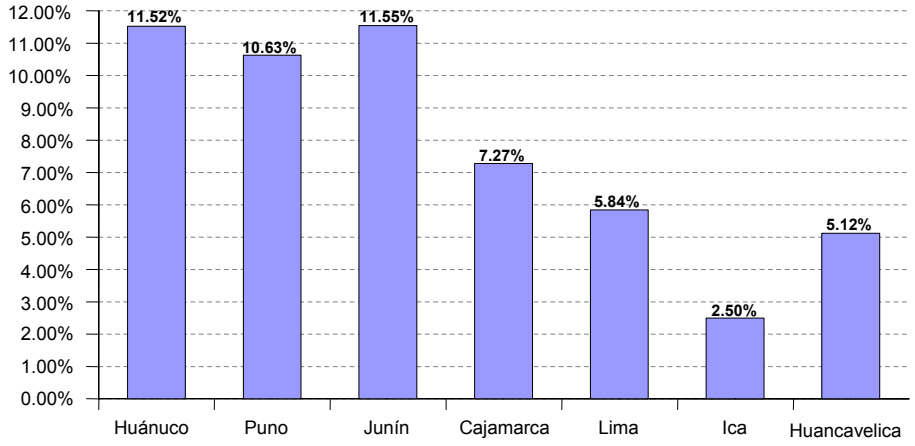
Source: Ministry of Agriculture, Peru.

According to the Agriculture Census (CENAGRO), there were around 800.000 potato producers in the entire country in 1994, where nearly 60% of them worked on agricultural plots smaller than 5 hectares. The most important zones of production are located in the central Andes, in the Mantaro Valley; it extends through the regions of

Junin and Huanuco, which together with the Andean Plateau in the south-eastern part of Peru — mainly in the region of Puno — represent the regions with the highest levels of potato production. Also, some valleys on the south coast, like the valley of Cañete and the valley of Ica, in the regions of Lima and Ica respectively, have become important production areas lately, mainly because they were able to attain very high yields thanks to better soil conditions. The intensive entrepreneurial production is concentrated in the central region and on the coastal valleys as they are the major suppliers to Lima, the largest market of in Peru (covering around 30% of the population of the country). On the other hand, the potato production in the Andean Plateau is mostly for self-consumption, and marginal local trade.

Figure 2 shows the average participation of the principal potato producer regions over the last twelve years. Junin, Huánuco and Puno together constitute more than 35% of the total production, while the rest of the departments are below 10%.

Figure 2—Average share of regional production of potato by region, 1990-2002



Source: Ministry of Agriculture, Peru.

Nevertheless, although the regions of Lima and Ica contribute only 5.8% and 2.5%, respectively, to the national production, the yields in those regions are double the national average, and even three times the national average in the case of Ica only.

Figure 4, shows the monthly evolution of the real farm prices during the last years. Contrary to what happened with production yields the prices show a clear decreasing tendency on the last years.

Figure 3—Potato: Average yield by region, 1990-2002

(tons per hectare)

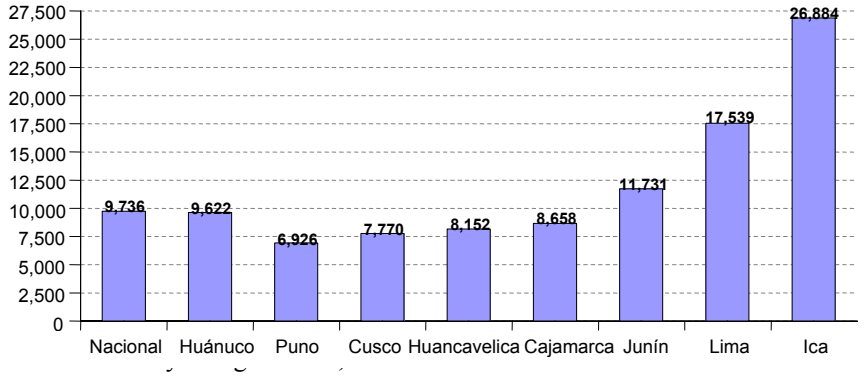
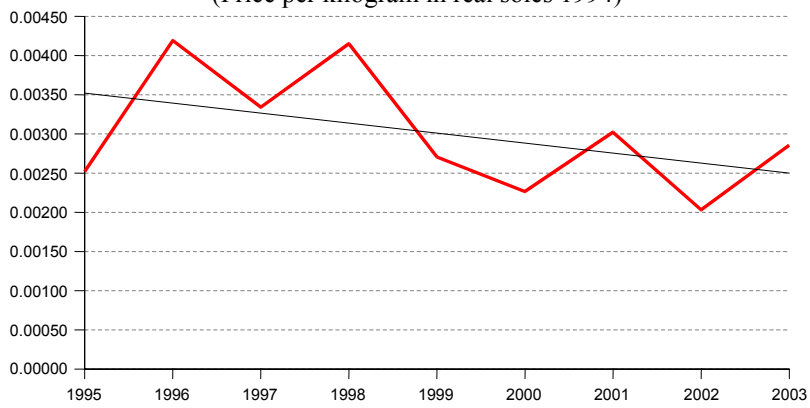


Figure 4—National average on farm prices

(Price per kilogram in real soles 1994)



Source: Ministry of Agriculture, Peru.

3. POTATO MARKETING IN THE MANTARO VALLEY

The sample for this paper includes potato producers along the Mantaro Valley. As one of the main potato producing regions in Peru, Mantaro Valley is characterized by an unequal development of goods, capital, and services markets. Within the valley the production methods are predominantly traditional, but the areas along the valley plains have specialized production systems with strong links to the market.

This section compares small potato farmers who have received technical assistance and are integrated into dynamic markets, and those that have not made the transition to dynamic markets yet. There are two different ways in which potato producers in the Mantaro Valley establish links with dynamic markets: (a) through the production and sales of certified potato seeds, and (b) through the production and sales of potatoes belonging to an industrial quality intended for the chips industry.

The objective of this section is to compare producers linked to the dynamic markets, either through the production and sales of certified potato seeds or through the production and sales of industrial quality chips, with other (similar) producers that did not have access to these marketing alternatives. For the purpose of making this contrast clearer, producers that did not demand technical assistance (essential in establishing links to new markets) were treated as a potential control group.

The study identifies two companies that have provided the necessary technical assistance to producers for developing links with dynamic markets: (a) FOVIDA (Promotion to life or *"Fomento a la vida"*), (b) ECOSER (Commercialization and

Agricultural Services Company or *Empresa de Comercialización y Servicios Agropecuarios*). These technical assistance companies have been working on the provinces of Chupaca, Concepcion, Huancayo and Jauja in the Region of Junin and their activities were conducted under the framework of the INCAGRO[5] program.

FOVIDA is an NGO that has been working in the Mantaro Valley since 1997; it has commercial links with Snacks America Latina, Peru SRL (Frito Lay) since 1998, and has been one of its major suppliers since then. FOVIDA has worked toward establishing alliances with small potato farmers in the valley and helping them develop economic opportunities. These alliances are established between the small potato farmers in the Mantaro Valley as FOVIDA's clients, FOVIDA as a service provider and high quality seeds supplier; and indirectly, with Snacks America Latina Peru SRL, as a commercial partner, an agreement that guarantees the selling of potatoes for the *"capiro"* crop that complies with the quality standards of the company.

According to FOVIDA (2002), an assistance service proposal is sustained on the development of three axes: the transference of organizational capacities, techno-agro ecologic capacities and, finally, management and commercial capacities. The extension services offered are:

1. *Organizational strengthening* to improve the negotiation capacity of small farmers, so they can gain access to dynamic markets; incorporate an

[5] INCAGRO (Innovation and Competitiveness in Peruvian Agriculture) is a project of Peru's Ministry of Agriculture. The main objective of INCAGRO is to promote technical and managerial services for farmers on activities related to agricultural technological innovation systems, incorporating concepts of pluralism, competitiveness, and co-financing. The project administers resources provided by the World Bank and the Public Treasury, and supervises contributions from sub-project implementing entities.

entrepreneurial logic in farmers' collective decision making processes, guide them not only on how to reach markets and prices for their products, but also explain alternative ways in which they can increase their competitiveness, for example, through cost reduction as a result of advantages from collective input acquisition.

