Export Entrepreneurs: Evidence from Peru*

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We examine customs transactions data on the non-traditional agriculture export sector in Peru from 1994 to 2007 to understand the micro-foundations of export growth. This sector grew seven-fold over this period, driven in a large part by firm entry and new product and market discoveries. We find tremendous firm entry and exit in the export sector, with exits more likely after one year and among firms that start small. There is also significant entry and exit in new markets. In contrast, such trial and error in new products is rare. New products are typically discovered by large experienced exporters and there is increased entry after products are discovered. Our results suggest that high sunk costs of entry are of concern for product discovery. In contrast, the tremendous entry and exit in exporting and in new markets suggests that initial sunk costs are relatively low. We develop a simple model that explains how entrepreneurs decide to export and to develop new export products and markets when there are sunk costs of discovery and uncertainty about idiosyncratic costs. The model explains many features of the data.

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I. Introduction

In developing countries many firms produce only for foreign markets. These firms typically produce several products and serve many markets. For example, cut flowers in Kenya, coffee in Rwanda, semiconductors in Costa Rica, and flat screen TVs in China. Countries are increasingly setting up special programs such as export processing zones to encourage such production. There are now 60 million people working in 3,500 export processing zones spanning 130 countries producing clothes, shoes, sneakers, electronics, and toys for export (Boyenge 2007). In this paper, we explore how firms begin to produce products that are not consumed locally and how production expands, using evidence from the non-traditional agriculture sector in Peru.

Our goal is to contribute to the growing literature on trade and firm dynamics by focusing on a particularly dynamic export sector, and examine the importance of entry, exit, and how new products and new markets are developed. The nontraditional agricultural sector in Peru grew more than 700 percent from 1994 to 2007, as compared with 450 percent for traditional agriculture.[1] Entry of new firms and expansion into new products and markets was vital for this growth. Specifically, firms that began exporting after 1994 accounted for nearly three-quarters of total exports in 2007. Similarly, exports of products new to the country and entry into new markets for existing products together accounted for almost a third of total exports at the end of the sample period. There was also a large amount of exit, with over one-third of export attempts exiting after one year.

Exporters in Peru maintain that trial and error is an important part of exporting. There is uncertainty, which makes export trials necessary, but entry costs are not so large as to discourage testing foreign markets. In contrast, new product and market

[1] Official numbers from the Central Bank of Peru.

development may be more complicated, involving high sunk costs and significant uncertainty.

We develop a model that generates entry and exit as form of trial and error. We extend the model to the case of new products and markets, where discovery costs are relatively large. Specifically, entrepreneurs first decide whether to enter the export sector, and then whether to continue exporting, and finally on whether to develop new products that have not been exported previously by any firm (or similarly access market new to a specific product). Prior to entry, each exporter faces uncertainty about their cost of exporting a particular product, and once they export the cost is revealed. The uncertainty generates significant entry and exit—some entrepreneurs with a negative expected value of entry will attempt to export, and if their cost draw is bad they will exit. The intuition is that there is a lifetime value of getting a good cost draw and only a one-period negative shock from a bad draw. This implies that the present value from attempting exports can be positive even if the one-period expected gain is negative. It also means that with sizeable sunk costs of entry, there can still be significant entry and exit. We show that if small trials are possible, the range of firms which attempt exporting expands.

In addition to entering existing markets and products, exporters can also start product lines that are new to the country (or enter markets that are new to the product line). Such development is relatively costly because the firm must develop a new product or meet new market requirements. The model shows that the quality of the pioneers in new products (and markets) is increasing in the cost of discovery. As a result, these entrepreneurs are less likely than followers to cease exporting these products after entry.

We use firm-level international transaction data from Peru for the period 1994-2007 to examine how the non-traditional agriculture sector developed. In addition, we incorporate a selection of industry studies and interviews with market participants to enhance our understanding of the industry. We have three main findings: (i) firms start exporting with small trials and there is significant entry, exit, and reentry, implying that entry into exporting entails small initial fixed costs. (ii) Entry into new markets is more cumbersome, but the amount of trial and error suggests that fixed costs are not so large as to prohibit new and good markets from being discovered. (iii) In new goods, there are fewer trials, pioneers are typically relatively large exporters that are more successful than followers, and there is herding following product discovery. This suggests that finding new export products is more costly and that many new (and profitable) products may not be discovered because of high sunk costs.

Our theoretical framework builds on previous models with heterogeneous firms. The well-known Melitz model (2003) explains which firms export in equilibrium, but it uses comparative statics to explain entry and exit patterns of firms into the export sector.[2] In contrast, we want to explore why firms enter and exit almost immediately, how new export products are developed, and how the transition to the equilibrium happens.[3] Several other recent papers focus on related issues. Segura-Cayuela and Vilarrubia (2008) and Eaton et al. (2009) incorporate uncertainty that is alleviated as firms learn about a market. In Eaton et al. the uncertainty is firm specific while in Segura-Cayuela

[2] Melitz (2003) models trade in differentiated goods in a framework with heterogeneous firms and fixed costs. The model predicts that exporting firms will be larger and more productive, and that trade shocks will lead to the type of reallocations within industries that are observed in the data.

[3] Our findings are also related to recent work that has modified the original Melitz model to incorporate multiproduct firms. While those models do a nice job explaining why some firms produce more products and how a trade shock alters within firm resource allocation, they cannot explain the discovery of a completely new export product, one of the things we want to model. (See Nocke and Yeaple (2006) , Bernard Redding and Schott (2006a and 2006b) and Eckel and Neary (200).

and Vilarrubia uncertainty about a market is reduced as more firms enter.[4] In these models entry is sub optimally slow, in contrast, in our model, greater uncertainty leads to more entry and exit by firms. Like ours, the model of Albornoz et. Al. (2009) has uncertainty about the profitability of a particular market that is revealed when a producer enters a market. However, their focus is on the sequence of entry into new markets and not on entry and exit in existing markets and the development of products and markets that are new to the country.

Our theoretical framework is also related to the literature on hysteresis and trade flows, which shows that with sunk costs and uncertainty about market conditions, positive shocks that lead to entry may not produce exit when they are reversed.[5] In these models, only bad market conditions induce exit and hence entry and exit will not be positively correlated. Our departure from these models is that we assume there is uncertainty about the firm's potential in a market. Specifically, export costs are revealed only if the firm enters, and the firm can exit if the cost is high. This generates a strong positive correlation between entry and exit, a feature confirmed in the data.

Our empirical results extend previous work that highlights the importance of heterogeneous firms in explaining firm behavior and export patterns, even within narrowly defined industries. A number of studies find that exporting firms are bigger, more productive, pay higher wages and offer better working conditions than otherwise

[4] In other related work, Hausmann and Rodrik (2003) offer a model of self discovery, with uncertainty and high costs of starting a new product. In their model there is a threat of imitation that discourages firms from innovating that leads to suboptimal discovery.

[5] See Baldwin (1988), Baldwin and Krugman (1989), and Dixit (1989). Roberts and Tybout (1997) also use this framework and find evidence that sunk costs are important in explaining entry into exporting by Colombian firms.

similar import-competing firms.[6] Recent work highlights high rates of entry and exit and the role played by heterogeneity in the way exporters enter into foreign markets.[7] While many of our findings are consistent with this earlier work, our contribution is to go into detail to uncover precisely why entry and exit is so ubiquitous and how new products and new markets are developed within a dynamic industry.

In sum, our work builds on previous theoretical and empirical developments in the literature of exports at the firm-level, but instead of focusing on equilibrium effects, we focus on the dynamics of a growing sector. In particular, the patterns of entry and exit of firms in exporting and the discovery of new products and new markets.

The paper is organized as follows. The next section develops the model. Section III examines the predictions from the model using transactions level data from customs. Section IV offers background information on the non-traditional agriculture exports in Peru that supports the findings from the previous section. Finally, Section V concludes.

II. Model

There are several important features of the industry that we want to capture in the model. First, there are heterogeneous entrepreneurs in terms of ability. The ability of the entrepreneur is related to management skills and technical knowledge. Second, there is

[6] Bernard and Jensen (1995) report detailed statistics for the United States. A number of papers followed their approach and find similar results in both developing and developed economies. Shank, Schnabel and Wagner (2007) provide a summary of these papers in Appendix A, and offer similar evidence for Germany. Bernard, Jensen, Redding, and Schott (2008) also provide a summary.

[7] Eaton, Kortum and Kramarz (2004) examine French data and find that most firms sell to only one market, typically the most popular one; while some firms that export widely serve the less popular markets. Eaton et al. (2008) examine data from Colombia and find extremely high entry and exit rates into exporting—total entrants in a given year exceed the number of continuing firms and most entrants exit after one year. Alvarez and Lopez (2008) use data from Chile and also find high rates of entry and exit. Volpe Martincus and Carballo (2008) examine exports from Peru from 2001 to 2005 and find that large firms export more products to more markets. Iacovone and Javorcik (2008) examine data from Mexico from 1994-2003 and find that new exporters tend to start small and that there is a lot of churning of products within firms.

idiosyncratic uncertainty—a firm does not know how costly it will be to export a particular product to a given market until the firm exports. Third, there are fixed costs of entry into exporting, reflecting changes to the product, required paperwork, and the gathering of market information that must completed before exporting. The model is meant to be illustrative and highlight the way entrepreneurs behave; it does not take into account general equilibrium effects.[8] We first describe the basic model then we discuss how the model changes if small trials are possible. Finally, we discuss how the model can be adapted to describe entry into new products and new goods.

i. Basic Model

We start with an entrepreneur, of type α_i, where α is distributed uniformly between *0* and *1*, and a higher α represents a more productive entrepreneur. It is the amount of product the entrepreneur can produce and it is known by him from the beginning.

In this model, we have two different markets: foreign and domestic. If a product is sold in foreign market *k* (*k* denotes the product-market combination), the entrepreneur receives price P_k, which is known for an existing product-market. For example, an entrepreneur can observe the price of a specific product in a specific market and knows how much he can produce, thus he has a very good estimate of potential revenues from that product-market combination. On the other hand, if the product is sold domestically, the entrepreneur charges a price P_D.

[8] We abstract from the precise production function in terms of labor and capital because when we go to the data, we will only observe exports.

Foreign and domestic markets entail distinct costs. An entrepreneur serving the foreign market pays a sunk entry cost and a fixed per-period cost of exporting (i.e. a fixed overhead cost). An entrepreneur selling to the domestic market pays only a fixed per-period cost. Specifically:

- C_k is the overhead cost that a firm pays to export to foreign market *k*. This cost is associated with bureaucracy, logistics, meeting standards, etc. This cost is unknown to the entrepreneur before exporting, and it is not revealed until he exports. The entrepreneur has an expectation of what this cost will be before trying to export. Specifically, with probability *q* he gets a low cost draw, C_k^L, and with probability *(1-q)* he receives a high cost draw, C_k^H.

- *F* is a sunk cost of entry into a foreign market. This is the cost that the entrepreneur has to incur to adapt his factory or his land to produce a particular product for export.

- C_D is the overhead cost that the entrepreneur pays to serve the domestic market.

We assume that the overhead cost of exporting, C_k, is larger than the cost in the domestic market C_D. The intuition is that exporting requires the producer to get the product through local distribution to the ports as well as through foreign distribution. In addition, we assume the price in the foreign market, P_k, is larger than the price in the domestic sector, P_D. Given the higher costs of accessing the foreign market, P_k must be greater for the entrepreneur to have incentive to export to that product-market.

The sequence of decisions to be made by the entrepreneur is the following. First, the entrepreneur faces the decision of whether to enter the export sector or the domestic sector. If the entrepreneur goes to the domestic sector he earns $\alpha_i P_D$ and pays C_D. If the entrepreneur enters the export sector he earns $\alpha_i P_k$ and pays the realization of the overhead cost of exporting, $C_{k,}$ plus the sunk cost *F* in the first period. As noted above,

there are two possibilities for the cost of exporting: with probability *q*, the exporter will obtain a low cost, C_k^L, and with probability *(1-q)*, he will obtain a high cost, C_k^H.

