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The Export-Production Decision of Chilean Farmers: The Case of Blueberry Producers

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Abstract: This article analyzes the relative importance of producers' attributes and farms' geographical characteristics in the decision to produce an exportable good (blueberries) in the southern region of Chile. Using farm-level data, a logit model is estimated to identify factors influencing the export-production decision. Results show that the probability of producing blueberries increases with the educational level of producers (a proxy for productivity), the presence of irrigation and drainage systems, and the availability of labor. The last factor, which arises from the proximity to large and urbanized regions, has a stronger effect on the export-production decisions of Chilean farms than either farmers' education or farms' physical characteristics.

Key Words: Agricultural Trade, Export Production, Geography.

JEL Codes: F11, Q17, O13

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*Contributed Paper prepared for presentation at the International Association of
Agricultural Economists Conference, Beijing, China, August 16-22, 2009*

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Introduction

The integration of Chile's economy into international markets during the last few decades has led many local firms to orient their production towards foreign markets. Agriculture, particularly the fruit sector, has responded very positively to this trend, taking advantage of selling in the northern hemisphere's off-season markets. In fact, Chilean fresh fruit exports have grown from \$160 million in 1980 to more than \$1.8 billion in 2006 (ODEPA, 2008).

The growth of agricultural production and exports in Chile has been geographically uneven. For example, producers located in the north and central Chilean zones (the Tarapacá and El Maule regions) have witnessed rapid growth in agricultural production and exports. In fact, more than 90 percent of agricultural exports in 2007 were produced in these zones. On the other hand, southern farmers are considered to be traditional producers, i.e. their production of beef, wheat and dairy products is aimed mainly at the domestic market. The most common reason cited by southern farmers for not producing export-oriented products such as fruits is that the region's geographic characteristics (e.g., soil type) severely limit the production possibilities of their farms.

Nevertheless, the production of blueberries - a product that is mostly exported - has expanded considerably in Chile's southern regions in recent years. Moreover, the spatial distribution of farms producing blueberries indicates that blueberry producers and traditional producers are located side by side in several micro-regions (see figure 1). This

conflicts with the common perception that regional geographic characteristics are the major determinant of the choice between producing exportable versus traditional products. In particular, the finding about the spatial distribution of blueberry production raises the possibility that other factors, such as producer-specific attributes and farm-specific geographic characteristics, may play an important role in the export-production decision.

The firm's decision to produce for foreign markets and export, commonly called the export decision, has been studied extensively for manufacturing industries. In general, these studies have found that exporting firms are larger and more capital intensive, pay higher wages, hire more skilled workers, and, importantly, are more productive than non-exporters (Bernard and Jensen, 1995; Bernard et al., 2007; Wagner, 2007). Previous studies have placed special emphasis on the role of productivity in the export decision because productivity is related to firms' competitiveness and economic growth. In fact, productivity seems to be the main factor that differentiates exporters from non-exporters (Melitz, 2003), although the causality between productivity and exports is not clear. Several studies have focused on whether productivity is a cause of exports (the self-selection hypothesis) or export activity is the cause of higher productivity (the learning-by-exporting hypothesis) (Aw, Chung and Roberts, 2000; Bernard and Jensen, 1999; Clerides, Lach and Tybout, 1998; Delgado, Farinas and Ruano, 2002; Girma, Greenaway and Kneller, 2004).

Some studies have focused on factors other than productivity that could be relevant to firms' export decisions. For example, in a study of spillover effects of exporters on non-exporters due to their proximity to each other, Aitken, Hanson and

Harrison (1997) found that the presence of multinational companies in a specific geographical area positively affects the decision to export by domestic firms that are located in that area. On the other hand, using a dynamic model, Roberts and Tybout (1997) found that a firm will export only if the expected benefits of exporting are greater than the sunk costs involved in the export process. Although there has been extensive research on the impact of geographic characteristics on industrial production decisions (e.g., Fujita, Krugman and Venables, 1999; Fujita and Thisse, 2002), few studies have used firm level data to consider the role of such factors in firms' export decisions. Most research has controlled for the effect of geographic characteristics using only categorical variables such as regional or provincial indicators (e.g., Aitken, Hanson and Harrison, 1997).

While there have been advances in the study of the export behavior of manufacturing firms, little is known about the export behavior of agricultural firms. Some studies have explored the link between productivity and agricultural exports, but only at an aggregated level (Arnade and Vasavada, 1995; Gopinath and Carver, 2002). And, although some studies have analyzed the production decisions of agricultural firms (Katchova and Miranda, 2004), none of them has focused on the export-orientation of production.¹ Any analysis of farms' export behavior must recognize that agriculture differs considerably from the manufacturing industry. In fact, in the Chilean case, most farmers do not export directly. Rather, exporting agribusiness firms buy farmers' products, make the export decision, and sell the products in foreign markets (Echeverria

¹ An exception here is the study by Echeverria (2006), who found that farm-specific characteristics were more relevant than regional geographic characteristics in the export-production decisions of Chilean farmers.

and Gopinath, 2008, Forthcoming). This implies that Chilean farmers only produce with an “orientation” towards foreign markets.