2. *Technical assistance on production* to achieve requested production levels by focusing on the relevant aspects of production. This includes seeds renovation, fertilizing plans, crop control, and prioritizing integrated techniques of plague control. As a consequence of the latter, farmers aim at achieving a production that represents physical and chemical standards required for the transformation industry (shape, size, sanitary requirements, contents of sugar reducers, and dry matter).
3. *Post harvest assistance*, which incorporates selection, classification, and packaging of the production according to the market demands.
4. *Assistance on management and commercialization*, incorporating economic and accounting management instruments that will support individual and collective management of the farmers.

ECOSER, on the other hand, is located in Jauja. Its main objective as an NGO is to improve the profitability of potato farming in the Jauja province through the use of high quality seeds. According to ECOSER Jauja (2001), the assistance services provided are as follows:

1. *Strengthening the potato seed production system* based on an efficient process of obtaining in vitro "seedlings" from the tissue labs, pre basic seeds from the

company greenhouse, and, finally, getting seeds from conducting fields through alliances or contracts with farmers for different categories of quality seeds according to the specific demands.

2. *Extension and capacity building events and the use of quality seeds*. The objective is to improve farmers' technology giving priority to commercial varieties and being responsive to the demand. These technologies include quality control, certification, and optimal management of the crop; they are complemented with post-harvest and in-store management techniques.

3. *Technical assistance and capacity building of the producers of seeds*. There is a special emphasis on the matter of prevention of plagues and diseases, through an integrated management strategy.

4. *Organizing producers, especially those producing seeds* (handling production costs).

4. THE RELATIONSHIP BETWEEN SMALL FARMERS AND THE POTATO PROCESSING AGRO INDUSTRY

In 1998, the processing firm, Snacks America Latina Peru SRL reduced the number of contracted farmers from 30 to 7. Nevertheless, this was done at a high storage cost for the firm, because to ensure a year-round supply of potatoes in Peru, the industry needs to combine the potatoes coming from the southern Costa (from December to March), the Sierra (from end of March to July), and the central Costa region (from August to November). However, consolidated land holdings at a scale needed for the industry are only secured in the Costa region. Thus, a reduced number of contracted

potato growers would imply a need for purchasing larger quantities of potatoes and storing them throughout the period when there is not available harvest in the Costa region.

This condition created a "window of opportunity" for an intermediary that could bear the monitoring cost associated with coordinating small potato farmers in the Sierra region. If the monitoring costs were lower than the storage costs, such a contracting scheme would have been possible. This is how FOVIDA, which had been working with potato farmers in both the Costa and Sierra regions, seized the opportunity of filling this gap.

FOVIDA set out on building its reputation as a reliable partner of Snacks America Latina Peru SRL, first in the central Costa — an area characterized with a greater production scale, better infrastructure, and lower transportation and transaction costs. Thus, in 1998, Snacks America Latina Peru SRL employed two methods of purchasing potatoes: (i) directly from farmers with a plot size of five or more hectares; or, (ii) from smaller farmers organized under the umbrella of FOVIDA.

It is important to note that, firms do not sign contracts with farms that are new potential direct contracting partners; instead they maintain an informal agreement, closely monitoring their activity and verifying that they can perform according to firms' standards. Only after one year, the firms sign a contract — usually for 5 hectares — and, if turns to be successful, they expand it to cover all the hectares owned by the farm. This process is costly for firms, which is why they are often reluctant to engage in it. The monitoring system that FOVIDA provides is considered a good alternative. In fact,

currently almost 50% of the potato supply for Frito Lay is provided by FOVIDA. In addition, another "implicit" service that FOVIDA offers for the firms is identifying and "screening" farmers that can potentially become direct farm contractors for the potato processing agro industry.

The contract that firms establish with individual farmers is essentially the same as the one they establish with FOVIDA on behalf of small producers. It is signed two or three months prior to the sowing season and establishes a fixed price that is always substantially above the price of potatoes supplied through traditional channels. However, the contract establishes specific objectives in terms of increasing yields production costs, proper management of the crop and so forth. The industry has very strict quality standards that farmers must meet. For example, the dry content of the potato should be in the 22% to 24% range to be accepted. Sugar content should be in the 0.02% to 0.03% range for proper frying. FOVIDA does this monitoring work for firms. For example, it uses a frying kit to evaluate the quality of potatoes through sampling before it is harvested. This process assures the timeliness of the harvest.

Although corporate policies prevent firms from giving loans to farmers, the industry does give advance payments to farmers in the form of seed. Nevertheless, this is restricted to the most qualified farmers. On one hand, this may be due to special abilities required to use effectively the seed produced by Frito Lay. On the other hand, the seed quantity produced by the firm is insufficient to cover the demand of all of its contracted farmers.

Frito Lay has organized a number of contests, and awards monthly and annual prizes that reward quality standards and productivity. These awards have served as a signaling system and have encouraged small farmers to adopt farming practices of those who win the contests.

The successful role of FOVIDA as an intermediary between the firm and the small producers is evident in a number of activities performed by the NGO, which can be summarized into three main areas: a) usage of information networks; b) building trust; and c) building capacity for collective action (Johnson et al. 2002).

Information networks

FOVIDA has been able to use its network of potato producers in the Costa region (that was built prior to its work in the Sierra region) to identify seed suppliers of the variety Capiro for Sierra. In addition, it has taken advantage of its knowledge of the input and output markets to benefit small farms through the reduction of key transactions costs. In addition, FOVIDA has provided technical and financial advice to farmers and, though it cannot provide credit to farmers, it has used its influence and expertise to ensure access to credit for several farm groups.

Building trust

FOVIDA has been able to build social capital in the form of trust. This has occurred, first, by reducing Frito Lay's cost of monitoring contract compliance and by managing emergencies that occur along the cropping season. A quick response to the

latter affects positively the quality of potatoes that reach the processing plant. The ability of the firm to verify that quality always meets the required standard has allowed for trust to emerge and consolidate. In turn, this increasing trust has affected the marketing behavior of the firm by increasing the share of the market that is supplied by FOVIDA and strengthening the bonds between the firm and the intermediary.

Building capacity for collective action

FOVIDA has organized small farmers to take advantage of their collective action and has obtained economies of scale in the input and output markets. In particular, collective commercialization, collective provision of inputs, collective financing, and collective purchase of complementary services like technical assistance are key elements that render tangible benefits in terms of lower input costs and higher output margins, when negotiating with the industry.

Unresolved market failures

Although FOVIDA has been able to provide an effective solution to a number of market failures, there still is a key problem that remains unresolved — poorly developed seed market in this sector. The type of seed used is a common pool good which does not generate proper incentives to develop this market. The varieties used to produce potato chips (Capiro and, to a lesser extent, Tomaza or Canchan) are "open-pollinated varieties", which can potentially be reproduced and disseminated through formal or informal seed distribution channels. Interviews in this study reveal that production coming from a good

Capiro seed may be used for four or five cropping seasons without degenerating. Under these circumstances it is unlikely that the private sector will be interested in developing, multiplying, and selling certified seed coming from these varieties. This may change eventually if there is a seller that establishes reputation for quality and reliability for the supply of such varieties and can either charge a premium or take advantage of lower unit costs thanks to securing a significant market share.