To concentrate on the trade-off that is important in the data, we impose a number of regularity conditions on the parameters. First, we assume that P_k-C_H>P_D-C_D, so that exporting is always more interesting than domestic sales on a period-by-period basis for a firm with the highest quality. Second, we assume that the sunk cost, *F*, is small enough such that entrepreneurs are willing to attempt exporting even if they may exit ex-post. Specifically, the condition is that there exists an α_i, such that expected lifetime profits given fixed costs are positive, but given a high overhead cost the firm prefers to exit $(\frac{\alpha_i P_k - E(C_k)}{1-\delta} - F > \frac{\alpha_i P_D - C_D}{1-\delta} \;\&\; \alpha_i P_k - C_k^H < \alpha_i P_D - C_D)$, where $E(C_k)$ is the expected overhead cost of exporting. Later, in a sub-section (III.iii), we discuss the situation when fixed costs are large enough to preclude an enter-exit strategy.

Now, we can solve the model backward. We examine what happens in the second period to a firm that entered the export sector in the first period. The decision is whether to stay in or exit the foreign market given the realization of C_k. This will depend on the profits from staying versus shifting to the domestic sector. Subsequent to entry, the profits from staying in the export sector are

$$Profit_{stay} = \frac{1}{1-\delta}(\alpha_i P_k - C_{ik}),$$ and the profits from exit are

$$Profit_{exit} = \frac{1}{1-\delta}(\alpha_i P_D - C_D).$$

The threshold, α_{stay}, can be calculated from comparing what the exporter earns if he stays in the foreign market forever ($Profit_{stay}$) and what he earns if he exits the foreign market and goes to the domestic sector ($Profit_{exit}$). $Profit_{stay}$ must be larger than or equal to

Profit$_{exit}$ for the entrepreneur to continue exporting. This implies that the threshold for staying in the export market is

(1) $$\alpha_{stay}(C_{ik}) \geq \frac{C_{ik} - C^D}{P_k - P_D},$$

Where $C_{ik} \in C_k^L, C_k^H$. Given the regularity conditions mentioned above, we know that α_{stay} is positive. All entrepreneurs with an α_i equal to or above this threshold, given the realization of their overhead cost, will continue exporting.

Now, having solved for the cutoff α_{stay} in the second period, we go back to the first period and solve for the threshold level of α for the entrepreneur to enter the export sector. In order for an entrepreneur to enter the export sector, it must be the case that the value of entry exceeds the value of going to the domestic sector. There are two possibilities for entry. In the first case, an entrepreneur enters and stays in the foreign market irrespective of the cost draw. This is the case for highly productive entrepreneurs, those with α always above α_{stay} in Equation1. This yields the value function

(2) $$V_{Xistay}(\alpha, P_k, C_k^L, C_k^H, F, P_D, C_D) = q\left[\frac{1}{1-\delta}(\alpha_i P_k - C_k^L)\right] + (1-q)\left[\frac{1}{1-\delta}(\alpha_i P_k - C_k^H)\right] - F \cdot$$

In the second case, an entrepreneur enters the export sector and stays only if he receives a low cost draw —he exits the foreign market if cost is high. This is the case for firms with α above $\alpha_{stay}(C^L)$ but below $\alpha_{stay}(C^H)$. The value function in this case is

(3) $$V_{Xiexit}(\alpha, P_k, C_k^L, C_k^H, F, P_D, C_D) = q\left[\frac{1}{1-\delta}(\alpha_i P_k - C_k^L)\right] + (1-q)\left[(\alpha_i P_k - C_k^H) + \frac{\delta}{1-\delta}(\alpha_i P_D - C_D)\right] - F$$

Note that an entrepreneur will never enter and then exit if the cost draw is low. If the value of entry (where cost is unknown) is greater than being in the domestic sector then it must be the case that the value of staying with a low cost draw is better than being in the

domestic sector since $C_L < E(C_k)$. This means the relevant stay condition, from equation (1), is evaluated at a high overhead cost.

For firms to choose to enter the export sector, the expected value of attempting export (Equation 2 or 3, depending on α) must be larger than the value of producing for the domestic sector. The value of selling domestically, V_{Di}, is

$$(4) \qquad V_{Di} = \frac{1}{1-\delta}(\alpha_i P_D - C_D).$$

Thus, the cutoff for entry lies at the intersection of Equations (3), where firms enter and stay if the cost draw is low, but exit if the cost draw is high and (4), the value of domestic production.[9] The cutoff in Equation 5 defines the lowest α firm that will enter.

$$(5) \qquad \alpha_{entry} > \frac{q(C_k^L - C_k^H) + q\frac{\delta}{1-\delta}(C_k^L - C_D) + (C_k^H - C_D) + F}{(P_k - P_D) + q\left[\frac{\delta}{1-\delta}(P_k - P_D)\right]}.$$

Again, given the regularity conditions mentioned above, this cutoff is positive.

It is straightforward to show that, given the regularity conditions, $\alpha_{stay}(C^H)$ is above α_{entry} and thus some firms exit in equilibrium (see Annex 4 for proof). The difference between the two cutoffs is

$$(7) \qquad \alpha_{stay}(C^H) - \alpha_{entry} > \frac{q\frac{1}{1-\delta}(C_k^H - C_k^L) - F}{(P_k - P_D) + q\left[\frac{\delta}{1-\delta}(P_k - P_D)\right]}.$$

The gap described in Equation (7) reflects the range of α for which the enter-exit strategy is valid. It is increasing in the difference between C_k^H and C_k^L; and it is decreasing in the difference between P_k and P_D and the fixed cost. The intuition is that there is an option

[9] The intersection of (2) and (4) yields the cutoff for entry applicable to the entrepreneurs that always stay. We develop this case later when we explore the effects of having large fixed costs in the model.

value of exiting if the cost is high. This option value is higher when C_k^H is very high. This implies that more uncertainty leads to more exit in equilibrium, all else equal. A higher fixed cost makes entry more costly, so as the fixed cost rises the range of α for which there is entry and exit declines. Interestingly, a small difference between P_k and P_D leads to a larger range of α between entry and staying. The reason is when this difference is small; more of the gain from the foreign sector is coming from low costs, which is where the uncertainty lies. For given q, F, C_k, and P_k, the proportion of exits also depends on distribution of α between two cutoffs.

We can represent the decision of the entrepreneur in Figure 1. The three lines represent the value of serving the domestic sector (Equation 4), the value of entering the export sector and exiting if the realization of cost is high (Equation 3), and the value of staying in the export sector irrespective of the cost (Equation 2). Agents with α above α^* can profitably produce for the domestic market, while those with an α below α^* are not entrepreneurs. Entrepreneurs with α above α_{entry} will enter the export market. If α is between α_{entry} and α_{stay} the entrepreneur exits in the second period if the cost of exporting is high and remains if the cost is low. Entrepreneurs with α above α_{stay} always find the exporting sector more profitable than the domestic sector, irrespective of the realization of C_k. The bold curve represents the entrepreneur's expected value of producing based on his type.

In sum, there are three groups of entrepreneurs. (i) Those who do not enter into exporting but serve the domestic sector. (ii) Those who enter into exporting and stay if they get a low C_k but exit the foreign market if they get a high C_k. Finally, (iii) those who

enter into exporting and continue exporting forever regardless of the type of overhead cost they obtain.

ii. Starting small:

Next, we consider what happens if firms can enter the export market with only a fraction, θ_k *(0<θ_k<1),* of their effort in the foreign sector (and the rest in the domestic sector) and expend only a fraction of the fixed cost. The intuition is that instead of adapting a whole field to the export market, an entrepreneur can plant a small plot of export crop. This allows entrepreneurs to test the foreign market, and thus there will be a larger range of firms using the enter-exit strategy.[10]

Again, we solve the model backwards. In the second period, there is a cutoff α for the entrepreneurs that always stay in the foreign market. The difference from the basic model is that if the firm chooses to remain in the export sector, it must pay the remainder of its sunk cost in this period. This cutoff level can be found from the comparison of the profit equations in the second period:

$$Profit_{stay} = \frac{1}{1-\delta}(\alpha_i P_k - C_k^H) - (1-\theta_k)F, \quad \text{and}$$

$$Profit_{exit} = \frac{1}{1-\delta}(\alpha_i P_D - C_D).$$

From solving this, we obtain:

$$(7)\ \alpha_{staysmall} \geq \frac{C_k^H - C^D + (1-\theta_k)(1-\delta)F}{P_k - P_D}$$

[10] Rauch and Watson (2003) show that a developed country buyer may prefer to start with a small trial if he is uncertain of the developing country firm's ability to fill a large order and search for a new supplier is costly. Their model also predicts that small starts are less likely to last as long.

The cutoff level to stay in the market in the second period is similar to the previous one in Equation (1), however, in this case, the cutoff depends on the size of the trial in the first period, θ_k. Smaller trials make staying less likely in the second period because the fraction of *F* that still must be expended rises. In the first period, the associated value of entry is as follows:

(8)

$$V_{Xi}(.) = q\left[\theta_k(\alpha_i P_k - C_k^L - F) + \frac{\delta}{1-\delta}(\alpha_i P_k - C_k^L) - (1-\theta_k)\delta F\right] + (1-q)\left[\theta_k(\alpha_i P_k - C_k^H - F) + \frac{\delta}{1-\delta}(\alpha_i P^D - C^D)\right] + (1-\theta_k)(\alpha_i P^D - C^D)$$

The first term is the value of getting a good cost draw after starting with a small trial θ_k. In period 2, all resources are moved to the foreign sector and the remainder of the fixed cost, *F*, is paid. The second term is the value of getting a bad cost draw. In this case, the entrepreneur shifts all resources to the domestic sector in the second period, and does not pay the remainder of the sunk cost, *F*. The final term is the return from putting the remainder of effort in the domestic sector in the first period, while making a trial in the export sector. The cutoff α for an export attempt will be at the intersection of Equation (8) and Equation (4), the value of producing only for the domestic sector.

Comparing Equations (8) and (4) yields a cutoff level of productivity for entry into exporting of

(8) $$\alpha_{entrysmall} \geq \frac{\theta_k(F - C^D) + q\left[\theta_k(C_k^L) + (1-\theta_k)\delta F\right] + (1-q)\left[\theta_k(C_k^H)\right] + q\frac{\delta}{1-\delta}(C_k^L - C_k^D)}{\theta_k(P_k - P^D) + \left[\frac{q\delta}{1-\delta}(P_k - P^D)\right]}.$$

If θ can be very small, provided an entrepreneur has positive profits at a low cost, he will attempt entry. To see this, note that as θ approaches zero the cutoff is

(9) $$\alpha_{entrysmall} \geq \frac{F + \frac{1}{1-\delta}(C_k^L - C^D)}{\left[\frac{1}{1-\delta}(P_k - P^D)\right]},$$

which is exactly the cutoff for entering if a low cost draw is guaranteed (*q=1* in Equation 5). Relatively low α entrepreneurs will choose to start small since this reduces the fixed cost that is wasted if the cost draw is high. This expands the region between α_{entry} and α_{stay}. The intuition is that the entrepreneur can discover his cost by making a very costless and cheap trial. For firms that are very good, above α_{stay}, there is no incentive for making a small trial because they are always better off in the export sector than in the domestic sector. Thus, for higher α firms, initial exports will be larger.

iii. New Products: Fixed Discovery Cost and Greater Uncertainty

In this section, we discuss the case of a sunk cost of discovery, as it offers insight into entry into new and complex products and new and distant markets. The rational for a discovery cost is that finding a new product requires finding the most productive seed, determining the best climate for the product, evaluating irrigation needs, and finding someone qualified to manage production. For accessing a new market it requires meeting phytosanitary restrictions, determining necessary logistics (e.g. air temperature while in transit for fresh product), transit times, transit type, and finding a buyer.