The objective of this study is to analyze the export-production decision of Chilean farmers. In particular, we evaluate the relative impact of producers’ attributes and farm-specific physical and geographic characteristics on the decision to produce an exportable good - blueberries - in southern Chile.² It is important to note that this study does not examine the *absolute* effect of geographic variables on the decision to produce exportables, but rather the *relative* effect of these variables when the production decision is compared among neighboring farms. More specifically, using farm level data, we evaluate whether farm-specific geographical variables make a farm inherently better suited for export production rather than traditional production. If this is not the case, we attempt to identify those producer-specific characteristics that affect the production choice.

The rest of the article is organized as follows. In the next section, we present a simple logit model for analyzing the export-production decision of farms. We then describe the dataset. This is followed by a discussion of the analysis and the results of the modeling exercise. In the final section, we present some policy implications of our findings.

The Model

Although existing export-decision models work well in the context of manufacturing industries, they are generally not well suited for explaining the export-production

² Unlike Echeverria (2006), the focus here is only on blueberry production, more than 90 percent of which is exported. Clearly, farmers that produce only blueberries have more of an export orientation than other farms.

behavior of agricultural firms (farms). As mentioned above, Chilean farms often do not export their products directly. Instead, marketing firms make the export decision, with farms' export participation limited to producing the commodities or goods that will subsequently be exported. Thus, because it is these marketing firms that actually make the export decision in Chile, we employ a simple model that is based on the approach of Aitken, Hanson and Harrison (1997), who studied the export behavior of manufacturing firms in a static context.³

We assume that farms can produce domestic-oriented products (i.e., traditional products), exportables, or both. The production of exportables differs from the production of traditionals in both prices and costs. The production of exportables is desirable because of their higher prices. However, production is constrained by the cost function, which is determined by farm-specific geographic characteristics (e.g. soil type, availability of water for irrigation) and some producer-specific attributes (e.g. productivity, age of the farmer). We assume that the production cost function of traditionals is also constrained by geographic characteristics and/or producer attributes.⁴ Thus, to make its production decision, a profit maximizing farm i will calculate the following:⁵

$$(1) \quad \max_{q_t, q_e} \{ [p_t q_t - c_t(q_t, S, G)] + [p_e q_e - c_e(q_e, S, G)] \}$$

$$s.t. \quad q_t, q_e \geq 0$$

where t and e indicate traditional and exportable production, respectively, p represents product prices (not necessarily specific to the farm), q represents the quantity of

³ Dynamic models, such as the one proposed by Roberts and Tybout (1997), cannot be used in this study due to the nature of data.

⁴ In practice, geographic characteristics seem to have less of an effect on traditionals than exportables because all farms produce at least a traditional product. However, for the sake of simplicity, we do not include this factor in our model.

⁵ For simplicity, we have suppressed the superscript i in this equation.

production, $c(\cdot)$ are the production cost functions, S represents the producer-specific attributes, and G represents the farm-specific geographic characteristics. We assume that the production cost functions are increasing and convex in their respective arguments.

The optimal output choice may be zero for either kind of production. All firms produce positive quantities of traditional products but, in practice, firms can produce zero export-oriented products. Using this framework, we estimate the probability that a farm will produce exportables. Let the dummy variable y^i be:

$$(2) \quad \begin{cases} y^i = 1 & \text{if } q_e^i > 0 \\ y^i = 0 & \text{otherwise,} \end{cases}$$

which indicates whether or not a farm i has positive production of exportables. Equation (2) assumes that the decision to produce exportables is a continuous latent variable (q_e^i) that can be observed only in two stages: produce exportables ($y = 1$), or not ($y = 0$). The estimation of the discrete choice model in equation (2) allows us to obtain consistent estimates of factors underlying the optimal solution to q_e^i . Note that the probability that y will take the value 1 is equal to the probability that the latent variable q_e^i is greater than zero (Long, 1997). So, it follows from equation (2) that the probability that the i -th farm will produce exportables is given by:

$$(3) \quad \Pr(y^i = 1) = \Pr(y_e^i > 0) = \Pr(\alpha + \beta S^i + \gamma G^i + \varepsilon^i > 0),$$

where ε^i is the random error; S^i is a vector of farm- or producer-specific characteristics (e.g. education, size, age) arising from the production cost function, and β is the associated parameter vector that measures the relative importance of these characteristics to the probability of export production; G^i is the vector representing farm-specific

geographic characteristics, and the parameter vector γ measures their relative importance to the probability of export production.