Currently, in the Mantaro Valley area there are few, if any, good and reliable potato seed producers. There is, in fact, a high willingness to pay for good seed. However, many seed producers sell common seeds as if it were basic (certified) seed. As there is no public seed supervision system, farmers cannot tell the difference between these types of seed until it is too late. Because of insufficient quantities of good quality seed in the potato chips market, the agro industry (Frito Lay) has been compelled to produce certified seeds of the varieties they prefer. This seriously affects Frito Lay's interests, which is incurring additional costs because potato seed imports are prohibited (supposedly because of sanitary reasons). Consequently, even when, for example, a corporation has three biotechnology laboratories (located in Chile, México, and Australia) that are part of its network, they need to produce their own genetic material to multiply and sell pre basic and basic seeds to "seed growers" who will, in turn, produce "certified" seeds.

5. THE DATABASE

The data on the producers receiving technical assistance was obtained with the help of ECOSER and FOVIDA, as they both worked on the frame of a public program for technical assistance which co-finances around 50% of the provision of services. In addition, the list of farmers provided by these two NGOs was modified to exclude from the sample those producers that had received assistance for less than a year. This was done to ensure that those farmers that were sampled as "connected to dynamic markets" had enough time to incorporate into their activities what they learned from the technical assistance programs. Map 1 and 2 show the exact distribution of our sample of producers under receiving technical assistance from FOVIDA and ECOSER.

As mentioned earlier in the paper, the study focuses on a sample of about 300 potato producers located in the region of Junin, in the central Andes of Peru. The sample is quite heterogeneous, encompassing a wide range of production scales and market insertion mechanisms so as to generate an in-depth assessment of the restrictions as well as potentialities that dynamic markets exhibit in the context of small farm producers.

The sample design is such that it consists of small producers that have accessed some market niche (considered as dynamic markets) through technical assistance, compared to other producers that have not requested technical assistance, but continued to use traditional markets to sell their output.

For the purpose of this study, "dynamic market" refers to those markets able to absorb increasing levels of farm output due to their size or rapidly increasing demand.

For the crop under analysis (i.e. potato), there are two market niches that can be considered as dynamic: a) the market for processed potato (chips) and b) the seed market.

Table 1—Number of cases with different institutional arrangements

Product	Institutional arrangements	
	With access to dynamic Markets thanks to Technical Assistance	Potential Control Group
Potato	83	206

Source: Authors' findings.

Given the sample design, all producers that have access to dynamic markets are also recipients of technical assistance. Thus, by excluding producers who have not received any technical assistance from the sample, the analysis cannot distinguish between the pure effects of the technical assistance from the impact that the technical assistance generates by allowing farmers' access to new market opportunities. This being the case, the results of this research must be read as the joint impact of both processes.

The differences between farmers with access to dynamic markets through specialized technical assistance, and those without access to any technical assistance and still relying on traditional consumption market evidence that ECOSER and FOVIDA have accomplished to enroll in their program a group of farmers that could be called "elite".

As Table 2 shows, the potato producers with access to dynamic markets have a higher educational level (an average of almost two or more years of formal schooling for the head of the family), better life conditions (associated to the characteristics of dwelling), and more household assets (almost three times more productive assets, and

almost two times the size of the land property) than farmers relying on traditional markets. Additionally, farmers with access to dynamic markets participate in more organizational activities. They also have the perception that access and levels of credit they could have are significantly higher than those available to farmers with no access to such markets. Finally, the results also show that these farmers are willing to take bigger risks.

These differences are also evident when comparing certain strategies of market insertion and agronomic practices. For example, the use of quality seeds is clearly higher among farmers with access to dynamic markets; it is also evident that, in contrast with traditional farmers, they dedicate an exclusive part of their land to commercial production.

When considering the agronomical practices, there are differences in the use of living walls and the use of rotation; all of which need to be analyzed in depth to find out if they are associated to the practices advised, directly or indirectly, by ECOSER and FOVIDA.

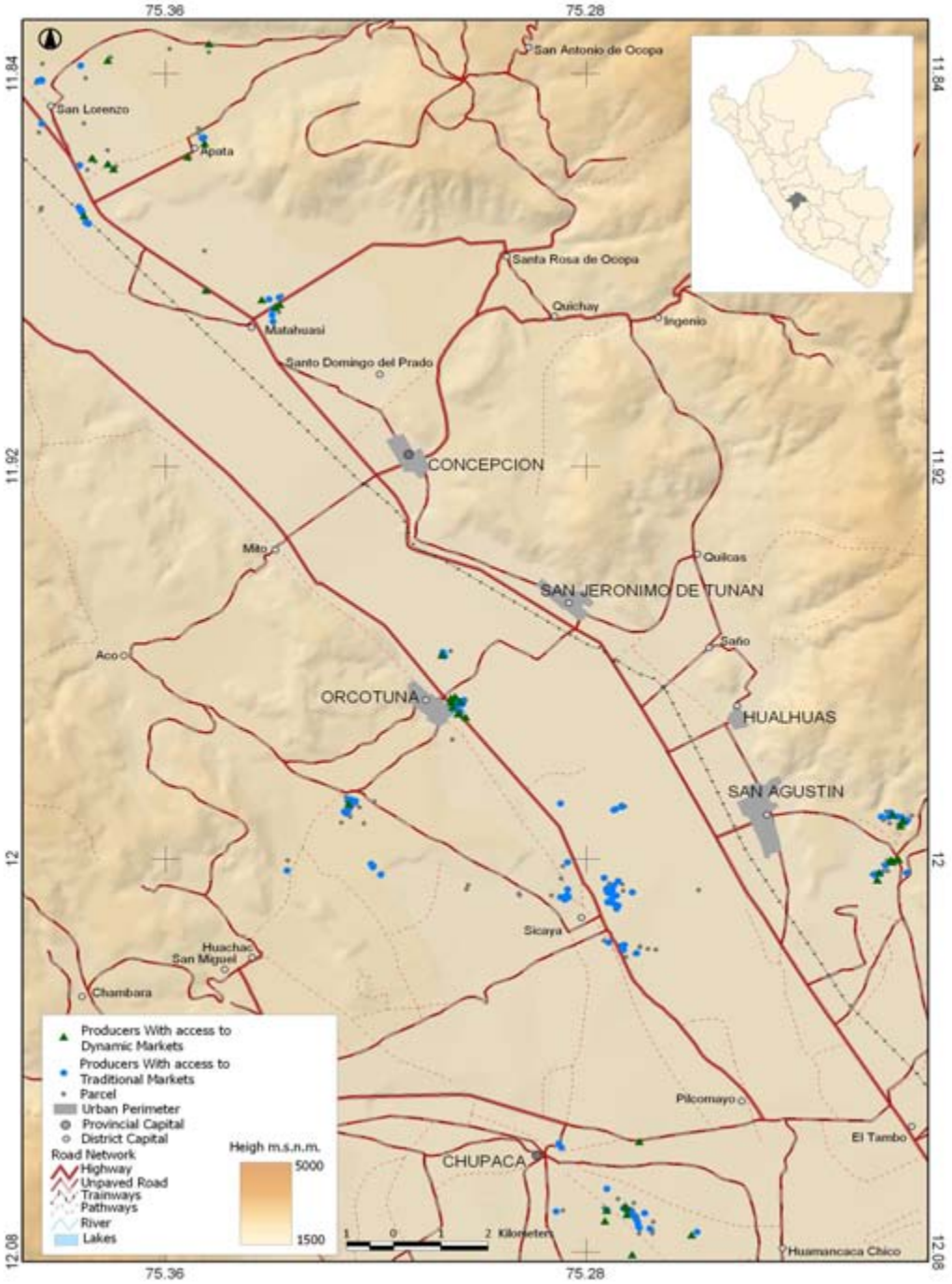
The first evidence of the impact of dynamic market access comes from the significant differences between the potato production rates and prices of farmers with access to dynamic markets, as a result of the technical assistance, compared to those that do not have access to dynamic markets. It must be noted that there are yield differences (production per hectare), but they are not significant. This shows that the intervention allows the improvement of the market linkages (through products with different characteristics) that goes beyond an improvement of the yields levels.