One way of thinking of discovery costs is as a large fixed cost of entry in the model above. In Figure 1, as fixed costs rise, the lines representing the value of entry and exit and the value of entry and stay shift down. This squeezes the range of firms that choose to enter and then to exit if the cost realization is high. Eventually, as the fixed cost rises, the enter-exit strategy will be eliminated. This case is shown in Figure 2. The

locus of entrepreneur profits is shown by the bold lines: between α and α* firms serve the domestic market and above $\alpha_{enter\&stay}$ firms enter the export sector and stay permanently. Thus, all firms that can afford the fixed cost will continue exporting after their cost is revealed. (And, an extremely high fixed cost can preclude all entry.)

Mathematically, comparing the value of entering the export sector and staying, irrespective of the cost draw, Equation (2), with the value of producing for the domestic sector, Equation (4), we can determine the cutoff α for entry in this case.

(10) $$\alpha_{entry\&stay} \geq \frac{\frac{1}{1-\delta}(qC_k^L + (1-q)C_k^H - C^D) + F}{\frac{1}{1-\delta}(P_k - P^D)}.$$

It is precisely those firms for which the present value of profits (relative to the domestic sector) is positive.

Finally, since the sunk discovery cost will not be there for later entrants, pioneers face the decision of whether it is better to enter first or wait for others to enter. To consider the effect, let *D* be the part of the fixed cost that is only required if the entrant is among the first in the product or product-market combination. This adds the condition that the entrant will only enter now if it is better than waiting for another firm to pay the discovery cost. The value of being a pioneer (assuming the entrant stays irrespective of the cost draw[11]) is:

(11)

$$V_{pioneer\&stay}(\alpha, P_k, C_k^L, C_k^H, F, P_D, C_D) = \frac{1}{1-\delta}(\alpha_i P_k - qC_k^L - (1-q)C_k^H) - F - D$$

The value of waiting, assuming the product or market will be discovered in the next period, is:

[11] The condition incorporating the possibility of exit is similar and shown in Annex 4b.

(12) $V_{wait\&stay}(\alpha, P_k, C_k^L, C_k^H, F, P_D, C_D) = \frac{\delta}{1-\delta}(\alpha_i P_k - qC_k^L - (1-q)C_k^H) - \delta F$

In order for a firm to want to enter now, it must be the case that $V_{pioneer} > V_{wait}$, which yields the additional condition:

$$\alpha_{ientry\&stay} > \frac{D + (1-\delta)F + qC_k^L + (1-q)\left[(1-\delta)C_k^H\right]}{qP_k + (1-q)\left[(1-\delta)(P_k)\right]}.$$

This implies that α is higher for a new product also because there is a value to waiting. When D is high, this condition will be binding and only very high quality entrepreneurs will start new products. After products are discovered and the cost of discovery is no longer relevant there will be increased entry.

In sum, developing new products requires a much larger F, because the production process is very different for these products. Similarly, for entering distant markets where new standards must be met. This implies that firms that start new products or new markets are likely to be the better firms, and these firms are likely to have a lower exit rate than later entrants, all else equal. After successful products (or markets are discovered) there will be herding into those markets as discovery costs fade.

Several testable predictions come out of the theory:

1. **Size and quality.** There is self selection into exporting with high and medium productivity entrepreneurs exporting (they are on average more productive than the average in the industry). The highest productivity exporters will enter and survive in more products and markets on average, and export more to each product-market.

2. **Entry and exit patterns.** This model naturally generates entry and exit by the same firm. Exit is especially likely after the first attempt. This yields a positive correlation between entry and exit. Weaker entrepreneurs (small entrants) are more likely to exit. Weaker firms will enter into exporting with small trials in order to avoid high fixed costs if they receive a bad cost draw. As a result of entry and exit, in the first year of a given cohort, there will be more different quality types of firms in the export sector. This implies that the variation with respect to the mean of exporters' size should decrease with age of the firm. Many of the lower quality exporters will exit, while some that receive a good cost draw will expand.
3. **New products and new markets.** Firms that pioneer new products or new markets tend to be high productivity (large) firms, among the exporters, and have a lower exit rate than later entrants. After a product or market is discovered and discovery costs disappear, there is more entry (herding).

III. Empirical Evidence from Transactions Data

In this section, we use the model as a guide to analyze evidence obtained from the Peruvian experience in the non-traditional agricultural sector. This is a particularly dynamic sector (Figure 3). The product that mainly explains this surge is asparagus, but there is also considerable growth in the exports of other non-traditional crops (in particular, canned artichokes, avocados, paprika, grapes and mangos) in recent years (Figure 4). The main markets for these products are the United States and Europe, but there has recently also been a lot of entry into new markets. We start by describing the

data utilized and then we proceed to explore the predictions from the theoretical framework.

i. Description of the Data

We use transaction data on Peruvian export flows included within Chapter 7 (Edible vegetables and certain roots and tubers), Chapter 8 (Edible fruit and nuts; peel of citrus fruit or melons), Chapter 9 (but only the lines related to the exports of paprika) and Chapter 20 (Preparations of vegetables, fruit, nuts or other parts of plants) of the HS Code. Although we have daily information on all shipments between years 1994 and 2007, for much of the analysis, we report annual results. The dataset allows the identification of the exporter (information on firms' names and corresponding Tax ID number), the destination market for each trade flow, the custom port from which the merchandise is shipped, the description of the item exported (at 10-digit) and the FOB value of each shipment.

The values exported by year/date of the different products under analysis in this study (i.e. asparagus, canned artichokes, avocados, mangoes, paprika, grapes, etc.) include all the relevant lines and items of the HS code. In the definition of each product, we included all those lines related to the exports of each product in its different forms/presentations. After collapsing the information by firm, year, market and product we obtain 16,053 observations. The summary statistics of the data (by firms, products and markets) can be found in Annex 1. The details of all the lines or items included in the definition of each product can be found in Annex 2.[12]

[12] As part of the data cleaning process, we eliminated trade flows registered under the name of individuals that showed erratic patters (i.e., exports of tiny amounts for one or few years not consecutively registered to

To analyze the model's predictions, we split the presentation of the evidence up into three parts. The first part focuses on exporting firm characteristics: correlations between the number of markets and products and size of firms. The second part focuses on entry and exit of firms into exporting. The third part focuses on entry into new products and markets.

ii. Characteristics of the Exporters

This section explores the main characteristics of the exporters in our sample relating size across products and markets. The model suggests that higher quality entrepreneurs export more to a given product-market, export to more markets, and export more products. Since we cannot directly estimate firm quality, we examine whether larger exporters export more to a given product-market, export to more markets, and/or export more products.

Figure (5a) plots average exports in the product-markets to which a firm exports against average size for the beginning and end of the sample period (1994 and 2007). It shows that the largest firms export more on average to each product-market. In addition, we observe that larger firms not only tend to export more of a product to a given market, but they also export to more product-markets—if they only export to one product-market and grow the picture would be the 45^{o} line. Figure (5b) confirms that larger firms export more products. While this fact holds throughout the period, it appears to strengthen over

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an individual). These individuals are 579 of a total of 2,676 exporters (see also Annex 1), and on average, they represented 1.5% of the yearly total amount exported during 1993 and 2007. Market participants informed us that these are individuals, so-called "gatherers", buy from small farms and sell on an agricultural exchange. If we include them in our sample, none of the results change dramatically, except that the one-year exits are more extreme. We also excluded those exports that after collapsing by firm, product and market were less than US$ 1,000 a year.

time. For instance in 2007, we observe relatively more firms exporting a large number of products (above 5) and most of these firms are in the upper half of the distribution of firms by size. Similarly, larger firms export to more markets, especially in the last years, where we observe that most of the firms exporting to more than 10 markets are located in the upper fourth of the distribution by size (Figure 5c).[13]

iii. Entry and Exit into Exporting

This section examines the pattern of entry and exit into exporting across the firms in our sample. The model suggests that we should observe a large number of entries and exits, and entries and exits will be positively correlated. In addition, exit is more likely in the first year and among firms that start small (relative to other entrants).

Figure 6 shows firm entry and exit by year. Entry and exit is common. The number of entries and exits has increased throughout the period; however, the entries have remained higher than the exits for most of the period analyzed. Another striking result is the correlation between entries and exits (0.87). As we will see below, this can be explained by the large number of exits after the first year, thus when entry increases, we expect to see exit increase the next year.

Entries are very important in terms of the development of the industry. Figure 7 shows the market share in 2007 by cohort.[14] Firms that enter during the period make up nearly three quarters of exports by 2007. Many of the entries that occur later correspond

[13] In all comparisons, we have evaluated the pattern for each of the years included in the sample and we observe the same: larger firms export more products and to more markets and this trend accentuates with time. However, we only report the results for years 1994 and 2007 for simplicity in the presentation of the results.

[14] More complete set of statistics by cohort (in terms of the number of firms, the total and average value they represent) can be found in Annex 3.

to large and growing firms. In particular, the strongest entries happened in 1998, 1999, and 2001 with firms that combined concentrated one-third of the market in 2007. These strong entries corresponded to Sociedad Agricola Drokasa in 1998, Camposol in 1999 – two of the largest exporters- and a Consortium of fruit producers in 2001.[15]

Figure 8 presents the average number of exits according to the age of the exporting spell. We observe a drastic decrease in the average number of exits after the first year of exporting. In particular, we observe that in 667 exporting attempts, exporters cease to export after their first year of operation. Then, for spells that lasted at least two years, on average, only 271 came to an end after their second year of operations.

If we translate the exits into the share of attempts that came to an end by age of the spell (fail rate by age group, Figure 8b), we observe that the decrease in the fail rate remains, although it is less abrupt. For instance, a one-year old spell has a 34% probability of failure (exiting the market), a two-year old spell has a 27% chance of failure. This declining trend continues as the attempts last longer.

Who are these exits? A large part of them are occasional exporters that try with only one shipment. Figure 9 shows the distribution of the annual number of shipments exported by firms that lasted only one year. Fifty-six percent of these single-year firms exported only one shipment.[16]

[15] According to the export transaction data from SUNAT, Camposol exported for the first time using that name in 2002. However, based on information obtained from the company's website and during an interview with a representative of the company, we observed that Camposol started to export in 1999 under the name of Sol Produce (and a different id number), previous name of the company and one of the brand names that the company uses today for its exports of packed asparagus. We took note of that fact and we combined the export transaction data from both companies and treated them as one under the name of Camposol.

[16] We made a similar calculation for the group of individuals with single-year entries and obtained an even larger percent: 60% of the individuals that lasted one year exported only one shipment.

In addition, the model suggests that lower quality entrepreneurs are more likely to exit. To examine this hypothesis, we develop a binary variable for the entrants that is one if the firm exited after one year. We expect exits to occur more frequently among low quality entrepreneurs. Low quality entrepreneurs are also likely to start with smaller exports. In Table 1, we report results from a Probit regression of exit after one year on the log value of exports during the initial entry, controlling for crop, market and year (Column 1) –results from a similar regression using OLS are reported in Column 2. We find a robust negative relationship, indicating that a ten percent larger entry is associated with about a 4 percent lower likelihood of exit (1 percent lower using OLS estimation). However, we know that many of these exits occur after the initial shipment. Therefore, firms may all start with similar size shipments, with some firms exiting after one shipment while others continue. This would generate a negative relationship between size and exit in the annual data, but only because firms that exit have fewer shipments. To control for this possibility, we also regress exit on the log value of the initial shipment exported by each firm (Column 3) –results from a similar regression using OLS are reported in Column 4.[17] We find that a ten percent larger initial shipment is associated with a 0.7 percent lower chance of exiting the market after the first year (0.3 percent using OLS estimation). The smaller coefficient suggests that part of what is driving the coefficient at the annual level is variation in the number of shipments.

