The Determinants of Farmers' Participation to Extenso*

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Abstract

In this paper I study the factors determining the voluntary participation of farmers to Extenso, an ecological scheme banning the use of pesticides in Switzerland. I focus on the impact of the opportunity cost, with the hypothesis that higher forgone revenues lead to less participation. Using Swiss FADN data, I apply a logit model for panel data to compare the adopters to the non-adopters who could potentially participate. To estimate the forgone revenues, I use the harvest revenues the year before the adoption of the scheme. I show that higher revenues and more pesticides used the year before participation diminish the probability of entry. Consequently, differentiated subsidies related to the yield potential would increase the participation rate and induce the more pollutant farmers to participate too.

Keywords Agricultural Policy, Agriculture & Environment, Farm Subsidy, Micro Analysis of Farms

JEL Classification Q120, Q150, Q180, Q570

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1. Introduction

Every taxpayer in Switzerland pays on average approximately 900 CHF per year for the agricultural policy. Between 2014 and 2017, 13.8 billion will be spent by the Confederation and the cantons for this purpose and 85% will be dedicated to direct payments. Through these payments, farmers receive support in exchange of a general contribution to the society, as landscape maintenance, food security or decentralised occupation of the territory. Direct payments were implemented in 1999 and their part in the agricultural policy has been constantly increasing. They are divided into two types, general and ecological payments. The general payments are automatic if the farmer achieves some environmental targets. It is called "ecological contribution required" (PER - Prestations Ecologiques Requises in French) and almost every farmer in Switzerland complies with it, otherwise they do not receive any support.

The second type of direct payments are the ecological ones. They are paid if the farmer participates to additional ecological measures. Here the participation is voluntary. I classify these measures as "agri-environmental schemes", defined as all measures aiming at diminishing the negative environmental impact of agriculture. The results of the ecological payments are disappointing: pollution of the phreatic table and rivers due to agriculture has not diminished, biodiversity has not improved, agricultural nitrogen emissions have increased, etc[1].

I focus on one scheme of the ecological payment, Extenso. Under this scheme, farmers receive a subsidy to cultivate some types of cereals or rapeseed without pesticides, and therefore renounce to a part of their harvest. The reduction of pesticides is critical not only for the preservation of the environment, but also for humans' health. A huge amount of research has been conducted on the subject, and it has been proved (Aubertot et al. (2005)) that the use of pesticides is environmentally harmful, leads to undesirable side-effects on the ecosystems

[1]Swiss Agriculture, pocket statistics 2013, FOS.

and affects the whole food chain and consequently human beings.

A key factor for the success of agri-environmental schemes is the participation rate. I study what determines the participation of the farmers to Extenso. I rely on the existing literature on the subject to determine the characteristics playing a role in the participation and I add one specific factor rarely taken into account: the opportunity cost (OC). The OC is not easy to estimate and therefore not often considered. To measure it, we need to answer one question: How much revenues from the harvest could the farmer have if he was not participating to the scheme? To answer such a hypothetical question, I use the harvest revenues *the year before the adoption* of Extenso. My hypothesis is that the higher these revenues, the more the farmer gives up by participating, and the lower the probability of participation. To test it I use data from the FADN (Farm Accountancy Data Network) and a logit model to compare the adopters to the non adopters who could potentially enter the scheme.

Understanding what determines the participation to agri-environmental schemes is important to influence the participation rate, to design effective policies and to improve the current ones. For Extenso, the main issue is that the subsidy is the same for every farmer everywhere in Switzerland. By showing that the farmers take their opportunity cost into account when they decide to participate or not, I recommend different subsidies according to the potential yield.

In the next section I present a review of the literature on the factors determining the participation to agri-environmental schemes, in section 3 more details about Extenso are given and the hypothesis are developed, in section 4 I describe the data, in section 5 the econometric model is set, the results are reported in section 6, and finally in section 7 I discuss their implications to design a more effective scheme.

2. Literature Review

Morris and Potter (1995) are among the first authors who used quantitative methods to study the participation of farmers to agri-environmental schemes (AESs). They surveyed farmers in the UK and found that farmers running a large business and younger farmers were more likely to participate. Since then the subject has been widely studied, often by using survey data and applying a logit or probit model to compare the characteristics of participants and non-participants. The majority of the studies focus on the participation to one or two specific schemes, and the conclusions of Morris and Potter have been nuanced. In fact there is hardly any consensus about which factors affect positively and which factors affect negatively the participation to AESs. If one factor is found to increase the likelihood of participation in one study, there is another study which tells the opposite, or finds it as not significant. One explanation for this lack of convergence is the specificity of each scheme studied, usually implemented only in one country or one region. Moreover the studies often rely on survey data and not numerous observations, in general only a few hundred. I also study one specific scheme, but for a whole country, and I use panel data over 10 years, so more than 3000 observations.