Table 2—Characteristics of the potato producers

Variables Description	Dynamic Mkts.	Traditional Mkts.
Number of Household Members	4.5	4.9
Sex of Head of Household	0.93	0.94
Age of Head of Household	48.3	48.6
Years of Education of Head of Household	11.7	9.9***
Maximum Years of Education within the Household	13.5	12.1***
Dwelling has a Quality Roof (yes=1)	0.19	0.09**
Appropriate Access to Water on dwelling (yes=1)	0.9	0.70***
Dwelling has a Qualiity floor (yes=1)	0.64	0.39***
Dwelling has a Quality walls (yes=1)	0.31	0.17***
Appropriate Access to toilet services on dwelling (yes=1)	0.34	0.25*
Appropriate Access to power supply on dwelling (yes=1)	0.96	0.94
Household Assets Value	3,100	2,105**
Productive Assets Value	14,117	5,179***
Land Holding (Has.)	5.7	2.3***
Risk Attitude - (1=more averse, 5=less averse)	3	2.5**
Maximum Credit access	20,859	7,476***
Number of Organization Memberships	2.2	1.2***

Note:***99% significance, ** 95% significance, * 90% significance.
Source: Authors' calculations.

Map 1—Sample of producers connected and not connected to dynamic markets from the list of FOVIDA



Map 2—Sample of producers connected and not connected to dynamic markets from the list of ECOSER

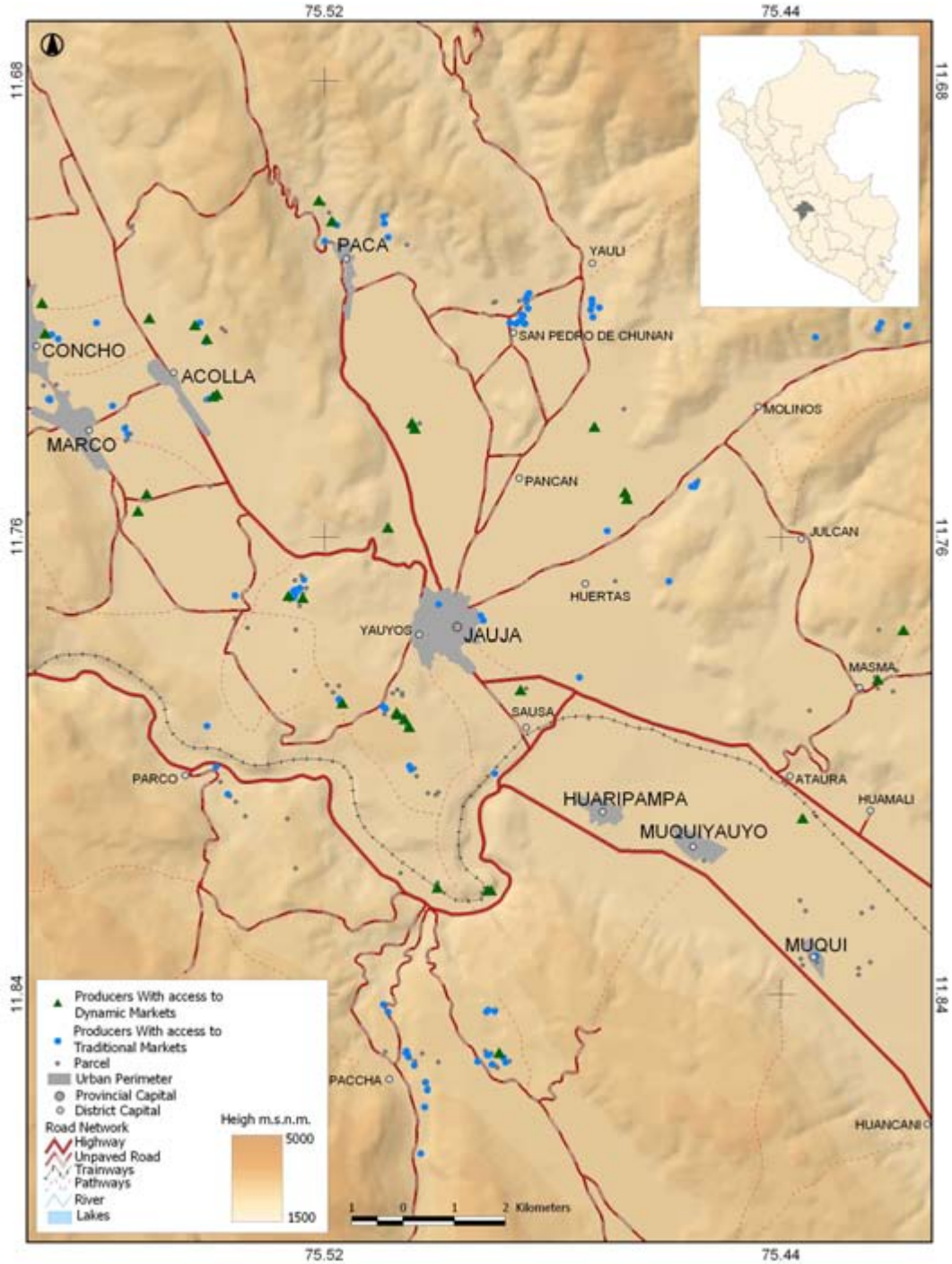
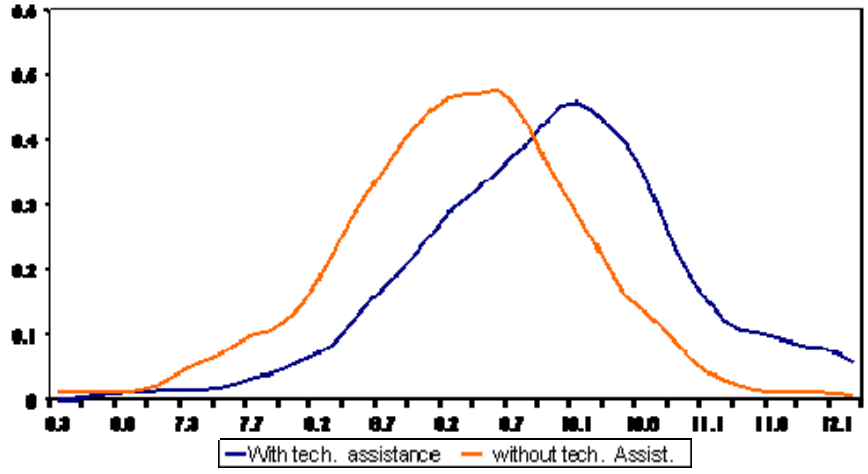


Figure 5—Income distribution of potato producers

(Income in natural logarithm)



Source: Authors' calculations.

Finally the difference in prices is also reflected in the net income differences by hectare and the well-being, measured based on the per-capita family expenditure in Figure 5 and 6. Despite the important variability on the income of farmers with access to dynamic markets and the control group (those without access to dynamic markets), Figure 5 and 6 show clearly that the income distribution of farmers with access to dynamic markets is located to the right of the income distribution of those without access to technical assistance and who choose not to sell their potato for consumption.