Frequent entry and exit implies that the sunk costs to entry into exporting are low. In addition to the large number of entries and exits observed in the data, additional evidence of the presence of low sunk costs (for the entry into exporting) is the observed pattern of re-entry of some firms in our sample. Not all firms enter and exit exporting

[17] We also tried Logit and results are similar, not reported.

only once. There are 194 firms (almost 10% of the total number of firms, excluding individuals, in our sample) that reenter after a few years (see also Annex 1). This is not consistent with very high sunk costs on entry.

Finally, we examine the distribution of the size of firms as they age. In Figure 10 we present the residuals from a regression of size on age, controlling for main product exported and year. In the Figure 10a we observe that the variation in the residuals among firms declines significantly as they age. Also, we analyze the distribution of these residuals in two different ages (Figure 10b) and we confirm that in fact there is less dispersion among firms as they age from their first year to their ninth. This is consistent with weak firms with high cost draws exiting and weak firms with low cost draws expanding.

In sum, we observe considerable entry and exit of exporters each year; they are positively correlated; exit is especially likely after the first year and among firms that start small; there is less variation in terms of size as firms grow older; entry is important, accounting for two-thirds of total exports in 2007. All of these findings are consistent with the model, where entry and exit are a form of trial and error, and initial sunk costs are not very high.

iv. Innovation: The Discovery of New Products

This section examines which exporters (by size and experience) are the first to enter new products and new product-markets (defined at the country level). Once they enter new products and markets, we also examine the development of the industry. The model suggests that, when sunk discovery costs are high, larger exporters will be more likely to

start new products (or markets), that they will be more successful in surviving in the export of these new products (or new markets) and that there will be herding after successful products (or markets) are discovered.

A product is defined as "new" in our sample if the product was not exported from Peru in 1994 (the first year of our sample) and was later exported for at least four years consecutively at any time within our sample.[18] A product is defined as "old" if it was exported for at least for two years consecutively starting in 1994. All cases not covered by these definitions are either intermittent products or products that were exported only once in our sample. In these cases, we dub these products "trials", unless exports are either left or right censored. New markets are defined at the product level, in a similar fashion. Specifically, a product-market is "new" if it was not served in 1994 and then was later covered for at least four consecutive years. A product-market combination is defined as "old" if it was covered consecutively for at least two years starting in 1994. And cases not covered by the types described above are either intermittent product-market combinations or product-markets that have been covered only once according to our sample. In these cases, we define product-markets as "trials", with the exception of product-markets whose coverage is left or right censored. Using these definitions, exports of new products made up 12 percent of the value of exports in 2007, and exports of old products to new markets made up 16 percent of exports. Thus, without these discoveries, growth would have been significantly slower.

Table 2 shows the distribution of the various types of products and product-markets over the sample period. New products make up 19 percent of the total number of

[18] We excluded from this group the products that never exceeded US$10,000 in any of the years included in the sample. The only products excluded for this reason are "carrots, turnips & other edible roots, frozen or chilled" (all grouped under HS codes 0706).

products that are exported and new markets are 22 percent of total product-markets. An important difference between products and markets is the amount of trials. Market trials are commonplace, with 496 new market attempts in specific products, or over 55 percent of the total number of product-market combinations served at some point in the sample period being trials, i.e. unsuccessful. In contrast, in products there are 10 trials, which amount to only 16 percent of products. This is an indication that entry costs into new markets for existing products are lower than entry costs for entirely new products. Old products are by far the most common type of export, comprising 60 percent of the total number of products.

Table 3 presents the statistics on the characteristics of entrants[19] in all the products that can be considered "new" in the sample from 1994 to 2007. If entry costs are high, we expect pioneers to be the better (larger) and more experienced firms. Column (1) shows the total number of firms that started to export each new product. Differences are observed between fresh produce and canned produce. The new products with more entrants are mostly products in the segment of fresh produce (avocado, passion fruit, piquillo pepper, etc.), suggesting that discovery may be easier in these products. Column (2) presents the exporters with previous experience as a share of the total number of entrants. Most of the firms that entered the markets for the products in the processed food industry (canned products and juices) had previous experience as exporters. In contrast, the fresh vegetables have lower shares of exporters with previous experience. Column (3) shows the value of average exports in the main product in the previous period relative to the exports of the average exporter in that product. Exporters that start new products tend to be larger than average by about 24 percent. Column (4) shows the average ratio of the

[19] Entrants are defined as all firms exporting in the first three years of the lifecycle of a specific product.

count of products exported by the entrants over the average number of products exported by all the firms whose main product exported was the same as the entrant's main product during the year of entry into the new product. The ratios above one show that, on average, the entrants export more products than their main competitors. These results imply that exporters of new products tend to be bigger, export more products, and be experienced exporters. These results are somewhat stronger for canned products, where discovery is likely to be more costly.

In terms of the characteristics of the entrants into new markets, there is a much larger sample (1,767 observations), enabling us to use regression analysis to capture characteristics of pioneers as compared with late entrants into a market.[20] The dependent variable is one if a firm is a pioneer into a product-market and zero if the firm is a late entrant into that product-market. Thus, we are comparing firms that enter a product-market first to firms that enter the same product-market later. The variables of interest are size in the year before entry, experience in the product, and experience in the market (an indicator that is one if the firm served that product or market previously). Table 4 presents the results. Using Probit, we find that entrants into new product-market combinations are relatively large exporters (the coefficient of the size of the exporter in t-1 is positive and significant). Experience exporting the same product is positively and significantly correlated with pioneering new product-markets. Past experience in the same market is never significant. These results hold in the estimation made with OLS. These results suggest that firms that pioneer new markets have experience exporting the

[20] Again entrants are defined in terms of the firms that started to export during the first three years in the lifecycle of a particular new product-market combination.

product to other markets and there is some evidence that they tend to be larger than other firms.[21]

Another feature suggested by the theory is that the firms that are the first to export "new" products/to "new" markets survive longer than the followers. Given the fact that they incurred in the relatively high fixed entry costs, they should be higher quality. Table (5) shows the average one-year survival rates in new products and new product-markets for the group of pioneers and followers.[22] On average, pioneers survive longer than the followers, and the difference between the survival rate of pioneers and followers is larger in the case of new products than in new markets. This offers additional evidence that the discovery costs of new products are higher than the discovery costs of finding new markets for a product. Therefore, to enter into new products, exporters need to be of very high productivity, while to enter into new product-markets, the cutoff productivity level is somewhat lower.

There are 109 comparable new product-market combinations (with groups of pioneers and followers), so we can examine statistically whether high entry costs lead to better firms being the initial entrants. In particular, we regress the difference in survival rates of pioneers and followers on the log of the median initial size of pioneers (Figure 11). The dependent variable captures differences in quality between pioneers and late entrants, where higher quality survive longer on average. The independent variable is a proxy for entry cost. In markets where initial size must be large, entry costs are likely to be much greater. We find a positive and significant partial correlation (5.36, t-sat=1.78).

[21] This result is consistent with the model of Albornoz et al. (2009) that shows that if there is correlation in costs across markets, firms that enter one market are more likely to enter other markets (as well as new markets).

[22] In the case of new product-markets we only show the results for the average of all new product-markets for the purpose of simplicity in the presentation (the new product-markets are 109).

This offers some additional support for the hypothesis that high discovery costs lead to relatively high quality firms entering first.

Finally, if discovery costs are large, we should observe herding after successful entry, when other firms can imitate this success without paying large sunk discovery costs. We now examine the pattern of imitation. Figure (12a) shows the mean and median of entry in new products over the lifecycle of the new products. We observe increasing entry a few years after discovery. Figure 12b shows a similar picture for new product-markets. Herding is less obvious: while the mean of entries increases over time, the median remains almost flat from the fourth year onwards. Again, this suggests that the entry costs to new product-markets are not as high as the costs of discovering of new products, therefore, the role of the pioneers in new markets is not as strong as it is in the case of new products.

The imitation that takes place in the case of new products could be the result of a product becoming more attractive—i.e. an increasing foreign price. Figure 13 shows the mean and median of unit values in the products. Peru appears to be a price taker. Thus, the increased entry appears to be the result of following the pioneers into the product rather than expanding foreign demand.

In sum, we find some evidence that sunk costs of discovering new markets discourage entry, and strong evidence that sunk costs of discovering new products discourage entry. Both entrants in new products and new markets tend to be relatively large and more experienced. However, while trials are very common in new product-markets, they are very rare in new products. The rate of success of entrants relative to followers is greater for products as compared with new product-markets. Finally, we only

observe herding after entry only in new products. These results, taken with the results from the previous section, imply that if there is a role for policy to stimulate entry it is in new products where entry is rare, and much less for entry into exporting or into new markets. In the next section, we discuss anecdotal evidence on the discovery of new products that confirms that entry was in fact costly into many new products.

IV. History of the Surge in the Non-Traditional Agricultural Sector in Peru

The empirical work above suggests that entering exporting is relatively costless, entering new markets with existing products is somewhat more costly, and that starting new products is extremely costly. It also indicates that once products are discovered imitation is relatively straightforward. Below, we describe briefly the story behind the development of the asparagus industry—the main Peruvian nontraditional crop—and then explain the discovery of other new crops. This anecdotal evidence offers further support for the presence of high discovery costs of new products.

i. The development of the asparagus industry

Asparagus is the most important nontraditional crop. It is interesting because it is not consumed locally, and the story behind its development highlights not just the importance of the investment climate, but also significant market intervention.

The production of asparagus started in the 1950's in the valleys of the North coast of Peru, with exports of canned white asparagus. The expansion into fresh asparagus was due to an experiment in the south of Lima, involving both the private sector's initiative and international cooperation provided by the U.S. Agency for International

Development (USAID). The Ica Farmers' Association decided to explore options to replace traditional crops with export crops. With funding from USAID, many products were studied for this purpose (melons, paprika, green beans and asparagus); the one with the most profit potential was asparagus (Shimizu 2006). As a result, a new variety of seed designed for Peru (UC-157, created by an expert from the University of California, Davis) was introduced successfully. USAID also provided funding for experts who advised on crop management, packing, and exporting. Fresh asparagus started to be exported at the end of the 1980s, and in 2002 exports of fresh asparagus surpassed exports of canned asparagus. This highlights the potential role for market-led intervention in finding new products. Next we turn to other more recent discoveries.

ii. The development of other new crops

Recent new export crops include: artichoke (in canned version), paprika, mangos, avocados, grapes, and piquillo pepper.[23] Some of these products were not new in the sense that they had been produced traditionally for domestic consumption (mangos, grapes and avocados) but others were completely new for Peruvian farmers (artichoke, paprika, piquillo pepper).

The new products each have their own story. The case of artichokes is especially interesting and provides evidence on the importance of sunk costs of discovery, and how networks and coordination help firms to overcome them. Artichoke exports where first attempted by the large asparagus firms. Several trial plots for artichokes were developed

[23] Paprika does not appear as a new product in the previous section because it was discovered before the beginning of the sample we are studying (1994). However, its evolution from Figure 4 shows paprika is a very dynamic product. It has been growing fast and steadily, which is a common characteristic of the new products studied in our sample.

independently –according to different sector participants. However, the trials were costly and the farmers ultimately gave up. A seed distributor (Mr. Fumagalli) heard of these trials, studied the market for artichokes' seeds and invited the exporters to present this information. As a result of this meeting, many of the attendees decided to conduct a large coordinated effort. The advantage was that they could try many seed varieties, climates, and irrigation techniques and share information on what was most efficient. This culminated in the takeoff of the exports of canned artichokes; the trials revealed that the climate was inappropriate for fresh artichoke (Klinger 2007).