Overall the factors influencing the participation to AESs can be divided into three groups: farmers', farms' and schemes' characteristics. Table 1 summarises the most common factors found in the literature as well as the hypothesis and results corresponding to each of them. The lack of convergence is seen in the column "results", except for the last four factors, but they are less often taken into account. Knowler and Bradshaw (2007) make a review of 31 studies on the adoption of conservation agriculture, which embeds extensive production (without pesticides). They find only two factors displaying consistent results: "awareness of environmental threats" (positive effect on the adoption) and "high productivity soil" (negative effect on the adoption). However these factors appear only in four and three studies respectively.

The second factor, the productivity of the soil, is a measure of the opportunity cost. Farmers taking part in a conservation scheme, for instance the extensive production of cereals, have to give up a part of their production. The higher the soil productivity, the higher the part lost and the less incentives to participate.

Table 1: **Summary of the factors influencing the participation to an AES**

Factors (and usual expected sign)	**Hypothesis**	**Results**
1) Farmers' characteristics:		
- Age (-)	The younger farmers participate more.	+ (Barreiro-Hurlé et al. (2008)) ; **-** (Wynn et al. (2001), Mann (2005)★)
- Education (+)	The more educated are more likely to participate.	+ (Damianos (2002)) ; **-** (Defrancesco et al. (2008))
- Tenure (+ if owner)	Farmers who own the farm tend to participate more.	+ **or -** (Wynn et al. (2001), Defrancesco et al. (2008))
- Past participation (+)	Past participation to an AES increases the probability of participation.	+ (Defrancesco et al. (2008)) ; **n.s.** (Vanslembrouck et al. (2002))
- Positive environmental attitude (+)	Positive attitudes towards the environment increase the participation.	+ **or -** (Wynn et al. (2001)) ; + (Vanslembrouck et al. (2002))
2) Farms' characteristics:		
- Size (in ha)	No consensus about the hypothesis.	+ (Damianos (2002)) ; + **or -** (Mann (2005)★)
- Specialisation in crop production (+)	Farms specialised in animal production participate less than those specialised in crop production.	+ (Finger and Lehmann (2012)★); **-** (Wynn et al. (2001))
- Hilly or mountain areas (+)	This location increases the probability of participation.	+ (Finger and Lehmann (2012)★, Mann (2005)★)
- Neighbours' participation (+)	If his neighbours participate, the farmer is more likely to participate too.	+ (Wilson (1996), Drake et al. (1999))
3) Schemes' characteristics:		
- Fit of the scheme (+)	Participation is increased if the scheme can be easily implemented on the farm.	+ (Wilson (1996), (Wynn et al. (2001))
- Financial compensation	The premium paid must be sufficient to compensate the cost incurred.	Defrancesco et al. (2008)

Note: + corresponds to a positive relation between the factor and the participation, **-** to a negative relation and + **or -** to a positive or negative relation depending on the scheme studied. **n.s** stands for non-significant.★ refers to studies on Switzerland.

Alberini and Segerson (2002) assess the voluntary approaches in the environmental protection in general. For them economic factors are of paramount importance and the economic rationality explains the participation as following: An agent will participate only if his payoff is at least as high with participation than without it. It means that the individual must perceive a net gain from participation, or at least not suffer a loss. For the farmers the gain is obvious, it is the subsidy paid and possibly the satisfaction to protect the environment. The costs are less obvious, but a major part of them are the forgone revenues. I develop some measures of these opportunity costs and test the hypothesis that higher forgone revenues lead to less participation.

Despite their importance, economic factors and opportunity costs have been rarely taken into account to explain voluntary participation of farmers to AESs. Crabtree et al. (1998) in the UK and Zingg et al. (2011) in Switzerland include the soil quality in their analysis. Crabtree et al. (1998) find that farmers in less-favoured areas (LFA)[2] have greater likelihood of participation. Zingg et al. (2011) study the participation to AESs at the municipality level and use the Swiss soil suitability index. One of their conclusions based on this index is "a high yield potential decreases the likeliness of adopting environmental stewardship practices". I use this index as a measure of the soil quality. One study in Switzerland by Finger and El Benni (2013) is on the adoption of extensive wheat production (a part of Extenso) between 1990 and 1999. They include the wheat yields before the adoption as an explanatory variable, but they do not include the soil quality. They find only two significant variables in their final model based on a duration analysis: the yield (in tonnes per hectare) and the ratio (price/payment). A high yield before adoption decreases the probability of participation, as well as a high ratio (price/payment). Both variables show that farmers do indeed react to economic incentives and do take their forgone revenues into account, i.e. their opportunity cost of participation. I test this hypothesis using other measures of opportunity costs than Finger and El Benni (2013): the harvest revenue per hectare, the pesticides cost, and the yield potential with the soil suitability index.

[2] LFA are areas where agricultural production is restricted by soil, slope or climate conditions.