6. ESTIMATION OF THE "DISTANCE" TO DYNAMIC MARKETS

6.1. CONCEPTUAL FRAMEWORK

According to Lapar, Holloway, and Ehui (2003), a way of studying the decision of farmers on accessing or not dynamic markets, is the comparison between the utility that the farmers would receive if they had access to such markets (for example by gaining technological knowledge) — expressed as $y_i^* = U(Z_1)$ — and the utility that they would obtain if they did not have access to such markets — expressed as $v_i^* = U(Z_0)$ — where Z represents the sales[6]. Assuming that the difference between the utilities is determined by a set of specific characteristics of each producer, x_i, the following relationship can be established:

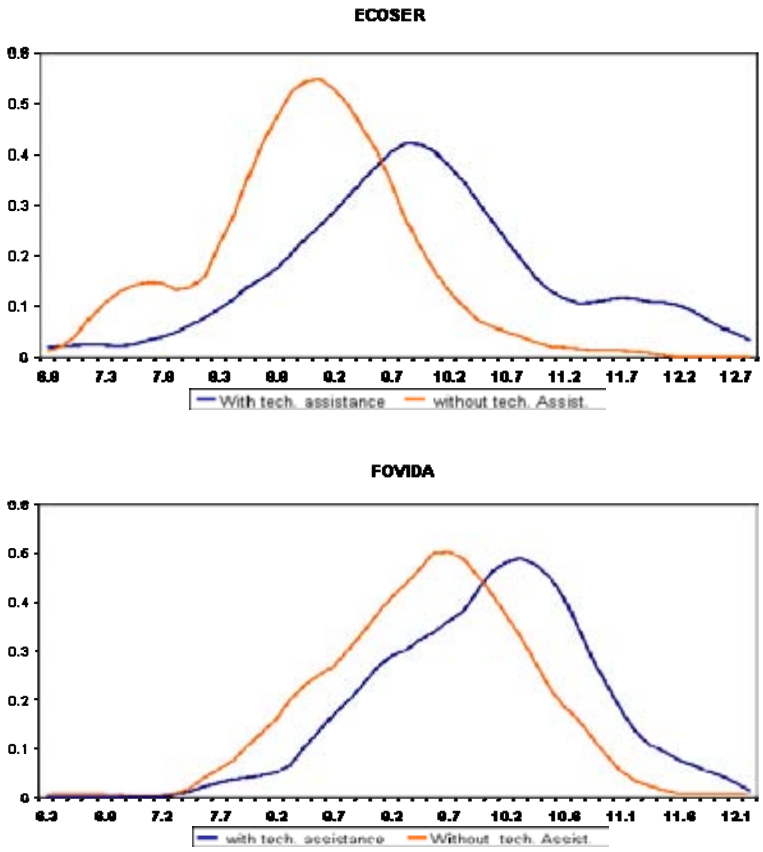
$$y_i^* = f_i(x_i) \qquad (1)$$

Where it is assumed, without loosing generality, that the utility without access to dynamic markets is equal to 0, and therefore the difference of utilities is equal to y_i.
If Z_{si}, the sales value, of those who cannot sell in dynamic markets could be observed, this would be negative value ($Z_{si} < 0$), and the distance to the axe would show how far a farmer is from the dynamic market. At the same time, that "distance to the market" (δ_i), on the context of this study, shows the distance to the dynamic market.

[6] The asterisk (*) indicates that both utility levels are latent variables, not observable variables.

Figure 6—Income distribution of potato producers by program

(Income in natural logarithm)



Source: Authors' calculations.

Due to the fact that the utility levels are not observable, it is necessary to define an observable indicator, y, which will take the value of 1 when the utility related to the access to dynamic markets is higher than the utility of not having that access, and 0 in the contrary case.

That could result in the following:

$$y = \begin{cases} 1 & \text{if } y^* > 0 \\ 0 & \text{o.w} \end{cases} \quad (2)$$

In this context, a probit model approximation of access to dynamic markets would be:

$$prob(y_i = 1) = \Phi(X_i \beta) \quad (3)$$

where the endogenous variable takes the value of 1 if the household has access to a dynamic market, and 0 otherwise. The X_i vector contains a set of variables that characterize the farmer, these include: demographic variables (number of household members and the age of the head of household), education (years of education for the head of household), value of goods possessed (value of households' assets for production), measures of risk aversion (the rate of risk aversion is calculated through a set of games), access to credit (farmers perception of credit line), and social capital (number of organizations in which the household takes part). β is a vector of coefficients, which controls the relationship between the household characteristics mentioned earlier and the dynamic markets participation; and finally u_i is a random error.

When it is assumed that $x_i\beta$ follows a normal distribution, the interpretation of the coefficients in the Probit model can be difficult, because they are interpreted as a change in standard deviations in $x_i\beta$ when there is one unit increase of an exogenous variable. To avoid this complexity, the following transformation is carried out:

$$\frac{\partial \Phi}{\partial x_1} = \phi(\bar{x}\beta)\beta_1 \qquad (4)$$

where ϕ and Φ are the density function and the standard normal function, respectively, evaluated in $(x\beta)$; x_1 is the exogenous variable and β_1 is its respective coefficient. After this transformation the coefficients show the change in the probability $(\partial\Phi / \partial x_1)$ when there is an infinitesimal change in an exogenous variable.

Once the estimation of the probit model has been carried out, it is possible to obtain from the equation an estimation of the "distance to the market". This distance is defined in terms of the required increase in any variable that characterizes farmers, for example x^c, in such a way that the farmers that do receive technical assistance can still have access to the market. For this particular case, in order to have a monetary measure, the "distance to the market" is quantified by estimating the additional credit level that each household not participating in the dynamic market will require to be able to take part in this market.

This study simulates the increase on the credit level for all of the non-participating farmers, so their probability of participating on the market exceeds 0.5. When starting from equation (3), the amount of credit necessary for these producers to

increase substantially their probability of participation on the dynamic markets is identified:

$$\hat{x}_i^c - x_i^c = -\frac{X_i \beta}{\beta_c} \tag{5}$$

where $\hat{x}_i^c$ is the amount of credit that the household i needs in order to participate in a dynamic market, x_i^c is the credit level observed on that household, β_c is the parameter that represents the measure of the credit effect over the participation, and $X_I \beta$ is the product of the matrix of household characteristics multiplied by the coefficients without the credit level.

6.1.1 Tobit estimation of the sales to dynamic markets

Since the data is only observable for the potato sales that take place in dynamic markets, the only farmers considered here are those that participate in such markets. The sales of farmers who use traditional markets are classified as 0 (censured data). That is why the estimation of a Tobit model is relevant, because it would provide an estimator of the latent variable for those with no access to dynamic markets.

The amount of potatoes offered by all farmers who are represented in the dynamic markets sample can be described as:

$$y_i^* = f_i(x_i) \tag{6}$$

Additionally, the sales on dynamic markets observed are:

$$y = \begin{cases} y_i^* & \text{if } y^* > 0 \\ 0 & \text{if } y^* \leq 0 \end{cases} \tag{7}$$

This means that we are only observing the sales that take place in the dynamic markets, for the farmers that sell in those markets.

The determination and interpretation of the parameters on the censored regression models of the Tobit type will depend on the objectives of this specific study. This paper is trying to predict the volumes of potato sales in dynamic markets, due to a set of household characteristics. Therefore, the correct estimation of the marginal effects must be carried out from the conditional expected value of the censored variable.

$$\frac{\partial \mathrm{E}[y_i \mid x_i]}{\partial x_i} = \beta \Phi\left(\frac{\beta' x_i}{\sigma}\right) \tag{8}$$

Once the estimators are obtained, it is possible to use the decomposition of the marginal effects proposed by McDonald and Mofitt (1990), to assess, under an exogenous shock, the relative importance of the presence of new producers with respect to the increase on the sales of the ones that were already selling on the dynamic markets. That decomposition is as follows:

$$\frac{\partial \mathrm{E}[y_i \mid x_i]}{\partial x_i} = \Pr ob[y_i > 0] \frac{\partial \mathrm{E}[y_i \mid x_i, y_i > 0]}{\partial x_i} + \mathrm{E}[y_i, y_i > 0] \frac{\partial \Pr ob[y_i > 0]}{\partial x_i} \tag{9}$$

From this equation, a change in x_i have two effects: the first one affects the conditional average of y^*_i on the positive part of the distribution; and the second one, affects the probability that the observed data falls on that part of the distribution. For this study equation (8) will show the change on sales in dynamic markets and the change on

the probability of selling in that market under a change in an exogenous variable, for example the credit level of the farmers.