The Data

The analysis of farms' export-production decisions requires data on both export-oriented and domestic-oriented producers. Export-oriented producers are relatively rare, which means that a completely random sample may not allow for a comparison between the two types of producers (Bernard et al., 2007). Indeed, according to the 2007 Chilean Agricultural census (Instituto Nacional de Estadísticas, 2007), only 5 percent of farmers export directly or indirectly. Thus, in order to include export-oriented producers in the sample, we first selected a random set of producers from all export-oriented producers and then randomly selected another set of producers from those that are domestic oriented. This two-step process is explained in more detail below.

Selection of producer samples

In the first step, export-oriented producers were selected from a database of the Natural Resources Information Center of Chile (CIREN) (Centro de Información de Recursos Naturales, 2007), which contains information about Chilean fruit producers, including the final destination of production (i.e., domestic or foreign markets). An analysis of these data shows that more than 90 percent of blueberry production is exported. Thus, blueberry producers were treated as export-oriented producers, despite the fact that these farmers can also produce some traditional products. Blueberry producers receive invoices with prices that are based on foreign sale prices. That is, farmers are aware that they are producing for foreign markets. This implies that they

know the risks, costs and benefits of making the production decision. CIREN's data are reported in a geographical information system format. This means it is possible to know the exact location of each farm. Using this geographical information, for each export-oriented producer, a traditional producer (within a 5 km radius of the export-oriented producer) was selected randomly. This method of selecting farmers guarantees that the comparison of export-oriented and traditional producers will be based on farm-specific geographic characteristics, because we have controlled for those geographic variables that are regional (e.g. temperature or precipitation levels) and hence not specific to individual farms. In this way, a random sample of 100 export-oriented producers and 100 domestic-oriented or traditional producers was selected. Figure 1 shows the spatial distribution of these producers.

Each of the farms in our sample was visited between November 2007 and January 2008, and a brief interview was conducted with each producer to obtain the farm-specific geographic characteristics and producer attributes. Next, the data for each farmer were linked to the data from the 2007 agricultural census. Because of several inconsistencies in the census data, complete information was available for only 70 farmers. It is important to note that farmers were not willing to answer personal questions about producer-specific attributes such as their educational levels, their age, and whether there is a separate farm manager, because they had already been asked these questions in the 2007 census. Thus, our econometric analysis is based on two samples: one with 200 producers, which includes only farm-specific geographic characteristics, and another with 70 producers, which includes both producer attributes and the geographic characteristics.

Geographic variables

Farm-specific geographic variables were analyzed based on the particular location of each farm. Some of these variables had to be collected and interpreted directly by the interviewer (with the collaboration of the farmer). In the case of blueberry producers, the analysis of variables was restricted to the area of the farm where blueberries were being produced. For traditional producers, farmers were asked to identify an area that could potentially be used to produce blueberries. This area was used to identify the value of some geographic variables, such as “irrigation”, “drainage”, “slope”, “acidity of soil”, and “access to the farm.”

Irrigation is an important factor in the production of blueberries. In our analysis, this variable includes the availability of water as well as the water rights owned by farmers. It takes the value 0 if it is not possible to irrigate (i.e., no water and/or no water rights), and 1 otherwise. “Drainage” indicates the capability of soils to drain water. Soils with insufficient drainage are not suitable for producing blueberries. Thus, the variable takes the value 0 if the soil has drainage problems, and 1 otherwise. It is important to note that the irrigation and drainage variables are closely related because irrigation projects must include a drainage system. The “slope” variable represents the slope of the area that is used for producing blueberries (or, in the case of traditional producers, the area that could potentially be used for producing them). It takes the value 0 if the terrain is almost flat (slope less than 30°), and 1 otherwise. An important characteristic of blueberries is that they grow well in acidic soils, so the variable “acidity of soil” is also included. Farm-specific soil acidity was obtained using a dataset from the Centro Tecnológico de Suelos y Cultivos (CTSyC). Soils with strong acidity received the value of 0, and 1 otherwise.

The variable “access to the farm” represents the quality of roads for accessing the farm. Good quality roads make the transportation of products and labor easier. Thus, this variable takes the value of 0 if access is poor, and 1 otherwise.

Given that production of blueberries is highly labor intensive, another geographic variable included in the study was a farm-specific index of labor availability. This index depends not only on the labor supply that a geographical area can offer, but also the cost of commuting to the farm. A labor availability index (LAI) that considers labor supply and commuting is given by:

$$(4) \quad LAI = \left[\left(\frac{1}{DNC} \right) \times PNC + \left(\frac{1}{DNT} \right) \times PNT \right] \div 1000$$

where DNC is the distance to the nearest city, PNC is the population of the nearest city, DNT is the distance to the nearest town, and PNT is the population of the nearest town. The index is standardized by dividing by 1000. This index was created considering that farmers hire people from either the nearest city (high labor supply) or town (low labor supply). In general, a city was considered as such if its population was above 50,000 people. It is important to note that the index captures the availability of labor in relative terms. That is, it compares labor constraints between farms based on their geographical location. For example, a farm that is located close to a big city will have higher labor availability than a farm that is located far away from this city. In the same line, if a farm is located very close to a town, it will have lower labor availability than a farm located close to a city.