3. The Rationale for the Participation to Extenso

3.1. Extenso in general

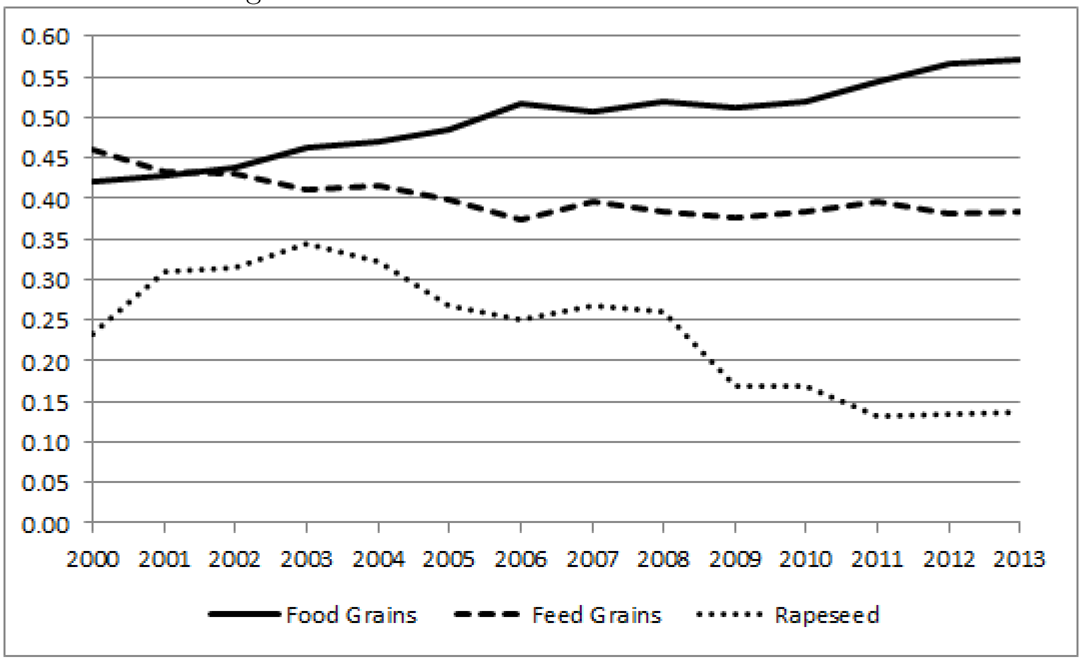
Three categories are included in Extenso: food grains, feed grains, and rapeseed[3]. Food grains are wheat, rye, and dinkel; feed grains are barley, oats, and triticale. The farmers receive a subsidy of 400 CHF per hectare of land under Extenso per year, if they cultivate all their food grains or feed grains or rapeseed without pesticides. The use of herbicides is allowed and the use of fertilizers not regulated. The category "pesticides" includes insecticides, herbicides, fungicides, rodenticides and plant growth regulators. Herbicides represented in average 38% of the pesticides between 2006 and 2012 according to the FOAG (Federal Office for Agriculture). The current form of Extenso was introduced in 1999 and did not change until 2014. Farmers receive a subsidy because they provide an ecological service to the society and because they lose a part of their harvest due to the non-use of pesticides.

The participation rate[4] to Extenso differs for each type of crop. In 2013, 57% of the food grains were cultivated under Extenso, 38% of the feed grains and 14% of rapeseed. The trend for each crop since 2000 is also different as shown in figure 1. The participation rate has increased for the food grains, remained stable for the feed grains and decreased for rapeseed. The low participation rate for rapeseed is an issue, especially because the hectares of rapeseed have increased constantly since 2000 (from 14'000 to 22'000 ha). The hectares of food and feed grains have decreased, respectively from 100'000 to 84'000 ha, and from 83'000 to 63'000 ha. In total, 30 million were paid to the farmers for Extenso in 2013.

[3]Translation of specific terms in the glossary after the conclusion.

[4]Sources: Stat-tab (FOS) & Agristat (USP) & Rapports Agricoles 2000-2012.

Figure 1: **% of hectares cultivated under Extenso**



Sources: Stat-tab (FOS) & Agristat (USP) & Rapports Agricoles 2000-2012.

3.2. Condition for participation

The choice of the farmers is to produce extensively all his food grains, or/and all his feed grains, or/and all his rapeseed. Hence I study separately the participation to these three categories. According to the theory, a farmer will participate only if his payoff with participation is higher than his payoff without participation. Focusing on economic factors, his payoffs or net revenues are (for any of the three crop categories included in Extenso):

- *Without* participation: the revenues from the production - the production costs
- *With* participation: the subsidy + the revenues from the production - the production costs[5].

The revenues from the production are calculated as the francs received for the harvest per hectare of the crop category in question. I use the abbreviation (revenue/ha) for these revenues. Every variable of the payoffs is divided by the hectares of the crop category to compare

[5]If we were able to estimate it, we could add to the payoff "with participation" the possible satisfaction to participate in the protection of the environment.

farms of different size. Using these payoffs, the decision of participation for any of the three categories can be summarised as below (on the left it is with participation (with p.) and on the right without participation (without p.):

- **No**: $\frac{Subsidy}{ha} + (\frac{Revenue}{ha})_{with\ p.} - (\frac{Pesticide\ costs}{ha})_{with\ p.} < (\frac{Revenue}{ha})_{without\ p.} - (\frac{Pesticide\ costs}{ha})_{without\ p.}$

- **Yes**: $\frac{Subsidy}{ha} + (\frac{Revenue}{ha})_{with\ p.} - (\frac{Pesticide\ costs}{ha})_{with\ p.} > (\frac{Revenue}{ha})_{without\ p.} - (\frac{Pesticide\ costs}{ha})_{without\ p.}$

All the production costs, except the pesticides cost, are eliminated from the inequality because I assume they are identical in both cases. The payoffs include only what varies between the situation without participation and the situation with participation. The pesticides cost are not completely removed with participation because they include the herbicides allowed with Extenso. The pesticides cost are measured as the francs spent on pesticides for each of the three categories. The ratio (subsidy/ha) is equal to 400 CHF in most cases[6], but some deviations are possible due to imprecisions in the dataset or fines from the authority if there is a mistake in the hectares declared under Extenso or a non-respect of the rules of the scheme.