6.2. EMPIRICAL RESULTS

6.2.1 Determinants of access to dynamic markets for the small potato farmers

Table 3 shows the main characteristics of the farmers with access to dynamic markets for potatoes are related to the use of technical assistance. As it can be seen, the main variables that begin to explain participation are those associated to the degree of organization of the producers, their level of education, and their access to credit (represented by the credit line indicator).

It is interesting to note that the education shows some discontinuity, i.e. the variable is significant (and negative) just for incomplete primary school, but after completing primary schooling it shows important positive returns.

Table 3—Probit models for market participation in potato dynamic markets

Variables	Marginal Effects (St. Desv.)		
	Model 1		**Model 2**
Number of Household Members	-0.028	*	-0.026*
	(0.015)		(0.015)
Age of Head of Household	-0.004	**	-0.003
	(0.002)		(0.002)
Maximum Years of Education within the Household	0.021	*	.
	(0.011)		.
Maximum Education Achieved is Incomplete Primary (0=no, 1=yes)	.		-0.224***
	.		(0.060)
Risk Attitude - (1=more averse, 5=less averse)	0.023		0.025
	(0.018)		(0.019)
Credit Line (thousand of soles)	0.01	***	0.011***
	(0.003)		(0.003)
Land Holding (Has.)	0.005		0.005
	(0.006)		(0.006)
Number of Organization Memberships	0.114	***	0.118***
	(0.024)		(0.024)
NGO Dummy (0=Ecoser, 1=Fovida)	-0.122	**	-0.124**
	(0.060)		(0.061)
Number of Observations	287		287
Pseudo R-square	0.219		0.222
	Participants		
% positive predctions	40.7%		34.6%
% negative predictions	59.3%		65.4%
	Non participants		
% positive predctions	5.8%		4.4%
% negative predictions	94.2%		95.6%

Note: Marginal Effects are calculated for dummies reflect the change when dummy changes from 0 to 1.
***99% significance, ** 95% significance, * 90% significance.

Table 4, shows the results of the estimation of necessary credit increase to turn non-participant farmers to participate in the dynamic markets as a result of the technical assistance services. To express the distance to the market on monetary units, the necessary amount of the credit line increase has been simulated for those that do not have

access to dynamic markets. The relative magnitude of that "distance" is surprising; in average it represents less than 2% of the production value.

Table 4—Transaction costs or distance to "dynamic markets"

(units of credit)*

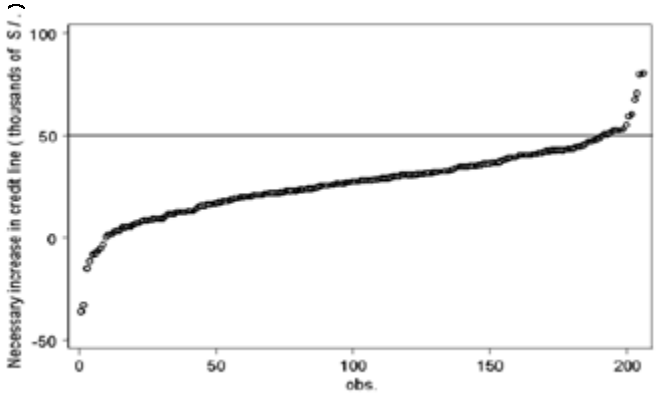
Potato Producers Households by zone	Average increase on the credit required to access the Technical Assistance Market (thousand of Soles)	Credit increase by….		Credit increase as % of the Potato Production Gross Value
		Hectares of potato (thousand of Soles)	Metric Tons. of Potato Production (Thousand of Soles)	
Total Sample	26.9	24.4	4.9	1.39%
Ecoser Sample	25.4	19.1	4.5	1.44%
Fovida Sample	28.1	28.3	5.1	1.35%

Source: Agropecuary producers Survey GRADE 2003.
Authors' calculations.
Note: * US$ is approximately 3.3 Peruvian Soles.

Nevertheless, as Figure 7 shows, there is a strong variance among farmers. Some farmers are extremely close to the market, in the sense that only a small increase on the credit line would allow them to access dynamic markets. On the other hand, an important group of small farmers (more than half of them) are located further away from the market; a distance of 25,000 soles[7] (in this case the number is almost three times greater than the average sales from a farmer in the traditional market). Moreover, 10% of the sample is located at distances greater than 50,000 soles (i.e. 15,150 US$), which is the maximum credit line registered on the sample of farmers with access to the dynamic markets.

[7] This is approximately 7,500 US$.

Figure 7—Simulation of necessary increase in credit lines to participate in the dynamic market



Source: Authors' calculations.

6.2.1 How robust are the results?

A potential problem with the estimated "distance to market" is that it is difficult to know its statistical distribution and make sure that the average values reported above are a reasonable approximation to the expected value of the distance to the market. It is not possible to obtain directly the distribution of δ since it is the ratio of two random quantities (see equation 5).

To see this more clearly recall that the participation equation in the dynamic market has the following from:

$$y_i^P = X_i^P \beta^P + u_i^P \qquad (11)$$

where y^p_i is not observable: $\delta i = 1$ when $y^p_i > 0$

From this equation it is possible to deduce the probit model shown above:

$$prob(\delta_i = 1) = \Phi(X_i^P \beta^P) \quad (12)$$

Similarly, sales in the dynamic market can be expressed as:

$$y^S{}_i * = d_i \, y^S{}_i ** \quad (13)$$

where $y^S{}_i **$ represents the potential censored sales due to high transaction costs. We can observe $y^S{}_i ** = \text{MAX}(\lambda, y^S{}_i *)$ where $y^S{}_i *$ is the optimal latent value (not observed) of sales in the dynamic market and λ is the transaction costs that needs to be overcome to access the dynamic market. This last equation can be rewritten as:

$$y_i^S * = X_i^S \beta^S + u_i^S \quad (14)$$

The simultaneous estimation of (13) - (14) will allow the estimation of the following function:

$$\delta \equiv \hat{x}_i^c - x_i^c = -\frac{X_i \hat{\beta}^S}{\hat{\beta}_c^S} \quad (15)$$

As noted earlier, δ measures what is needed for producer i, in terms of a particular observable (in this case credit), to participate and sell a certain quantity in the dynamic market. The problem is that δ is the ratio of two random quantities, which depend on u^p and u^s.

One indirect way of evaluating the distribution of δ is using the Monte Carlo simulation method. In this case following Holloway et al. (2002) the study uses a Gibbs sampler, which is a Markov Chain Monte Carlo method. The idea behind this way of

retrieving the posterior distribution of δ is the following: if the conditional distribution of the following equation is identified:

$$
\begin{aligned}
y^P \mid \Sigma, \beta, y^S &\sim Truncated\ Normal[E(y^P), v(y^P)] \\
y^S \mid y^P, \Sigma, \beta &\sim Truncated\ Normal[E(y^S), v(y^S)] \\
\beta \mid y^S, y^P, \Sigma &\sim Normal\ [E(\beta^S), v(\beta^S)] \\
\Sigma \mid \beta, y^S, y^P &\sim \text{Wishart - Normal Inverse}\ [E(\Sigma), v(\Sigma)]
\end{aligned}
\tag{16}
$$

It is possible to draw random samples of the posterior distribution of $F(y^P, y^S, \beta, \Sigma)$, which is the joint distribution of all parameters of interest (the latent variables that measure the distance to the market and the standard deviations of those estimates), these random samples can be obtained in a consistent way following the iterative procedure suggested by Holloway et al (2002). This procedure allows for obtaining simultaneously the parameters of the probit and tobit equation plus the estimate of the "distance to the market" and its confidence interval.