Producer Attributes

Data on producers’ characteristics were collected from the 2007 Chilean Agricultural Census. Variables such as education (years of schooling of the farmer,

gender (male/female), age of farmer, presence of a farm manager, and farm size are included. Although the trade literature argues that productivity is an important factor that determines the export decision (Wagner, 2007), it was not possible to obtain a measurement of productivity (e.g. total factor productivity) for this study. In particular, although technical efficiency could be used as a proxy for productivity, the nature of the data made such an analysis impossible. Farmers operate in a multi output-input context, i.e., they produce several products (e.g., grains, cattle) and use many inputs (e.g., fertilizers, labor), but each product requires a unique set and level of inputs. The techniques available to address this issue require disaggregated data on quantities of main products and inputs. However, such data are not available. Nevertheless, several studies have found a strong and positive correlation between highly-skilled workers and productivity (Munch and Skaksen, 2008; Turcotte and Rennison, 2004). Thus, we have used the educational level of farmers as a proxy for productivity. This approach also has the advantage of avoiding the need to correct for endogeneity caused by any causality between productivity and exports (i.e., self-selection and learning-by-exporting hypotheses).

Descriptive statistics of the variables for our samples of 70 and 200 producers are presented in Table 1. For the sample of 70 farms, these statistics indicate that average farm size and years of education are considerably higher for export-oriented producers than for domestic-oriented producers. On the other hand, age, slope, drainage and the labor availability index are higher for domestic-oriented producers than for export-oriented producers. Since all export-oriented producers in this sample had irrigation facilities and none of the domestic oriented producers had irrigation (i.e., there is a

perfect match), we dropped this variable from the econometric analysis of this sample. Statistics for the sample of 200 farms follow the same pattern that the sample of 70 farms. However, it is important to note that a 60% of traditional producers have irrigation, while 99% of blueberry producers have irrigation (only 1 producer of blueberries does not have irrigation).

In all cases studied, farmers sold their products to marketing firms that were private entities. In most cases (about 80%) farmers had contract sales with these firms which guarantee that firms will buy (and consequently export) their products. These contracts include an estimated price that the producer will receive. However, final prices paid to farmers will correspond to the actual prices paid in the final market (after deducting transaction costs and earnings of marketing firms). Thus, exporting firms assume the risk of having to sell all production abroad, and farmers assume the risk of potential low final prices.

Discussion of Analysis and Results

The export-production decision is analyzed through logistic regression. Two logit models are estimated in our analysis. The first model uses the complete sample of producers (200 farms) and includes only those variables that are related to farm-specific geographic characteristics. The second model adds producer-specific attributes to the geographic characteristics, but considers only the sample of 70 producers.⁶ The two models were regressed using robust standard errors (Huber-White standard errors), since a plot of residuals showed some degree of heteroskedasticity. The results are presented in Table 2. A comparison of the two specifications reveals that model 2 has a higher likelihood value

⁶ Some interaction effects were analyzed, but no significant effect was found.

(-27.47) and higher pseudo R^2 (0.37) than model 1 (-106.19 and 0.25, respectively).

These results suggest that the export production decision is better explained when both producer-specific attributes and geographic characteristics are included in the model. The results for each model are discussed in more detail below.

Results for Model 1

In model 1, the “irrigation” variable has a positive coefficient, which is statistically significant at the 1 percent level. As explained above, irrigation in a commercial orchard depends on having both physical access to water and the property rights for using it. The coefficient on “drainage” is also positive and significant at the 5 percent level. In practice, Chilean farmers treat irrigation and drainage as part of one, interconnected system, because irrigation projects include the drainage of water derived from irrigation. Thus, these two variables should be considered complementary factors.

The “availability of labor” variable deserves special attention. In a preliminary analysis, distance from the farm to the closest city or town and the sizes of these urban areas were included in the estimation. However, none of these variables was significant, despite the fact that in interviews both domestic-oriented and export-oriented farmers indicated that labor is an important factor in the decision to produce blueberries. Thus, in the subsequent analyses, the labor availability index was included to capture the effect of this factor. In model 1, this index has a positive and significant effect at the 10 percent level. This means that the probability of producing blueberries will be higher if farms are located near urban areas that have abundant labor and/or the cost of transporting labor is low (i.e., the distances between farms and sources of labor are short).