The farmer calculates his net revenue with and without participation and chooses the most profitable situation, but he has to *predict* his net revenue. Imagine it is year $t-1$, at this time the farmer predicts what will be his net revenue with or without participation in year t and makes the decision to participate or not. He will participate if the following condition is fulfilled (assuming myopic predictions):

- **Yes**: $(\frac{Subsidy}{ha})_t + (\frac{Revenue}{ha})_t - (\frac{Pesticide\ costs}{ha})_t > (\frac{Revenue}{ha})_{t-1} - (\frac{Pesticide\ costs}{ha})_{t-1}$

[6]Not many deviations are observed in the dataset indeed.

3.3. Hypothesis to test

- On the ratio (Revenue/ha) in year $t-1$:

The ratio (revenue/ha) in year $t-1$ measures the opportunity cost of entry. The opportunity cost of entry for a farmer is the revenue he could receive if he was not participating. The ratio (revenue/ha) in $t-1$ is an approximation of what the farmer could receive in t if he does not enter Extenso. The hypothesis I test is: the participants had a lower ratio (revenue/ha) before the adoption of the scheme (in t-1) than the non-participants, in other words the participants have a lower opportunity cost.

Another way to understand that farmers with high revenues in $t-1$ are less willing to participate is to look at the variations of these revenues with or without adoption of the scheme. Assume you expect a reduction of 15% in your yield[7] (measured as tonnes/ha) when you enter. The higher your (revenue/ha) before participation, the higher your loss in absolute value if you participate. For example imagine two farmers facing the same price of 50 CHF per tonne, but the first one produces only 50 tonnes per hectare while the second one 60 tonnes per hectare. If they adopt Extenso and lose 15% of their yield (and no change in the price), the first one will lose 375 CHF per hectare while the second one 450 CHF per hectare. The subsidy exists to compensate this loss, but it is one fixed amount equal for everyone and does not depend on the loss. Here it would be enough for the first farmer, but not for the second one[8]. The farmer with the higher (revenue/ha) has to give up more in terms of revenue and hence is less willing to adopt the scheme.

The variation in the ratio (revenue/ha) in year $t-1$ between the non-participants and the future participants can come from many sources. Firstly a variation in the type of crop exists. Food grains and feed grains embed different crops and the price and yield of each

[7]The numbers in this paragraph, and especially the 15% lost by entering Extenso, are representative of what is experienced in reality for wheat.

[8]We should add the amount saved on pesticides to complete the example, but it is not necessary to understand the hypothesis.

crop is different from another. However wheat accounts for 90% of the food grains and barley for 70% of the feed grains. Secondly the price can also vary for the same crop within Switzerland, but the variation is only a few francs per tonnes, depending on the collecting center. Finally a large part of the variation comes from a difference in the crop yield. By using the ratio (revenue/ha) I focus on the monetary units, it is not important from which sources the variation comes from. What matters is that the participants received less money for their production before their entry than the non-participants, the reason why does not matter.

- On the ratio (Pesticides cost/ha) in year $t-1$:

By looking at the payoffs in the last inequality, we could conclude that a high level of pesticides in year $t-1$ increases the chances of participation because the savings made by removing the pesticides are important. It is not what is generally found in the literature. Usually the more intensive farmers participate less and the hypothesis I test is: the participants had a lower ratio (Pesticide costs/ha) before the adoption of the scheme than the non-participants.

Farmers using a lot of pesticides expect a large variation in their harvest revenue by removing them. Those using already few pesticides do not expect a large decrease in their yield and therefore are more willing to participate. Note that the pesticides cost are about ten times lower than the harvest revenue, which means that what the farmers could save on pesticides by participating is much less important than what they expect to lose in terms of harvest revenue. Furthermore they will still use herbicides, accounting for about 40% of the pesticides, which diminishes the potential savings.

4. Dataset

4.1 Sources

The dataset is provided by Agroscope, a section of the FOAG, which collects every year the accountancy of about 3000 Swiss farms. These data constitute the Farm Accountancy Data Network (FADN). The variables are provided at the farm level. I use data from 2003 to 2013, which gives a total of 34'090 observations, however only about one tenth of them are useful for my research (the farms concerned by Extenso or which could be). Since a discontinuity exists in the dataset between 2002 and 2003 concerning the definition of some variables and the selection of the farms, I chose to take only the data since 2003.