The case of paprika is a case of pure private entrepreneurship. It was the initiative of a seed distributor (Mr. Chepote) who learned of paprika through a friend in Chile and decided to try it in Peru. He formed a company that produced and exported paprika. They were successful on a small scale and with the help of Spanish investment expanded significantly. After the expansion was complete, a virus destroyed the whole crop and Mr. Chepote had to close down. However, due to the original success of paprika, Mr. Chepote marketed his knowledge to other producers and the exports of paprika took off (Klinger 2007).

The way in which Peruvian exporters decide to try new varieties is typically based on extensive research and development and in some cases market intervention or coordination. This evidence on what are now some of the biggest crops in Peru in combination with the empirical results above suggest that discovering new products involves large sunk costs. This implies that there is a role for facilitating coordination among producers and subsidizing research.

V. Conclusion

We examine the development of non-traditional agriculture exports in Peru. Our theoretical framework assumes that there is idiosyncratic uncertainty about exporting and that there are sunk costs of entry—this leads to a process of trial and error (observed in the industry), with a high share of exits after one year. Many firms start with small trials and increase their exports over time, in this way avoiding losses from potentially uncompetitive products. High-quality entrepreneurs develop large firms that export more to a given product-market pair on average, enter more markets and more products, and enter new markets and products earlier. These predictions are confirmed in the data.

Our framework departs from previous studies because we examine export discoveries of products new to the country, some of which are not consumed locally. By definition these are products in which local producers have no initial expertise. There is no home market effect, and more productive domestic firms do not become exporters. Rather these are export products that entrepreneurs invest both time and money to develop. Because of hefty development costs and uncertainty about success, coordination and government assistance is likely to be important.

The results highlight significant differences between entry into exporting, entry into new markets, and entry into new product lines. The large amount of entry and exit that we uncover, with respect to exporting, suggests that entry costs are not so large as to deter entry. As the model shows, this is true provided firms can enter small and sunk costs are not too large relative to lifetime gains. This appears to be the case for firm entry into existing products and existing markets. Firms entering new markets with old products face somewhat higher costs of entry, but still, the large amount of trial and error

and the similarity of pioneers and followers suggest that they are not excessive. However, completely new products are different. They are costly to introduce, which deters entry, especially since followers do not have to pay discovery costs. Firms that discover new products are larger and more likely to succeed than followers. There are few new product trials and there is herding after products are discovered.

This suggests that the rate of new product discovery is likely to be suboptimal, implying that there is a role for government policy targeting discovery of new products. In Peru, in the early stages of the development of nontraditional exports, one form of government assistance was subsidizing producer-exporter associations (Diaz 2007). For example, IPEH, which promotes exports and competitiveness in asparagus and other nontraditional vegetables, was formed with government assistance (O'Brien and Diaz 2004). An important indication of its success is that it is now funded entirely by the private sector. Similarly, Volpe Martincus and Carballo (2008) find evidence that the main export promotion agency, PROMPEX, has helped stimulate exports more generally. More research into how to assist export discovery in developing countries, without introducing costly distortions, is warranted.

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Figure 1: The Value of Exporting and the Type of Entrepreneur

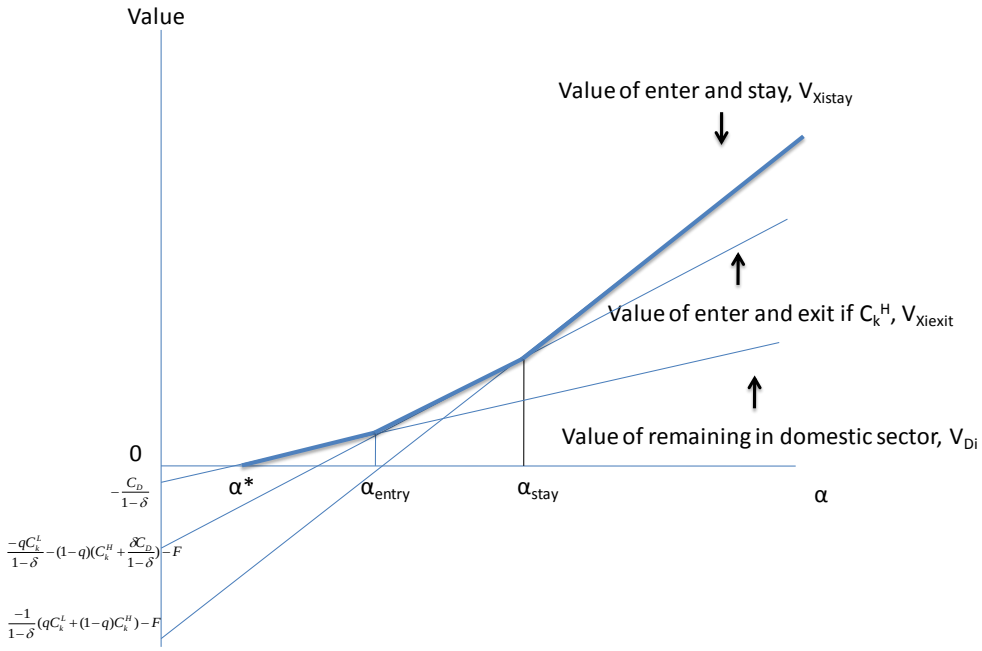


Figure 2: Entry and Exit with High Fixed Costs

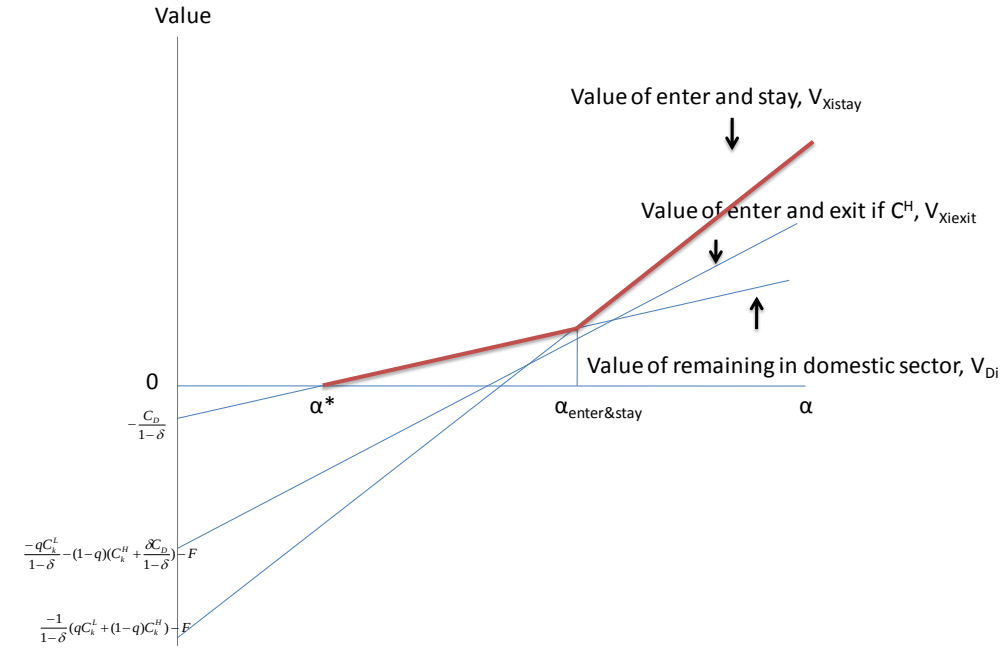
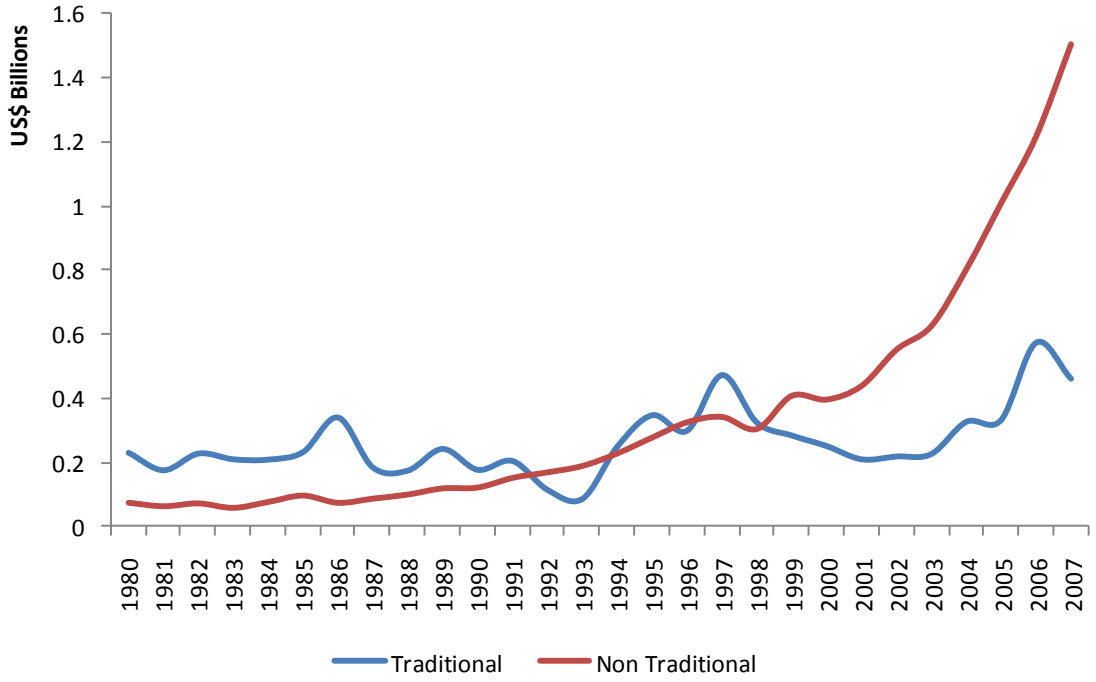
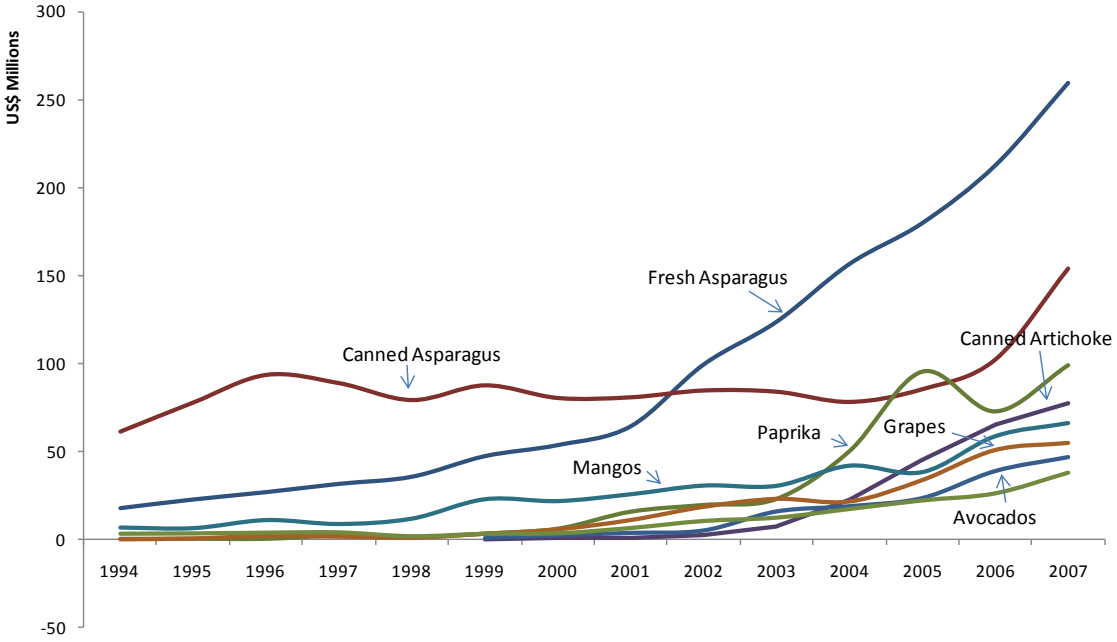