Results for Model 2

As indicated above, we excluded the “irrigation” variable from model 2 because there was a perfect match between this variable and the production of blueberries (that is, all blueberry producers had irrigation, but no domestic-oriented producers had irrigation). As in model 1, “drainage” had a positive sign and was significant at the 5 percent level and the “labor availability index” had a positive sign and was significant at the 10 percent level. None of the other farm-specific geographic variables had a significant effect on the export-production decision.

Regarding the producer-specific attributes included in model 2, “education”, the proxy for productivity, was the only variable with a positive and significant effect (at the 1 percent level) on the decision to produce exportables. That is, producers with an orientation toward foreign markets appear to be more productive than domestic-oriented producers. This result is consistent with previous studies on the export decision in the manufacturing sector (Bernard and Jensen, 2004), which find that firms with higher productivity tend to be exporters. The coefficients on other farm-specific attributes (i.e., age, gender, manager, and farm size) in model 2 were not statistically significant.

Analysis of Marginal Effects

The previous discussion of the export-production decision has focused on the signs of the coefficients (i.e., whether a variable has a positive or negative effect on the decision to produce exports) rather than on the relative magnitude of the impacts of producer attributes versus farm-specific geographic characteristics. To estimate these relative impacts, marginal effects are calculated for each of the explanatory variables. Formally, the marginal effect of the l^{th} element of a vector X_{jl} is:

$$(5) \quad \frac{\partial \Phi(\beta' X_j)}{\partial X_{jl}} = \phi(\beta' X_j) \beta_l,$$

where the partial derivative of the non-linear cumulative distribution function with respect to a particular variable (X_{jl}) will depend on the level at which the other independent variables are evaluated (Wooldridge, 2002). For model 2, the marginal effects for the three variables that were significant in the regression analysis—education, the labor availability index, and drainage—are 0.0645, 0.0142, and 0.3560, respectively (these marginal effects were evaluated with the other variables held at their means). Thus, drainage seems to be relatively more important in the export-production decision than the other two variables. However, given the nonlinearity of variables in discrete choice models, the marginal effects can mask the true magnitude of the variable of interest when it is analyzed for values other than its mean. To address this problem, the predicted probabilities of export participation arising from each significant variable are derived as:

$$(6) \quad \hat{P}(y = 1 | \bar{X}_j, X_{jl}) = \Phi(\hat{\beta}' X_j)$$

where $\hat{P}(\cdot)$ is the predicted probability when all variables except X_{jl} are evaluated at their respective means. Thus, holding all other variables at their means, the effect on export participation of changing X_{jl} can be illustrated with a plot of $\hat{P}(\cdot)$.

Figures 2, 3(a) and 3(b) show the predicted probabilities of export participation due to changes in education, drainage, and the labor availability index. Figure 2 indicates that education has a positive relationship with the probability of producing exportables. That is, farmers with more education, who are thus more productive, are more likely to produce exportables. In fact, when farmers have a college-level education, the probability of producing exportables can reach up to 50 percent. In the case of “drainage” (see figure

3(a)), the probability of producing blueberries reaches up to 30 percent when there is no problem with soil drainage. The labor availability index seems to have the strongest effect on the decision to produce exportables. As shown in figure 3(b), when there is a high availability of labor (the combined effect of being close to the source of labor and having this source of labor be abundant) the probability of a farm deciding to produce exportables can be close to 90 percent.

It is important to note that when the drainage variable is close to zero, that is, when soil drainage is very bad, the probability that a farmer will produce exportables is very low (this is very similar to the case of irrigation, which is essential for producing blueberries). On the other hand, the analysis indicates that when the other two variables (education and the labor availability index) are at their minimum values, there is still some probability of participating in blueberry production. In the case of labor, this result can be explained by the use of family labor, which will be available even when it is not possible to hire off-farm labor.

Summary and Policy Implications

The purpose of this study has been to evaluate the relative importance of producers' attributes and farm-specific geographic characteristics on the export-production decision of Chilean farmers through a case study of blueberry producers in southern Chile. The spatial distribution of blueberry producers -who represent export-oriented producers- and traditional farmers suggests that the export-production decision is likely influenced more by producer-specific attributes and farm-specific geographic characteristics than by regional geographic characteristics.

Results obtained from the logistic regression suggest that education, a proxy for productivity, is a producer-specific attribute that is key to the export-production decision. Thus, policies aimed at encouraging agricultural exports should include efforts to improve farmers' formal education as well as technical training.

Irrigation and drainage appear to be the main physical geographic variables that affect the export-production decision. The positive effects of these factors on agricultural production are well known in Chile. In fact, since 1985 there has been a national program that encourages irrigation and drainage projects by subsidizing up to 75 percent of the costs of such projects (Law 18,450). Although this policy has been successful in helping many farmers increase their production possibilities, it appears that traditional farmers have not benefited from it. Thus, another way to encourage export production would be to improve the availability of and access to water, which expands farmers' production choices. It is necessary to note that although the blueberry production requires irrigation, the presence of irrigation does not necessarily imply production of blueberries. This is evident when the sample of 200 farms is analyzed and 60% of traditional producers have irrigation.