Due to specific requirements for the accountancy, the sample of farms is non-random. Nonetheless the objective of Agroscope is to provide the best possible representative sample of the population (all the Swiss farms). The (very) small farms are not included in the sample as they usually cannot provide a detailed enough accountancy. The criteria to be in the sample are for instance to have at least 10 hectares of utilised agricultural area (UAA), or 6 cows, etc. According to Agroscope, 80% of the Swiss farms are concerned by these criteria, as well as 95% of the UAA, and 98% of the cows. The objective of the FADN sample is then to represent as best as possible these 80% of the whole population. To do so, the proportions of the farms in each canton, each region (flatland, hills, mountains), of each type (specialised in milk production, crop production, ...), etc. are respected.

The non-randomness brings one advantage for my analysis: the possibility to use the dataset as a panel as most of the farms appear many years. The difficulty to study the adoption of an ecological scheme is that you cannot compare the farms adopting and non-adopting it on characteristics impacted by the adoption. For example the production of the farms once they adopt Extenso will be lower than the production of the farms not adopting Extenso. Is it because Extenso has a negative impact on yields or/and because the farms had already a lower yield before entering the scheme? With a panel I am able to answer this question by studying the characteristics of the farms *before* they adopt Extenso. Thus I can compare characteristics which will be but are not yet altered by the adoption of Extenso. The characteristics in question are the ratios (revenue/ha), (pesticides cost/ha) and (fertilizers cost/ha).

I also use another source of data for two variables: the proportion of "good" land (the most productive land) and the proportion of "bad" land (the least productive land) in a municipality. I calculated these two variables by using an ArcGis software on the basis of the digital soil suitability index issued by the Federal Office for Statistics (FOS).

4.2 Descriptive Statistics

4.2.1. Representativeness of the dataset

The panel covers 11 years and contains 5959 farms for a total of 34'090 observations. 12.5% of the farms appear in the sample every year. The median number is five apparitions, but it is not always five consecutive years. Table 11 in the appendix shows some differences between the whole population and the dataset. The numbers in the table are the mean values over the 11 years and are the percentages of 60'722 farms for Switzerland and of 3'099 farms for the dataset. The only difference between the population and the sample is that farms with less than 10 ha of UAA are under-represented in the dataset, while bigger farms with 20 to 50 ha of UAA are over-represented. The question is: have big farms different criteria in their choice of adopting or not an ecological scheme than small farms? If yes, the results of my analysis would be biased and only applicable to farms with more than 10 ha of UAA. Yet there is no reason to think that small farms take their decision differently from bigger farms. Moreover what is found in the literature on Switzerland (Finger and Lehmann (2012)) is that the size has in general no consequence on the rate of participation to ecological schemes (small farms do not participate more or less often). No other significant difference is shown in table 11 about the region (flatland, hills or mountains) or about the proportion of food grains, feed grains and rapeseed in the UAA. I also compared the representation of the cantons in the dataset versus the true percentage of farms in each canton. Three cantons are over-represented in the dataset, Zürich, Vaud and Valais, and three cantons are under-represented, Bern, Lucerne and Uri. I do not expect these differences to have a significant impact on my analysis.

4.2.2. Definition of the entrants and non-entrants

Not the full dataset is useful for the analysis. The observations are divided into 6 groups every year, and two groups interest us: the farms adopting Extenso (the "entrants") and the farms which could have adopted Extenso but did not (the "non-entrants"). "Could have" means that the farmer cultivates one of the three crop categories, but not under Extenso. Table 2 summarises the entrants and non-entrants for 2013. Table 12 in the appendix gives their number for the three types of crop for each year (2003 is not reported as it is the starting year). There are less (non-)entrants for rapeseed because only about 20% of rapeseed is under Extenso, while it is 40-50% for food and feed grains. The organic farms are removed as they cannot participate to Extenso.

Unfortunately 49%, 53% and 25% of the entrants - respectively for food grains, feed grains and rapeseed - are lost in the next steps of the analysis because they did not produce the crop category in question before their participation. Then the harvest revenue and the pesticides cost are missing in year t-1. The farmers decide to cultivate the crop in question and enter directly Extenso. Some non-entrants are also lost for the same reason, but in a smaller proportion (13%, 14% and 14%, respectively for food grains, feed grains and rapeseed).

Table 2: **Definition of the groups for 2013 (for food grains)**

2012	**2013**	**Name of the group**	**Number**
No	No	Not potential (ha food grains = 0 in 2013)	1348
No	No	Non-entrant (ha food grains > 0 in 2013)	279
No	Yes	Entrant	51
Yes	No	Outgoing	50
Yes	Yes	Staying	509
Not in the panel	Yes or No	First apparition in 2013	418