Figure 3: Surge in the non-traditional agricultural exports in Peru



Source: WITS

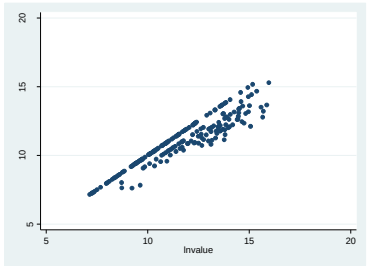
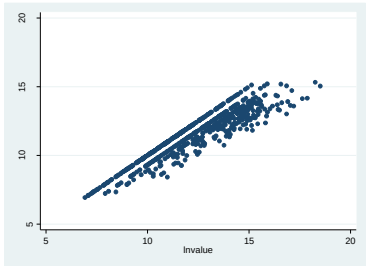
Figure 4: Main export products



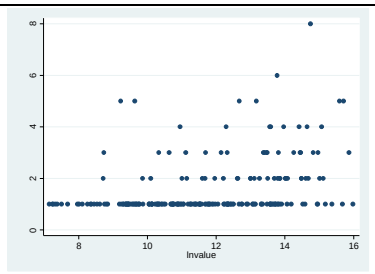
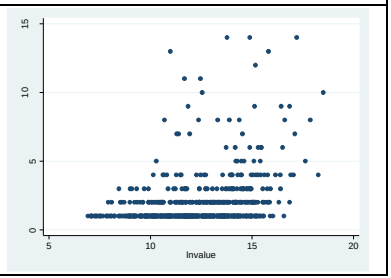
Source: SUNAT

Figure 5: Size versus products and markets

a) Average exports by product-market

1994	2007
	

b) Number of products

1994	2007
	

c) Number of markets

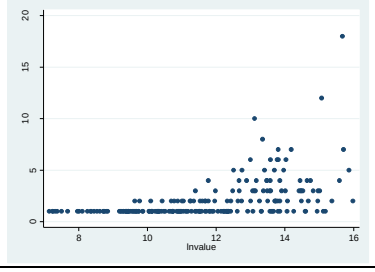
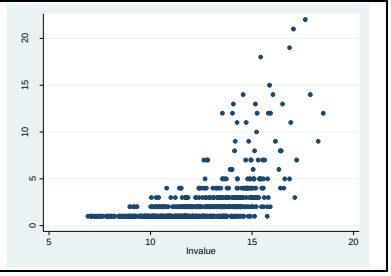
1994	2007
	

Figure 6: Entry and exit of firms into exporting (by year)

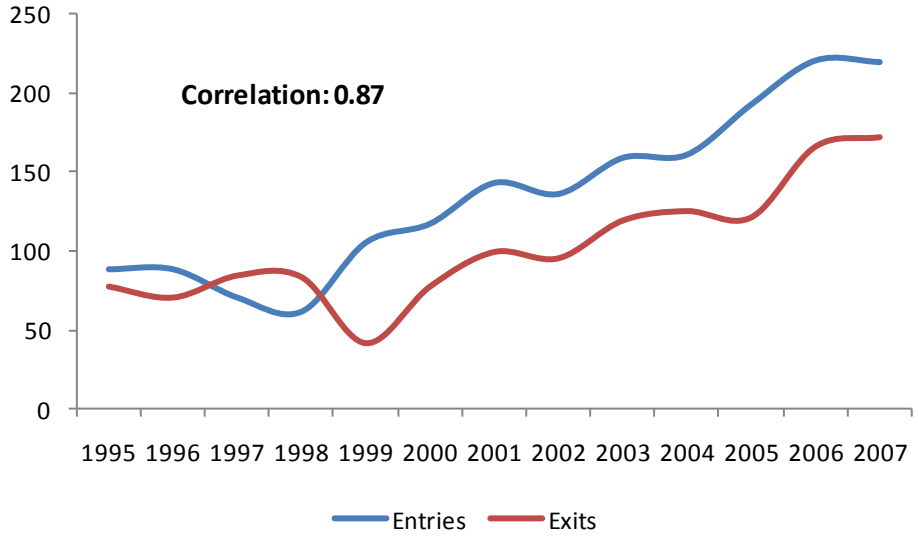


Figure 7: Market shares in 2007 by cohorts

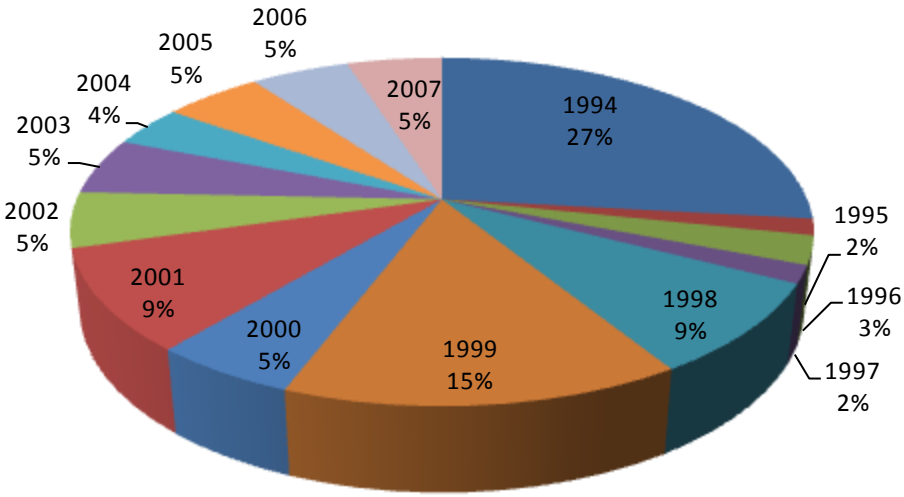
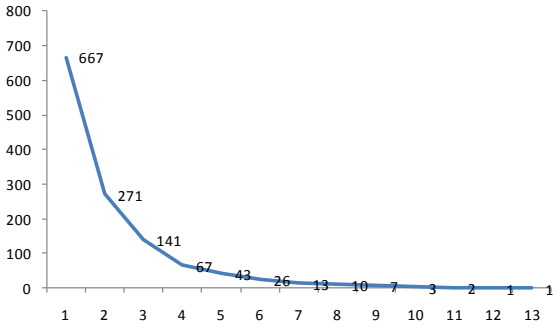


Figure 8: Exits of firms by age

a) Average number of exits by age of the spell



b) Percent of exit according by age of the spell

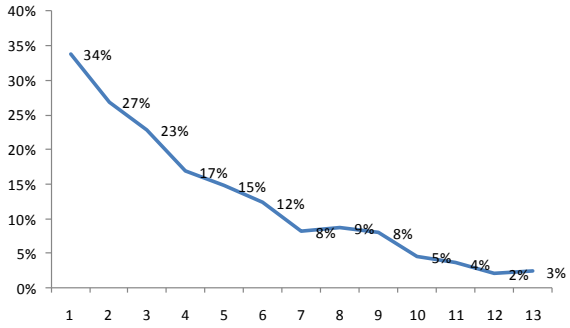


Figure 9: Distribution of the number of shipments exported within the single-year entry firms

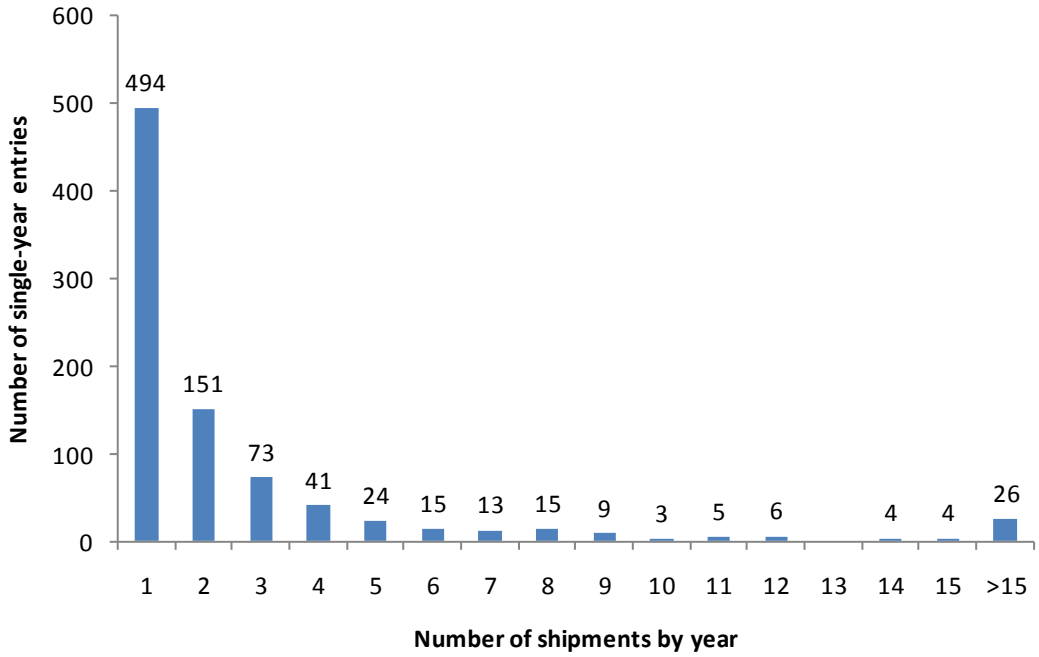
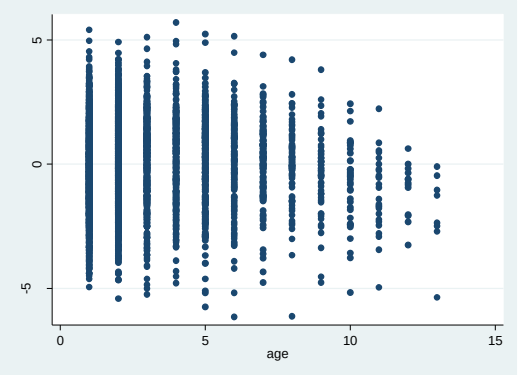


Figure 10: Distribution of the size of the firms by age

a) Residuals vs. age



b) Distribution of residuals

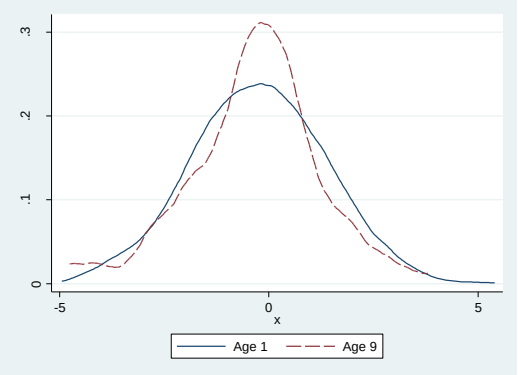


Figure 11: Size of median initial size (discovery cost) vs. differences in survival rates