Finally, the results of the analysis suggest that distance from metropolitan areas influences the export-production decision through its effects on labor costs, which arise from variations in both wages and commuting costs. Since fruit production is labor intensive, farms with lower labor costs have a higher probability of engaging in exportable production. This geographic effect, arising from proximity to larger and more urbanized regions, is particularly strong in our sample of blueberry producers, who export 90 percent of their production.

In summary, this research has provided new insights into the factors that determine the export-production decision of Chilean farmers. By focusing on export-oriented and domestic-oriented farms that are located near each other, we control for regional climatic factors and are thus able to assess the relative impact of producers' attributes and farm-specific geographic characteristics on the decision to produce exportables. We find that farmers' educational levels, their access to water, and the availability of labor are key to expanding farmer's production choices to include export products. In the short run, farmers who have high levels of education, good labor availability and irrigation should be targeted to promote export-oriented production. However, in the long-run, policies should be directed at eliminating education and irrigation as a barrier facing farmers. However, as labor availability is associated with the geographical location of farms and is determined by many factors influencing the economy at large and so is difficult to address.

Although the present study was conducted based on the blueberry production, their results can be easily extended to any other similar product (e.g., most berries). Indeed, this research methodology can be adapted to investigate the factors that are related to the export-production decision in other products or crops.

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Table 1. Descriptive Statistics of Export-Oriented (Blueberry Producers) and Domestic-Oriented Producers in Southern Chile; Sample of 70 farms

Variable	Domestic-oriented				Export-oriented				
	producers				producers				
	Std.				Std.				
	Mean	Dev.	Min	Max	Mean	Dev.	Min	Max	
<hr/>									
<i>Sample of 70 farms</i>	<i>n = 48</i>				<i>N = 22</i>				
Farm area (hectares)	48.1	75.5	0.5	400.0	123.5	165.5	0.8	550.0	
Gender (0: female; 1: male)	0.8	0.4	0.0	1.0	0.8	0.4	0.0	1.0	
Age of farmer (years)	63.1	13.1	37.0	90.0	58.1	17.1	32.0	88.0	
Education (years)	9.3	3.5	0.0	17.0	13.9	3.6	8.0	17.0	
Manager (0: No; 1: Yes)	0.1	0.3	0.0	1.0	0.3	0.5	0.0	1.0	
Irrigation (0: No; 1: Yes)	0.7	0.5	0.0	1.0	1.0	0.0	1.0	1.0	
Acidity of soil (0: Strong; 1: Weak)	0.4	0.5	0.0	1.0	0.6	0.5	0.0	1.0	
Drainage (0: Poor; 1: Good)	0.3	0.5	0.0	1.0	0.1	0.3	0.0	1.0	
Slope (0: Flat; 1: Steep)	0.4	0.5	0.0	1.0	0.2	0.4	0.0	1.0	
Access to farm (0: Poor; 1: Good)	0.8	0.4	0.0	1.0	0.8	0.4	0.0	1.0	
Labor availability index	5.4	6.8	0.6	39.4	5.1	6.8	0.6	31.2	
<hr/>									
<i>Sample of 200 farms</i>	<i>n = 101</i>				<i>N = 99</i>				
Irrigation (0: No; 1: Yes)	0.6	0.5	0.0	1.0	1.0	0.10	0.0	1.0	
Acidity of soil (0: Strong; 1: Weak)	0.5	0.5	0.0	1.0	0.6	0.5	0.0	1.0	
Drainage (0: Poor; 1: Good)	0.3	0.5	0.0	1.0	0.2	0.3	0.0	1.0	
Slope (0: Flat; 1: Steep)	0.4	0.5	0.0	1.0	0.3	0.4	0.0	1.0	
Access to farm (0: Poor; 1: Good)	0.9	0.3	0.0	1.0	0.9	0.3	0.0	1.0	
Labor availability index	4.7	5.6	0.6	39.4	7.1	10.7	0.6	31.2	

Source: Authors' calculations based on sample's data.