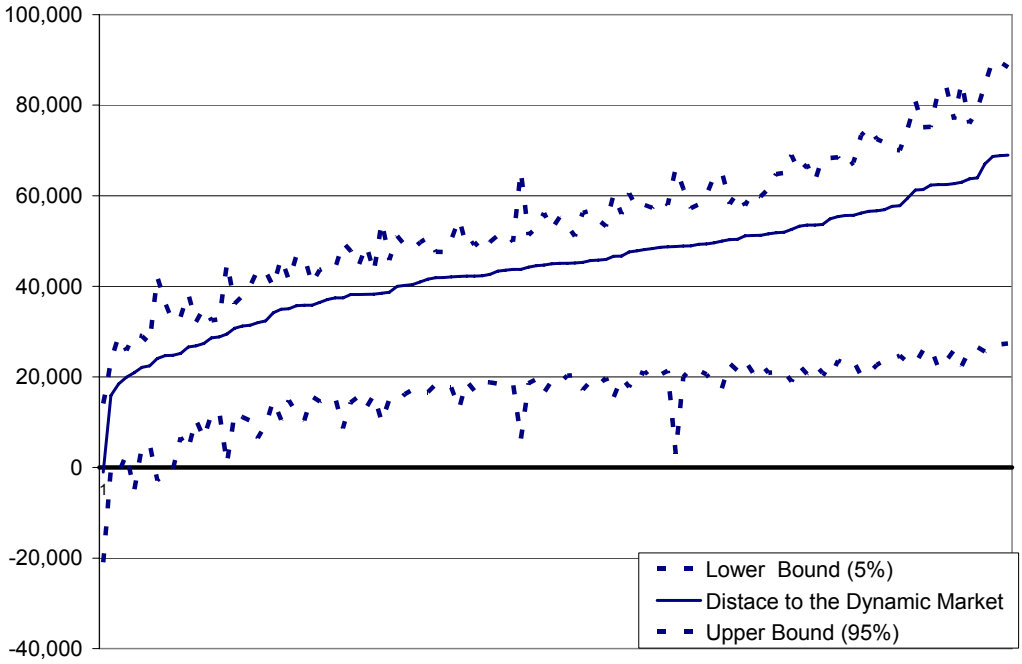
Figure 8 shows the confidence interval obtained for the distance to dynamic potato markets[8]. It is important to note that although the average values are similar to the ones reported above, the distribution of the parameter of interest (δ) is asymmetric and biased towards zero. This pattern may be a signal that farmers in the area under study may be more likely to enter the market than initially thought as a lower increase in any of

[8] Participation and sales equations are very similar to the ones reported above and are not report here but are available upon request.

the independent variables may be needed to motivate a demand for technical assistance that directs the producer into the dynamic market.

Figure 8—Estimated distance to the potato dynamic market

(Monte Carlo Simulation)



Source: Authors' calculations.

6.2.3 How profitable are dynamic markets?

The next question to ask is how profitable it is to have access to dynamic markets. In order to estimate the hypothetical difference in different outcomes for farmers with access to dynamic markets compared with similar farmers, but without access to dynamic

markets the study follows the Roy-Rubin model.[9] Let *D* be a binary assignment indicator, indicating whether an individual unit participated in dynamic markets, the treatment effect of each individual unit is then defined as the difference between its potential outcomes:

$$\Delta = Y^T - Y^C \tag{10}$$

where Y will be the change in the impact variable and the supra indices refer to the treatment group (T) and the control group (C). Since it is not possible to estimate individual gains with confidence without observing Y^T and Y^C for the same individual unit simultaneously, attention is paid to the population average gains from treatment (ATE), or the average treatment effect on the treated (ATT):

$$E[\underline{\Delta}|D=1] = E(Y^T \mid D=1) - E(Y^C \mid D=1) \tag{11}$$

Then, if the condition:

$$E(Y^C| D=1) = E(Y^C \mid D=0) \tag{12}$$

holds the non-participants can be treated as an adequate control group. If, in addition to the treatment and outcome, a background variable is observed (or vector of variables) X_i, and assuming that the treatment depends on the potential outcomes of only X_i, the unconfoundedness condition can be formally expressed as:

\
$$E(Y^C \mid D=1, X_i = x) = E(Y^C \mid D=0, X_i = x) \tag{13}$$

In non-experimental data, as in this case, having access to dynamic markets, generally, would *not* be independent of potential outcomes since the decision to access

[9] The original ideas can be found in Roy (1951) and Rosenbaum and Rubin (1994). For further discussion of these approaches, see Hujer and Wellner (2000), and Lechner (2000).

the dynamic market is likely to be correlated, for example, with the local lending environment or with unobserved characteristics of the property, such as the property's value in the local financial market when looking at the channel of collateral and credit markets. However, given that the technical assistance of FOVIDA and ECOSER was assigned to the data in a quasi-experimental fashion — independent of household demand for access to better markets for potato or to better selling prices or credit — and because the outcomes of interest would be changes in expenditure, income, value potato sales, and the selling prices, unconfoundedness is likely to hold conditional on characteristics of the household observed.

This is how the assumption concerning heterogeneity and selection of observables in the sample is justified. In addition the study, uses a matching method to identify the appropriate control group to each farmer who currently has access to the dynamic market (i.e. a "very similar" farmer who does not participate in the dynamic market). The similarity should correspond to the characteristics that are important to determine the access to the dynamic market described in Table 3.

There are different techniques that may be used for the matching method, as well as forms that help interpret what is considered "most similar". A matching method is, for example, one that relates each beneficiary to a control with the minimum Euclidean distance[10] between their characteristics. Another method is that of Mahalanobis, which corrects the Euclidean distance by using the variances and co variances among attributes.

[10] Euclidean distance is the traditional approach to estimate the distance between a pair of points in any given space.

In This paper the matching of a beneficiary will be done not with one particular control, but with a weighted average of controls, in which controls nearest to the beneficiary may have greater weight and those that are farthest, a smaller one. The non parametric Kernel method is used here:

$$W_{N_0}(i,j) = \frac{K_{i,j}}{\sum_{k \in \{D=0\}} K_{ik}} \qquad (14)$$

where $K_{I,k} = K((P_I - P_k)/h)$ is a kernel weight that gives less weight to the farthest controls from $P_{I,}$ and h is a parameter that defines the bandwith[11] (Heckman, Ichimura, Smith and Todd, 1997).

Table 5 presents the results for four output indicators: total value of potato sales, average potato price received by the farmer, total household expenditure, and household income. As it can be seen, in all cases, the difference between farmers with access and matched farmers without access is positive. This implies that having access to dynamic markets has positive impacts on the welfare of the farmers.

Specifically, in the case of potato sales and average potato price, the result is significant at 5% confidence level. Farmers linked to the dynamic markets get two cents of a dollar more per kilogram of potato. Although the differences in income and expenditure are not significant at 5%, the results are similar to those of Escobal (2004), who found that the net income is much higher (165 US$ per month) for those who were

[11] The selection of h is of central importance for the use of the kernel method; in this respect the procedure proponed by Silverman (1986) is used.

able to connect to the potato chips market than for the matched farmers (that is with similar endowments) who remained in the traditional potato market.

Table 5—Average treatment on the treated impacts of having access to dynamic markets

(in soles)

	Access to Dynamic Markets vs No Access			
	ATT	**ATE**	**[95% Conf. Interval]**	
Total Value of Potatoes Sales	10,826	6,432	2,409	28,571
Average Potato Price	0.069	0.064	0.019	0.109
Household Total Expenditure	3,477	3,016	-2,711	9,853
Household Total Income	6,699	2,992	-2,299	21,395

Source: Authors' calculations.
Note: ATT is average treatment on the treated, ATE is average treatment effect using non parametric Kernel method.
All values are in Peruvian soles, to convert to US$ the exchange rate is 3.4 soles per US$.

6.2.4 Impacts of sales to dynamic markets

Obviously, it is not only important to know how close a farmer is from selling the first unit of production in a new market, but also how much could the farmer sell in that market if some of the restrictions faced were relaxed.

Table 7 shows different simulations based on the Tobit regression results of Table 6, on changes on the credit line for farmers in the sample with access to dynamic markets as well as for those without it. The first simulation duplicates the average credit line available, but distributes it evenly among farmers (the same amount for each one). On the other hand, the second simulation duplicates the credit line of each individual farmer. Finally, the third one duplicates the credit line per hectare for each farmer.