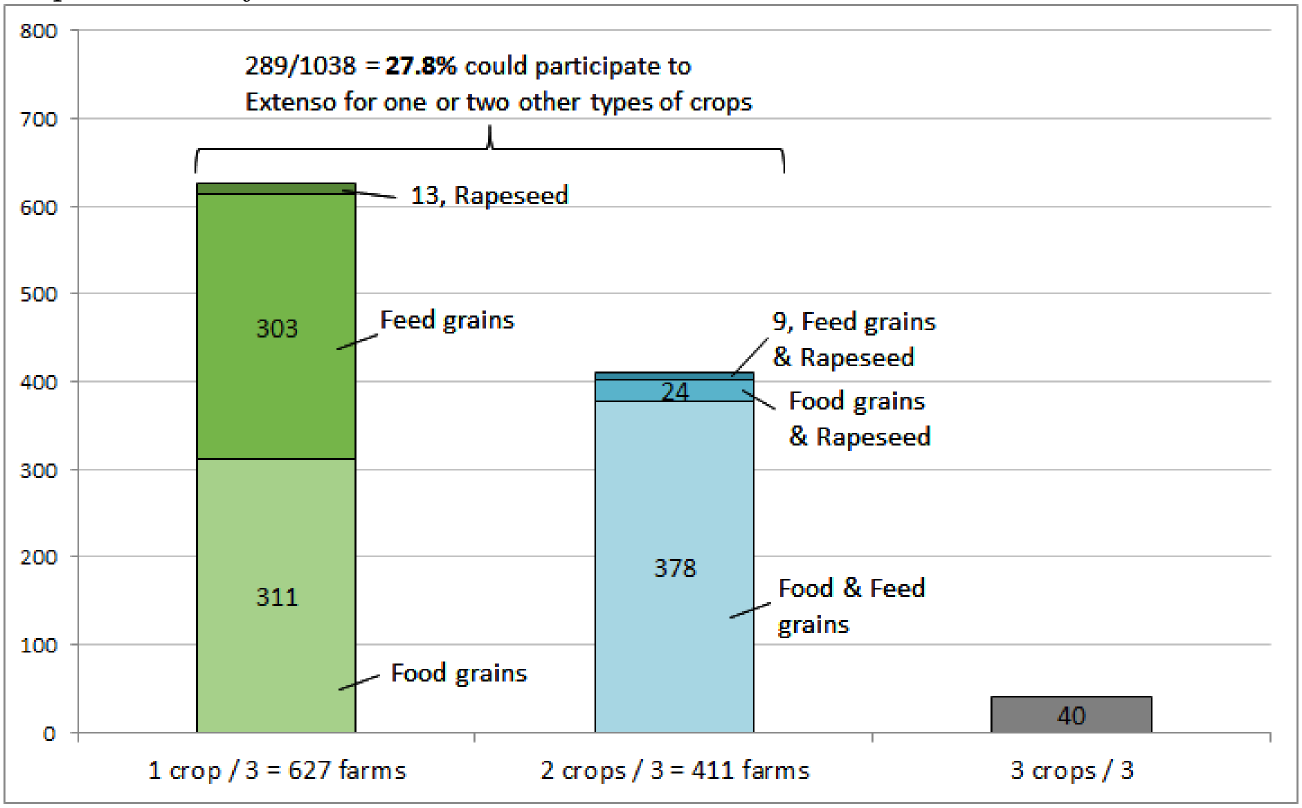
Note: *No* means the farmer does not participate in Extenso for food grains, *yes* means he does. The two groups of interest are the non-entrants and the entrants.

4.2.3. Explanatory variable

The explanatory variable is the decision to adopt Extenso or not, in other words it is the "No" of the non-entrants or the "Yes" of the entrants from the last table. The analysis is done separately for the three types of crops. It means that a farmer can be simultaneously in the non-entrants for the food grains and in the entrants for the feed grains for instance. It is not rare that a farmer participates in one or two of the three crops and could participate in one or two other crops but does not. "Could participate" means that the farmer cultivates the crop in question but not under Extenso.

Figure 2 summarises the number of farms participating in Extenso for one, two or three types of crops over one year. The numbers are the means over the 11 years of the dataset. The first green bar represents the 627 farms participating in one type of crop, the second blue bar the 411 farms participating in two types of crops, and the third grey bar the 40 farms participating in all the three types. Most interestingly, 289 farms participate to one or two types of crops and could enter a second and/or a third one, but do not. It represents 27.8% of the farms and shows that if a farmer enters Extenso, he does not automatically choose to enter for every type of crop he could.

Figure 2: **Number of farms participating in Extenso for one, two or three types of crops over one year**



Note: The numbers are the mean numbers of the participants to one, two or three crop categories over the 11 years of the dataset. *Source:* Swiss FADN.

4.2.4. Explanatory variables

The explanatory variables are taken from the literature review (age, education, size, etc.) and I add the revenue per ha in t-1 and the pesticides cost in t-1 to test my hypothesis. I also add the fertilizers cost in t-1 and the proportion of "good" land and "bad" land per municipality. Here are the details of every explanatory variable and then their summary statistics. The first five variables test my hypothesis, the five next ones are the characteristics of the farmers and the last three the characteristics of the farms.

- Explanatory variables:

  - $(Revenue/ha)_{t-1}$:

The revenue are the francs received by selling the harvest of food grains or feed grains or rapeseed. Precisely it is a "net" production, because the revenue takes into account only the harvest sold on the market and does not cover the harvest kept by the farmers to feed the animals and as a stock. For the food grains and rapeseed the total production and the "net" production are close, but not for the feed grains which are by definition used to feed animals. Unfortunately the FADN provides data only on the "net" production, and not about what is internally kept by the farmer for his own cattle. I therefore expect the results for the feed grains to be less robust than those for the food grains and rapeseed. Ha are the hectares of the corresponding cultivated land.