Table 2. Export-production decision of Chilean farmers analyzed through a Logit Model

	Model 1	Model 2
Producer-specific attributes		
Education		0.403 *** (0.112)
Sex		0.556 (0.744)
Age		-0.021 (0.030)
Manager		-0.361 (1.204)
Area		0.004 (0.004)
Farm-specific geographic characteristics		
Irrigation	4.177 *** (1.035)	
Drainage	0.912 ** (0.415)	2.222 ** (0.942)
Labor Availability Index	0.042 * (0.022)	0.088 * (0.050)
Slope	-0.203 (0.347)	-0.934 (0.946)
Access	-0.382 (0.519)	-0.055 (0.960)
Acidity	0.046 (0.359)	0.950 (0.745)
Constant	-3.743 *** (0.961)	-7.383 *** (2.443)
Number of observations	200	70
Wald chi ¹	34.51	21.59
Log-likelihood value	-106.19617	-27.47
Pseudo R ²	0.2339	0.3694

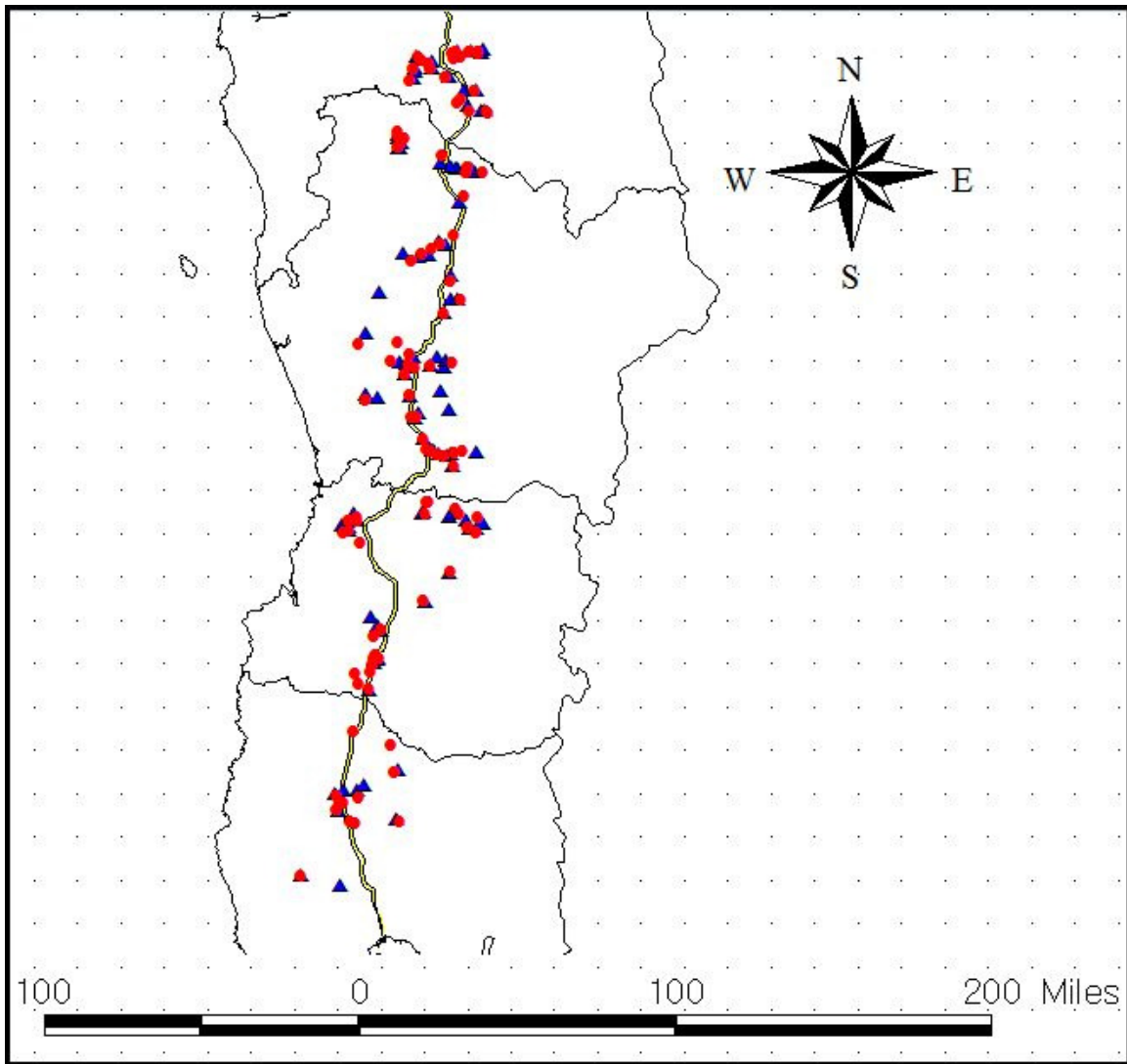
Source: Authors' calculations

Numbers in parentheses are standard errors.

* Significant at 10%; ** Significant at 5%; *** Significant at 1%.

¹ 6 and 10 degrees of freedom, respectively.