Table 6—Tobit model for sales in potato dynamic markets in accordance to NGO's influence zone

Variables	Marginal Effects (Standard Dev.)		
	All	**Ecoser**	**Fovida**
Number of Household Members	-2.291	-5.772	1.179
	(4.470)	(8.252)	(2.354)
Age of Household Head	-1.418**	-1.223	-0.74**
	(0.701)	(1.285)	(0.371)
Máximum Education Achieved is Incomplete Primary (0=no, 1=yes)	-71.908	-1.897	-247.696
	(56.238)	(92.586)	(0.000)
Risk Attitude - (1=more averse, 5=less averse)	0.067	0.413	0.306
	(5.609)	(10.705)	(2.787)
Credit Line (thousand of soles)	2.789***	4.92***	1.043***
	(0.598)	(1.146)	(0.304)
Land Holding (Has.)	4.801***	5.671**	0.518
	(1.549)	(2.377)	(1.158)
Number of Organization Memberships	22.124***	28.147**	10.046***
	(6.750)	(13.869)	(3.227)
NGO Dummy (0=Ecoser, 1=Fovida)	-53.047***	.	.
	(17.807)	.	.
Constant	-48.793	-112.56	-26.648
	(46.488)	(89.938)	(21.243)
Number of Observations	287	128	159
Number of Censured Observations	207	89	118
Pseudo R-square	0.0689	0.0781	0.0772
		Participants	
% positive predictions	30.1%	41.5%	28.6%
% negative predictions	69.9%	58.5%	71.4%
		Non participants	
% positive predictions	2.9%	3.4%	2.6%
% negative predictions	97.1%	96.6%	97.4%

Note: Marginal Effects are calculated for dummies reflect the change when dummy changes from 0 to 1.
***99% significance, ** 95% significance, * 90% significance.

Table 7—Decomposition of dynamic markets sales variation after simulations of positive credit shocks

Decomposition	(1) $credit_t + \overline{credit}$		(2) $credit_i * 2$		(3) $credit_i + \overline{\left(\frac{credit}{ha}\right)} * has_i$	
By older sellers	920	35.7%	2,443	58.0%	4,316	62.1%
By newer sellers	1,654	64.3%	1,772	42.0%	2,637	37.9%
Total variation	2,573	100.0%	4,215	100.0%	6,953	100.0%
Percentage increase over total sales	46.8%	-	76.7%	-	126.5%	-

Source: Authors' calculations.

Results of the first simulation suggest that the response is important, yielding a 47% increase on the sales to dynamic markets. Furthermore, two thirds of this increase is concentrated on producers that had never been related to dynamic markets, and only a third of it is related to old farmers that already had access to dynamic markets. On the other hand, under the other two scenarios, as it was expected, there was a bigger impact on older farmers that already had access, had a greater amount of land and possessed other assets that made them more productive. In contrast, under these scenarios, farmers with no current access would have smaller possibilities to access dynamic markets.

An alternative simulation is presented on Table 8. Here the simulation takes place on three different scenarios based on an increase in the scale of production of the small farmers: first, second, and third scenarios assign farmers additional land until they reach a minimum size plot of two, three, and five hectares, respectively. Those simulations can be interpreted as an accumulation of additional land or, alternatively, as a consolidation of different plots as a result of some association scheme. In these cases, the results, as it was expected, show that additional sales are concentrated among the small producers

with no access to dynamic markets and who benefited from the simulated increase in their production scale.

Table 8—Decomposition of dynamic markets sales variation after simulations of positive shocks in hectares possession

Decomposition	Scenario 1: min [2 own has.]		Scenario 2: min [3 own has.]		Scenario 3: min [5 own has.]	
By older sellers	44.7	24.8%	91.3	24.9%	224.7	25.9%
By newer sellers	135.5	75.2%	275.3	75.1%	643.6	74.1%
Total variation	180.2	100.0%	366.5	100.0%	868.3	100.0%
Percentage increase over total sales	3.3%	-	6.7%	-	15.8%	-

Source: Authors' calculations.

7. CONCLUSIONS

Market failure in rural Peru is widespread due to many problems like poor infrastructure, market segmentation, poor enforcement of contracts, imperfect information, high risk, and regulatory uncertainty, among the most important. Therefore, it is unrealistic to expect that, under this scenario, agro industry by itself will be successful in connecting farmers to output markets. Consequently, non-competitive markets and inefficient private provision may justify Government and/or NGO intervention. However, such interventions need to be cautious to avoid exacerbating the existing problems and further slowing down or, even worse, impeding the development of efficient and competitive markets

Evidently, the relationship between the small farmers and the two dynamic markets identified in this study has been mediated, in both cases, through NGOs. In cases

where thin or underdeveloped markets prevail, NGOs may provide the "social capital" needed to successfully link small producers facing high marketing and transaction costs with processors that face high uncertainty and monitoring costs. NGOs may provide market access information using their networks of contacts. They may also reduce transaction costs related to contracts by building trust in both sides of the market spectrum. Further, NGOs may build capacity for collective action for small and disperse farmers.

As Johnson, Suarez, and Lundy (2002) argue, firms use their information networks to identify and contact clients, access market information and inputs, and obtain technical and financial assistance. In this case, it is clear that both NGOs, and particularly FOVIDA, are very successful in using their information network to help small potato farmers reach new dynamic market opportunities. As a result farmers linked to dynamic markets have higher sales are receive higher prices for their potatoes.

According to the agro industry[12], the main bottleneck for connecting directly a processing firm to potato producers is producers' lack of scale. Most commercial producers have plot sizes smaller than five hectares. According to the industry, a minimum threshold of five hectare plot is required to absorb fixed costs of the potato production for the potato chips market. This fixed cost includes initial training costs, capacity to use (and destroy) a fixed batch of production for testing purposes, and paying for proper specialized soil analysis. The amount of fixed costs prevents many small farmers from entering to dynamic markets independently. This is also confirmed by the

[12] This information is based on an interview with a key manager of Frito Lay, in September 2004.

simulations of increases of the plot size for smallholders. Increases in the scale production of small farmers until they reach a minimum size plot of five hectares results in a 16% increase of sales mainly explained by new sellers linked to the dynamic markets.

In addition financing problems are very important for producers. Credit does not reach farmers in time; although this is a serious problem in general, it is especially critical when farmers are growing a variety like Capiro, which requires enough liquidity from sowing to harvest. For example, the loans for some farmers interviewed for this research were only disbursed after the harvest. Consequently, they were not able to test the sugar content of the potatoes (which cannot exceed 0.03%) and harvest them before reaching the required levels.

We showed in this paper that in average potato producers in the Sierra need about 7,500 US$ additional credit to access dynamic markets, although the variance between producers is huge. Some farmers, for example, are extremely close to gaining access the market and just a small increase on the credit line would allow them to achieve that. On the other hand, an important group of small farmers —more than half of them — are much further away from accessing the market; about 25,000 soles (US$ 7,500). In this case the amount needed to access the market is almost three times higher than the average sales of a farmer selling to the traditional market. Moreover the impacts are clear; results from the simulations implemented showed that by duplicating the average credit line available to the farmers and distributing it evenly among farmers, total sales to the

dynamic markets will increase in 47%. Furthermore, two thirds of this increase will be concentrated on producers that had never been related to dynamic markets.

In a nutshell, the results obtained in this study indicate that appropriate investment policies in infrastructure need to go together with well-functioning market institutions in order to take advantage of market opportunities, sustain increased agricultural output, and raise rural incomes. This is critical for smallholders who do not have access to market information and cannot gain access to dynamic markets independently; thus, even when the hard infrastructure exists, these farmers capture little of the value they create. The demand and supply remain highly unstable, and so are the distribution costs for goods produced in rural areas. Finally, markets often do not work for smallholders and that creates a need for intervention as recognized in this study.

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