The hypothesis is: the entrants have a lower ratio (revenue/ha) before participation than the non-entrants (a lower opportunity cost). With a low revenue, they have less to lose by participating.

– $(Pesticides\ cost/ha)_{t-1}$:

  Pesticides cost are the francs spent on pesticides used for food grains or feed grains or rapeseed. Ha are the hectares of the crop in question.

  The hypothesis is: The entrants have a lower pesticides cost before participation than the non-entrants. By adopting Extenso, the farmers who already used few pesticides before entry expect a smaller variation in their production than farmers using a lot of them. Thus the subsidy is more likely to cover the loss of the farmers producing less-intensively before the adoption of the scheme.

– $(Fertilizers\ cost/ha)_{t-1}$:

  Fertilizers cost are the francs spent on fertilizers used for food grains or feed grains or rapeseed. Ha are the hectares of the crop subject to Extenso. It is possible that the farmers using more fertilizers participate less because they produce intensively and have also more to lose by adopting Extenso. I use the ratio in t-1 although the adoption of Extenso has in theory no impact on the use of fertilizers. Since it is possible that, once they enter Extenso, the farmers use more fertilizers to compensate for the reduction in pesticides, I take the cost in t-1.

– *Good land*:

  It is the % of land by municipality with the code "one" in the soil suitability index. Code one stands for very good capacity for the production of cereals; it is applicable for the food and feed grains but not for rapeseed which is not a cereal. The quality of the soil is estimated with variables such as the nutritive substances content, the permeability, etc. I expect the farms in municipalities with a high proportion of good land to have a lower probability of entry to Extenso.

– *Bad land*:

  It is the % of land by municipality classified as "not suitable" for crop production in the soil suitability index. The non suitability is mainly based on the slope of the land. I expect the farms in municipalities with a high proportion of bad land to have a higher probability of entry to Extenso.

– *Age*: in years, age of the chief farmer. Generally it is predicted that younger farmers participate more often to voluntary schemes, though the results in the literature are not consistent.

– *Education*:

  The range is between 1 (no formation) to 5 (superior education as university). 2 stands for currently in formation/apprenticeship, 3 for a finished apprenticeship and 4 for higher education as a technical school. As age, the results in the literature are not consistent, but usually more education is assumed to lead to more participation.

– *Tenure*: It is the % of land rented by the farmer (versus land owned by the farmer). As this % increases, the probability of participation is assumed to decrease, although the results in earlier literature are discordant. It is suggested in the literature that owned land is better maintained by farmers than rented land, so farmers are more willing to adopt the scheme for their own land.

- *CHF from participation to Extenso in t-1*:

  It is the CHF received for the participation to Extenso in t-1 for the two other crop categories. For instance a farmer who adopts Extenso for his food grains in year t could have already produced his feed grains or/and rapeseed under Extenso in t-1. I expect that the more CHF already received for Extenso, the more probable the entry, because the farmer is already acquainted with the scheme.

- *% of the overall revenues from direct payments (except Extenso)*:

  It is the ratio (direct payments in CHF/overall revenues in CHF). Overall revenues are all the revenues resulting from agricultural and non-agricultural activities. Direct payments are the total payments received from the State minus the subsidies received for Extenso for the type of crop in question. I subtracted them, otherwise the entry to Extenso leads (almost) automatically to increase the ratio. The idea behind this ratio is: (a) some farmers are rather reluctant to comply with the rules prescribed by the authority about the agriculture, they feel as losing their freedom. As Extenso is voluntary, these farmers are less likely to enter because they will be even more dependent of the State. (b) In opposition, farmers receiving a large part of their revenues from the direct payments are at first sight not opposed to comply with the agricultural policy. Then I predict that the more revenues farmers get from direct payments, the more probable the adoption of Extenso.

- *UAA*: Utilised agriculture area in hectares. The UAA is the total area minus the forest. It is a measure of the size of the farms, sometimes found to increase or decrease the participation to voluntary schemes, but there is no consensus on the impact of the size on the participation.

– *Specialisation in crop production*:

  It is the % of the agricultural production[9] coming from the crop production. It is usually predicted that farms specialised in crop production participate more, despite the lack of convergence in the results.

– *Altitude*:

  As the altitude increases, the yields are reduced, and therefore I expect the altitude to have a positive impact on the probability of entry.

4.2.5. Summary Statistics

Table 3 displays the summary statistics of the explanatory variables for the non-entrants and entrants in parenthesis for the three crop categories. Some differences between the three are worth to note. First we see that the ratio (revenue/ha) in t-1 for the feed grains is much lower (2036 CHF) than for the food grains and rapeseed (around 3000 CHF). It comes mainly from the subtraction of the internal consumption as the revenues from the harvest are not very different from the food grains or rapeseed. Between 2007 and 2013, the overall revenues from the harvest (not the "net" production as in the dataset) were on average 2800 CHF/ha for barley and 2700 CHF/ha for triticale[10]. Data are not available for oats and before 2007, but the price of barley and triticale was higher before 2007[11] and oats account only for about 10% of the ha of feed grains. So the averages of 2800 and 2700 CHF/ha are even slightly too low for the period 2003-2013. We therefore see that on average about one third of the production of feed grains is used by the farmer for his own cattle or as a stock. I expect this to have an impact on my results, namely to lead to less robust result on the ratio (revenue/ha) in t-1 for the feed grains.