Figure 1. Spatial distribution of traditional and export-oriented producers in southern Chile

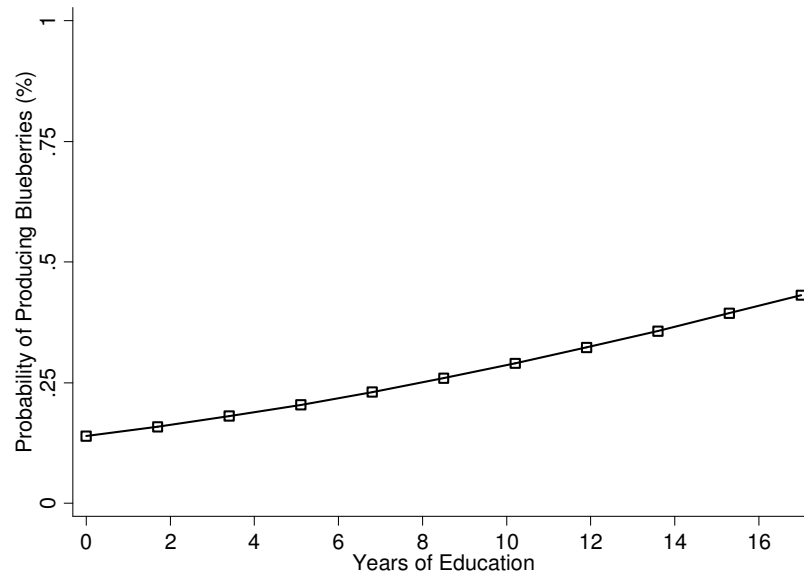


▲ Traditional producers

● Blueberry producers

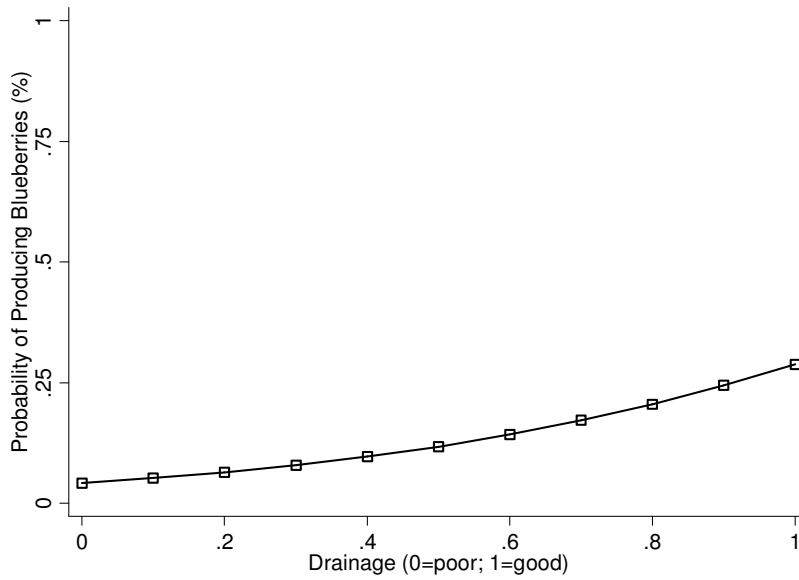
Source: Centro de Información de Recursos Naturales (2007)

Figure 2. Predicted Probabilities Due to Changes in Years of Education

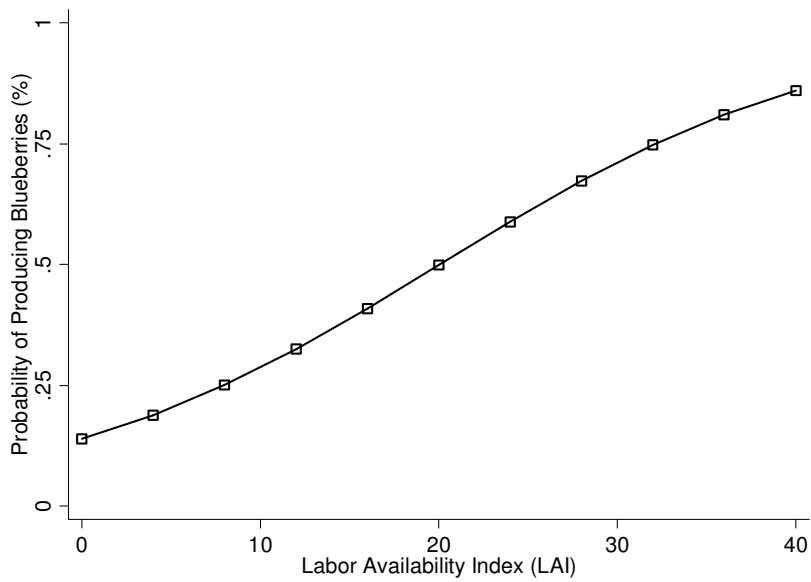


Source: Authors' calculations

Figure 3. Predicted Probabilities Due to Changes in Drainage and Labor Availability Index



(a)



(b)

Source: Authors' calculations