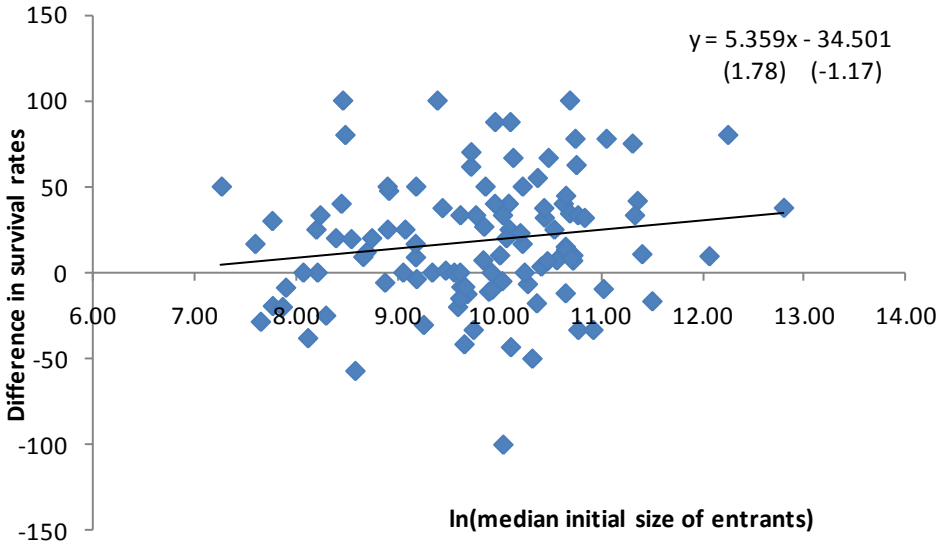
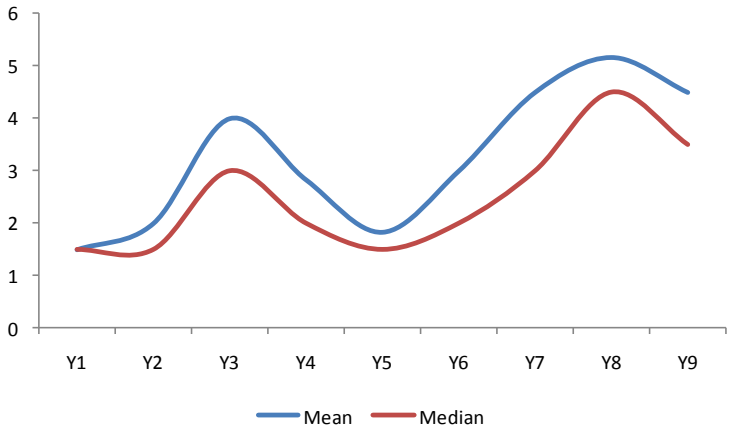


Figure 12: Entries after Discovery

a) In new products



b) In new product-markets

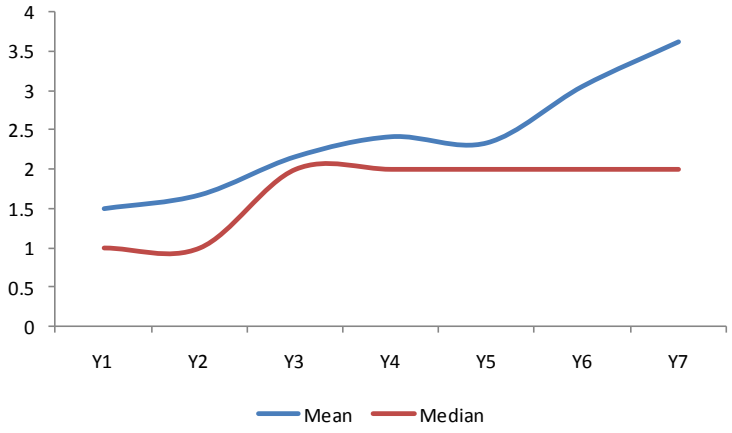


Figure 13: Unit Values in New Products (US$/Kilogram)

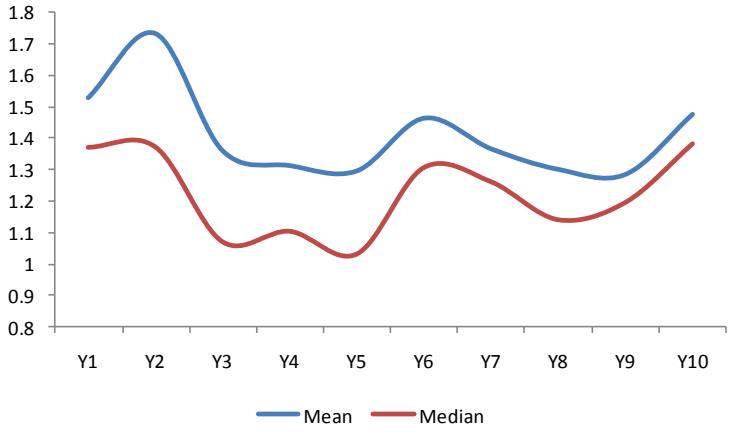


Table 1: Probit Regression on Probability of Exit

	Dependent variable: Exit			
	Probit	OLS	Probit	OLS
	(1)	(2)	(3)	(4)
ln(initial exports)	-0.37***	-0.12***		
	[0.03]	[0.01]		
ln (first shipment value)			-0.07***	-0.03***
			[0.03]	[0.01]
Observations	1370	1397	1370	1397
Product	Yes	Yes	Yes	Yes
Market	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 2: Trade flows by the type, role of trials

Type	Markets		Products	
	Number	%	Number	%
New	201	22.46	12	19.05
Old	109	12.18	38	60.32
Censored	89	9.94	3	4.76
Trials	***496***	55.42	***10***	15.87
Total	895	100.00	63	100.00

Table 3: Characteristics of exporters that start exporting completely new products

Product	Total Entrants	Exporters with previous experience (%)	Average(Firm i's main product's exports in t-1/ average exports of all firms with same main product in t-1)	Average(Firm i's number of products exported in t/ average number of products exported by all firms with same main product in t)
	(1)	(2)	(3)	(4)
Avocadoes	19	37%	0.78	1.30
Canned Artichoke	7	100%	3.03	1.71
Canned Mango	4	100%	1.42	2.30
Canned Nuts	2	50%	0.02	1.00
Canned Papaya	2	100%	1.16	3.38
Canned Sweet Corn	4	50%	3.44	2.28
Guanabana Juice	2	100%	1.56	1.47
Mango Juice	7	71%	0.64	1.04
Papaya Juice	1	100%	0.92	1.00
Passion Fruit	7	71%	0.81	2.11
Piquillo Pepper	9	33%	1.14	1.54
Pinneaples	2	0%	0.00	2.33
Average		68%	1.24	1.79

Table 4: Characteristics of exporters that start exporting to new product-market combinations

Dependent variable: Entry during first three years in each product-market

	Probit				OLS			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln (total exports in t-1)	0.137***			0.113**	0.0113***			0.008*
	(0.04)			(0.04)	(0.00)			(0.00)
Past experience in same product		0.744***		0.808***		0.059***		0.077***
		(0.17)		(0.30)		(0.02)		(0.03)
Past experience in same market			0.23	0.09			0.028	0.020
			(0.17)	(0.25)			(0.02)	(0.03)
Observations	734	1,152	1,152	734	1,128	1,767	1,767	1,128
R-squared					0.65	0.64	0.64	0.66

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Product, market and year are controlled for in all regressions.

Table 5: Average survival rates after one year, in new products and new product-markets combinations, only entrants and later entrants

Product	Surv. Rate 1year Entrants	Surv. Rate 1year Later Entrants	Median Initial Size
Avocadoes	43.48	31.82	17,805
Canned Artichoke	75.00	46.43	26,963
Canned Mango	85.71	38.10	32,000
Canned Nuts	66.67	0.00	1,042
Canned Sweet Corn	0.00	10.00	69,041
Guanabana Juice	100.00	50.00	123,833
Mango Juice	71.43	18.18	24,850
Papaya Juice	100.00	66.67	14,636
Passion Fruit	25.00	54.55	6,194
Piquillo Pepper	20.00	20.41	19,179
Pinneaples	33.33	20.00	5,788
Average products	**56.42**	**32.38**	**31,030**
Product-markets (109)	Surv. Rate 1year Entrants	Surv. Rate 1year Later Entrants	Median Initial Size
Average product-markets	**47.89**	**30.00**	**30,711**

Annex 1: Summary statistics of the data

a) By year

Year	Nr. Observations	Exports
1994	567	140,069,787
1995	620	169,345,874
1996	613	202,059,329
1997	652	208,153,040
1998	583	198,863,592
1999	782	263,332,652
2000	1,064	250,119,272
2001	1,050	304,436,362
2002	1,183	371,673,187
2003	1,297	438,881,446
2004	1,530	562,062,708
2005	1,744	726,224,496
2006	2,046	884,797,308
2007	2,322	1,101,137,051
Total	16,053	

b) By type of exporter

	Non single-year exp.	Single-year exporters	Total
Non individuals	1,272	825	2,097
Individuals	239	340	579
Total	1,511	1,165	2,676

	Exporters non-rentry	Exporters with re-entry	Total
Non individuals	1,903	194	2,097
Individuals	536	43	579
Total	2,439	237	2,676

c) By firms

Year	Number of firms	Average value exported by firm	S.D.	Min	Max
1994	210	666,999	1,311,441	1,265	8,686,215
1995	221	766,271	1,581,295	1,018	11,918,041
1996	239	845,437	1,933,473	1,000	17,818,464
1997	225	925,125	2,325,943	1,006	24,140,284
1998	203	979,624	2,593,879	1,920	24,164,342
1999	267	986,265	2,659,069	1,013	23,044,694
2000	307	814,721	2,317,083	1,048	23,325,820
2001	351	867,340	2,406,457	1,000	23,349,340
2002	392	948,146	2,774,388	1,004	29,665,694
2003	432	1,015,929	3,453,340	1,058	47,235,336
2004	468	1,200,989	4,099,953	1,001	61,607,304
2005	540	1,344,860	4,758,673	1,008	76,113,736
2006	595	1,487,054	5,999,261	1,207	97,699,096
2007	643	1,712,499	6,832,192	1,015	110,384,024

d) By products

Year	Number of products	Average value exported by product	S.D.	Min	Max
1994	42	3,334,995	9,959,187	1,042	61,421,740
1995	48	3,528,039	11,752,034	1,050	77,926,088
1996	44	4,592,258	14,655,546	4,098	93,610,584
1997	40	5,203,826	14,749,356	2,212	88,928,112
1998	39	5,099,067	13,837,446	6,150	79,323,688
1999	47	5,602,823	14,825,945	1,254	87,683,368
2000	47	5,321,687	14,115,093	1,100	80,498,160
2001	50	6,088,727	14,907,061	1,040	80,892,736
2002	46	8,079,852	19,334,110	1,137	99,071,856
2003	50	8,777,629	21,354,464	1,210	123,434,096
2004	48	11,700,000	26,273,140	1,017	156,307,728
2005	49	14,800,000	31,484,366	2,883	179,588,880
2006	53	16,700,000	35,586,412	1,227	212,422,752
2007	58	19,000,000	42,798,808	1,114	259,384,112

e) By markets

Year	Number of markets	Average value exported by market	S.D.	Min	Max
1994	45	3,112,662	13,800,000	1,265	89,960,888
1995	47	3,603,104	16,500,000	13,650	108,818,136
1996	48	4,209,570	19,800,000	2,100	131,603,600
1997	52	4,002,943	19,200,000	7,313	131,696,648
1998	41	4,850,332	19,300,000	1,605	110,707,712
1999	50	5,266,653	23,100,000	1,013	137,202,016
2000	54	4,631,839	20,800,000	3,500	132,834,520
2001	48	6,342,424	26,900,000	2,880	151,131,312
2002	59	6,299,546	29,900,000	3,831	181,650,688
2003	59	7,438,669	36,000,000	1,016	226,051,696
2004	67	8,388,996	42,900,000	1,238	268,860,672
2005	74	9,813,845	51,400,000	1,227	321,110,624
2006	78	11,300,000	61,900,000	1,904	398,428,704
2007	76	14,500,000	76,400,000	4,120	511,210,848

Annex 2: Product classification

1. Vegetables (Chapter 7)	2. Fruits (Chapter 8) & Paprika	3. Canned Food (Chapter 20)
Potatoes:	**Coconuts and nuts:**	**Canned Cucumbers:**
0701100000	(0801100000-0801190000)	2001100000
0701900000	**Nuts:**	**Canned Onions and Garlic:**
0710100000	(0801200000-0802900000)	2001200000
Tomatoes:	**Bananas:**	**Canned Olives:**
0702000000	(0803000000-0803002000)	2001901000
Onions, Garlic and other	**Avocados:**	2005700000
alliaceous vegetables:	0804400000	**Canned Tomatoes:**
(0703100000-0703900000)	**Pineapples:**	(2002100000-2002900000)
0712200000	0804300000	**Canned Fungi**
0712901000	**Guayabana:**	(2003100000-2003900000)
0711100000	0804500010	**Canned Potatoes:**
0712100000	0804501000	2004100000
Cauliflower, Cabbage and	**Mangos:**	2005200000
Broccoli:	0804500020	**Canned Asparagus:**
(0704100000-0704900000)	0804502000	2005600000
Lettuce:	0811909100	**Canned Artichoke**
(0705110000-0705290000)	**Citrus fruits:**	2005991000
Carrots:	(0805100000-0805900000)	2005901000
(0706100000-0706900000)	(0814000000-0814009000)	**Canned Piquillo Pepper:**
Cucumbers:	**Grapes:**	2005992000
0707000000	(0806100000-0806200000)	**Canned Legumes Shelled or U:**
0711400000	**Melons:**	(2005510000-2005590000)
Legumes Shelled or Unshelled:	0807100010	**Canned Peas:**
(0708200000-0708900000)	0807190000	2005400000
(0710220000-0710290000)	**Watermelons:**	**Canned Sweet Corn:**
(0713209000-0713909000)	0807100020	2005800000
Peas:	0807110000	**Other canned vegetables:**
0708100000	**Papaya:**	(2001909000-2001909090)
0713101000	0807200000	(2004900000-2005100000)
0713109010	0811909600	2005300000
0713109020	**Chirimoya:**	(2005909000-2005910000)
0710210000	0810900000	(2005999000-2006000000)
Asparagus:	0810902000	**Jams, fruit jellies, marmalades:**
0709200000	**Passion Fruit:**	(2007100000-2007999200)
0710801000	0810901000	**Canned Palm:**
Fungi:	0811909400	2008910000
(0709510000-0709590000)	**Camu Camu:**	**Canned Mango:**
(0711510000-0711590000)	0811909200	2008993000
(0712300000-0712390000)	**Lucuma:**	**Canned Peanut:**
Spinach:	0811909300	(2008111000-2008119000)
0709700000	**Guanabana:**	**Canned Nuts:**
0710300000	0811909500	(2008191000-2008199000)
Piquillo Pepper:	**Other Fruits:**	**Canned Pineapples:**
0709600000	(0804100000-0804200000)	(2008200000-2008209000)
Olives:	(0808100000-0810500000)	**Canned Citrus Fruits:**
0709902000	(0810903000-0811909000)	2008300000
0711200000	(0811909900-0813500000)	**Canned Papaya:**
0709900010	**Paprika:**	2008992000
Sweet Corn:	0904200000	2008999100
0709901000	0904201010	**Other Canned Fruits:**
0710400000	0904201020	(2008400000-2008809000)
0712902000	0904201030	(2008920000-2008991000)

Artichokes: 0709903000 0709100000 **Other roots and tubers:** (0714100000-0714909000) **Other Vegetables**: 0709300000 0709400000 0709900090 0709909000 0710800000 0710809000 0710900000 0711900000 0712909000	0904209000	2008999000 (2008999200-2008999900) **Mango Juice:** 2009801400 **Pineapple Juice:** (2009400000-2009490000) **Tomato Juice:** 2009500000 **Guanabana Juice:** 2009801300 **Passion Fruit Juice:** 2009801200 2009801910 **Camu Camu Juice:** 2009801500 **Papaya Juice:** 2009801100 **Other Juices:** (2009110000-2009399000) 2009801900 (2009690000-2009790000) (2009801990-2009900000)

Annex 3: Summary statistics of exports and entries by cohort

Exports of Non - Traditional Agricultural products by cohorts (number of firms)

	Cohort1994	Cohort1995	Cohort1996	Cohort1997	Cohort1998	Cohort1999	Cohort2000	Cohort2001	Cohort2002	Cohort2003	Cohort2004	Cohort2005	Cohort2006	Cohort2007	Total
1994	210	-	-	-	-	-	-	-	-	-	-	-	-	-	214
1995	133	88	-	-	-	-	-	-	-	-	-	-	-	-	220
1996	108	47	84	-	-	-	-	-	-	-	-	-	-	-	237
1997	85	29	44	67	-	-	-	-	-	-	-	-	-	-	218
1998	64	18	24	38	59	-	-	-	-	-	-	-	-	-	198
1999	60	18	23	34	42	90	-	-	-	-	-	-	-	-	260
2000	53	13	23	30	31	52	105	-	-	-	-	-	-	-	288
2001	45	12	13	24	27	42	57	131	-	-	-	-	-	-	324
2002	44	12	15	17	21	35	41	85	122	-	-	-	-	-	367
2003	39	13	16	15	19	28	33	61	66	142	-	-	-	-	399
2004	38	13	15	13	15	19	32	47	46	88	142	-	-	-	429
2005	38	12	15	9	15	16	28	48	41	63	85	170	-	-	464
2006	36	11	16	11	10	18	25	43	30	46	57	95	197	-	539
2007	36	10	12	8	8	18	23	42	27	42	39	80	106	192	593

Exports of Non - Traditional Agricultural products by cohorts (total values)

	Cohort1994	Cohort1995	Cohort1996	Cohort1997	Cohort1998	Cohort1999	Cohort2000	Cohort2001	Cohort2002	Cohort2003	Cohort2004	Cohort2005	Cohort2006	Cohort2007	Total
1994	140,100,000	-	-	-	-	-	-	-	-	-	-	-	-	-	140,100,000
1995	159,900,000	9,426,866	-	-	-	-	-	-	-	-	-	-	-	-	169,274,226
1996	172,500,000	15,552,607	14,056,445	-	-	-	-	-	-	-	-	-	-	-	201,974,201
1997	159,500,000	10,834,199	21,587,571	16,273,075	-	-	-	-	-	-	-	-	-	-	206,203,057
1998	148,500,000	8,930,792	10,056,849	17,152,844	14,222,079	-	-	-	-	-	-	-	-	-	197,966,429
1999	178,400,000	8,838,484	12,977,285	20,885,127	26,528,712	15,656,570	-	-	-	-	-	-	-	-	260,408,235
2000	141,700,000	7,447,453	13,075,186	16,950,109	27,906,561	28,077,101	14,956,075	-	-	-	-	-	-	-	244,266,281
2001	132,800,000	8,286,807	13,955,155	13,445,579	39,147,358	47,488,972	23,251,201	26,050,653	-	-	-	-	-	-	288,865,162
2002	142,800,000	8,984,371	18,310,625	12,548,193	51,868,733	52,043,031	23,072,951	39,325,798	22,748,088	-	-	-	-	-	352,305,389
2003	148,100,000	10,445,214	20,777,208	12,753,798	54,739,189	70,272,676	25,328,759	45,433,146	28,756,004	22,257,925	-	-	-	-	416,093,798
2004	167,300,000	11,482,384	24,536,344	11,923,248	57,495,428	88,773,745	35,677,086	62,503,635	39,772,636	41,634,382	20,983,038	-	-	-	511,921,373
2005	196,700,000	15,699,955	28,494,756	13,700,013	80,100,001	107,200,000	50,322,894	78,511,288	40,180,376	47,358,004	38,982,921	28,984,573	-	-	630,712,166
2006	256,200,000	17,504,631	29,462,398	13,803,093	89,073,786	134,500,000	52,399,298	86,320,778	42,943,540	46,239,579	33,174,894	47,672,319	35,426,928	-	812,001,938
2007	295,000,000	16,614,316	29,169,730	18,109,317	94,163,165	161,100,000	58,690,569	103,900,000	56,546,712	57,807,309	42,251,032	56,689,385	56,457,480	54,595,331	1,001,945,518

Annex 4: Mathematical Appendix,

4.a Profits at alpha entry

$$\Pr ofits = \frac{1}{1-\delta}\left(\frac{q(C_k^L - C_k^H) + q\frac{\delta}{1-\delta}(C_k^L - C_D) + (C_k^H - C_D) + F}{(1+q\frac{\delta}{1-\delta})} - \frac{(1+q\frac{\delta}{1-\delta})((q(C_k^L + (1-q)C_k^H) + C_D)}{(1+q\frac{\delta}{1-\delta})}\right) - F$$

$$= \frac{1}{1-\delta}\left(\frac{q\frac{\delta}{1-\delta}(C_k^L) + F}{(1+q\frac{\delta}{1-\delta})} - \frac{(q\frac{\delta}{1-\delta})((q(C_k^L + (1-q)C_k^H))}{(1+q\frac{\delta}{1-\delta})}\right) - F$$

$$= \frac{1}{1-\delta}\frac{q\frac{\delta}{1-\delta}(1-q)(C_k^L - C_k^H) + F}{(1+q\frac{\delta}{1-\delta})} - F$$

$$== \frac{\delta(1-q)(\frac{q}{1-\delta}(C_k^L - C_k^H) + F)}{1-\delta+q\delta}$$

The regularity condition on price ensures the denominator in Equation (6) is positive. The regularity conditions on fixed costs $(\frac{\alpha_i P_k - E(C_k)}{1-\delta} - F > \frac{\alpha_i P_D - C_D}{1-\delta} \;\&\; \alpha_i P_k - C^H < \alpha_i P_D - C_D)$ ensures the numerator is positive. To see this, multiply both sides of the second condition by 1/(1-δ) and subtract the left side from the left side of the first condition and the right side from the right side of the second condition. This yields $\frac{C^H - E(C_k)}{1-\delta} - F > 0.$). Substituting qCL+(1-q)CH for E(C) this is the same as $\frac{-q(C^L + C^H)}{1-\delta} - F > 0$. Note that some firms with expected lifetime profits from exporting (net of fixed cost) below zero will chose to enter because of the option of exit. The expected present value of net profits is

$\Pr ofits = \frac{1}{1-\delta}(\alpha_i(P_k - P_D) - qC_k^L - (1-q)C_k^H + C_D) - F$, At α_{entry} this is

$$\Pr ofits = \frac{\delta(1-q)(\frac{q}{1-\delta}(C_k^L - C_k^H) + F)}{1-\delta+q\delta},$$

which is negative given the regularity condition.

4.b Condition on Entry into New Product if Firm will Exit, Given Waiting is a Possibility

Condition to enter as a pioneer:

$$V_{pioneer\&exit}(\alpha, P_k, C_k^L, C_k^H, F, P_D, C_D) = q\left[\frac{1}{1-\delta}(\alpha_i P_k - C_k^L)\right] + (1-q)\left[(\alpha_i P_k - C_k^H) + \frac{\delta}{1-\delta}(\alpha_i P_D - C_D)\right] - F - D$$

Condition to enter later as a follower:

$$V_{wait\&exit}(\alpha, P_k, C_k^L, C_k^H, F, P_D, C_D) = q\delta\left[\frac{1}{1-\delta}(\alpha_i P_k - C_k^L)\right] + (1-q)\delta\left[(\alpha_i P_k - C_k^H) + \frac{\delta}{1-\delta}(\alpha_i P_D - C_D)\right] - \delta F$$

The cutoff α:

$$\alpha_{ientry\&exit} > \frac{D + (1-\delta)F + qC_k^L + (1-q)\left[(1-\delta)C_k^H + \delta(C_D)\right]}{qP_k + (1-q)\left[(1-\delta)(P_k) + \delta(P_D)\right]}$$