[9] Agricultural production = animal production + crop production

[10] Source: "Rapport de base", FADN, 2009, 2012 and 2013.

[11] Source: Agristat and FAO (Food and Agriculture Organisation).

Table 3: **Summary Statistics for the non-entrants (entrants)**

• **Food Grains: N= 2861 (286)**				
Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**
$(Revenue/ha)_{t-1}$ [in CHF]	3211 (2738)	1127 (1075)	0 (0)	9566 (5250)
$(Pesticides\ cost/ha)_{t-1}$ [in CHF]	318 (236)	146 (155)	0 (0)	1217 (927)
$(Fertilizers\ cost/ha)_{t-1}$ [in CHF]	294 (264)	161 (264)	0 (0)	1573 (1221)
Good land	0.20 (0.17)	0.22 (0.16)	0 (0)	1 (1)
Bad land	0.18 (0.20)	0.17 (0.19)	0 (0)	0.97 (0.74)
Age	48.2 (46.6)	9 (9)	19 (25)	74 (72)
Education	3.4 (3.3)	0.7 (0.8)	1 (1)	5 (5)
Tenure	37.9 (40.6)	28.9 (18.2)	0 (0)	100 (100)
CHF from partic. to Extenso in t-1	127 (322)	463 (774)	0 (0)	6500 (5856)
% overall revenues from direct paym.	0.19 (0.21)	0.09 (0.09)	0 (0.05)	1 (0.56)
UAA [in ha]	25.9 (26.8)	11.3 (13.7)	5.1 (7.6)	86 (117)
Specialisation in crop production	0.34 (0.30)	0.29 (0.27)	0 (0)	1 (1)
Altitude	543 (560)	112 (560)	280 (300)	1340 (916)
• **Feed Grains: N=3028 (276)**				
$(Revenue/ha)_{t-1}$ [in CHF]	2076 (1781)	1409 (1272)	0 (0)	17,683 (8280)
$(Pesticides\ cost/ha)_{t-1}$ [in CHF]	305 (228)	160 (169)	0 (0)	1640 (1331)
$(Fertilizers\ cost/ha)_{t-1}$ [in CHF]	253 (213)	158 (148)	0 (0)	1624 (882)
Good land	0.18 (0.15)	0.21 (0.21)	0 (0)	0.93 (0.95)
Bad land	0.18 (0.25)	0.18 (0.23)	0 (0)	1 (0.97)
Age	47.5 (47.1)	8.8 (8.8)	19 (25)	74 (67)
Education	3.5 (3.3)	0.7 (0.7)	1 (1)	5 (5)
Tenure	36.8 (39.4)	27.4 (28.2)	0 (0)	100 (100)
CHF from partic. to Extenso in t-1	372 (632)	878 (1018)	0 (0)	13,413 (5460)
% overall revenues from direct paym.	0.18 (0.21)	0.08 (0.09)	0 (0.09)	0.88 (0.54)
UAA [in ha]	25.1 (25.4)	11.1 (11.9)	6.3 (8.25)	86.1 (78.8)
Specialisation in crop production	0.30 (0.26)	0.28 (0.26)	0 (0)	1 (1)
Altitude	547 (591)	109 (133)	280 (306)	1200 (1440)
• **Rapeseed: N= 1940 (152)**				
$(Revenue/ha)_{t-1}$ [in CHF]	2948 (2594)	726 (644)	0 (0)	7243 (4261)
$(Pesticides\ cost/ha)_{t-1}$ [in CHF]	418 (339)	209 (172)	0 (0)	2058 (885)
$(Fertilizers\ cost/ha)_{t-1}$ [in CHF]	445 (360)	250 (204)	0 (0)	1782 (1111)
Bad land	0.20 (0.21)	0.18 (0.21)	0 (0)	0.85 (0.80)
Age	47 (47.1)	9.1 (8.8)	25 (26)	67 (65)
Education	3.4 (3.5)	0.7 (0.7)	1(1)	5 (5)
Tenure	43.9 (40.7)	28.2 (29.9)	0 (0)	100 (100)
CHF from partic. to Extenso in t-1	1384 (2255)	1847 (2248)	0 (0)	15,518 (13,544)
% overall revenues from direct paym.	0.23 (0.24)	0.09 (0.1)	0.03 (0.06)	0.70 (0.54)
UAA [in ha]	28.7 (29.6)	13.2 (9.9)	7.6 (9.9)	86.1 (78.8)
Specialisation in crop production	0.40 (0.41)	0.33 (0.31)	0 (0.02)	1 (1)
Altitude	537 (580)	106 (117)	300 (350)	870 (864)

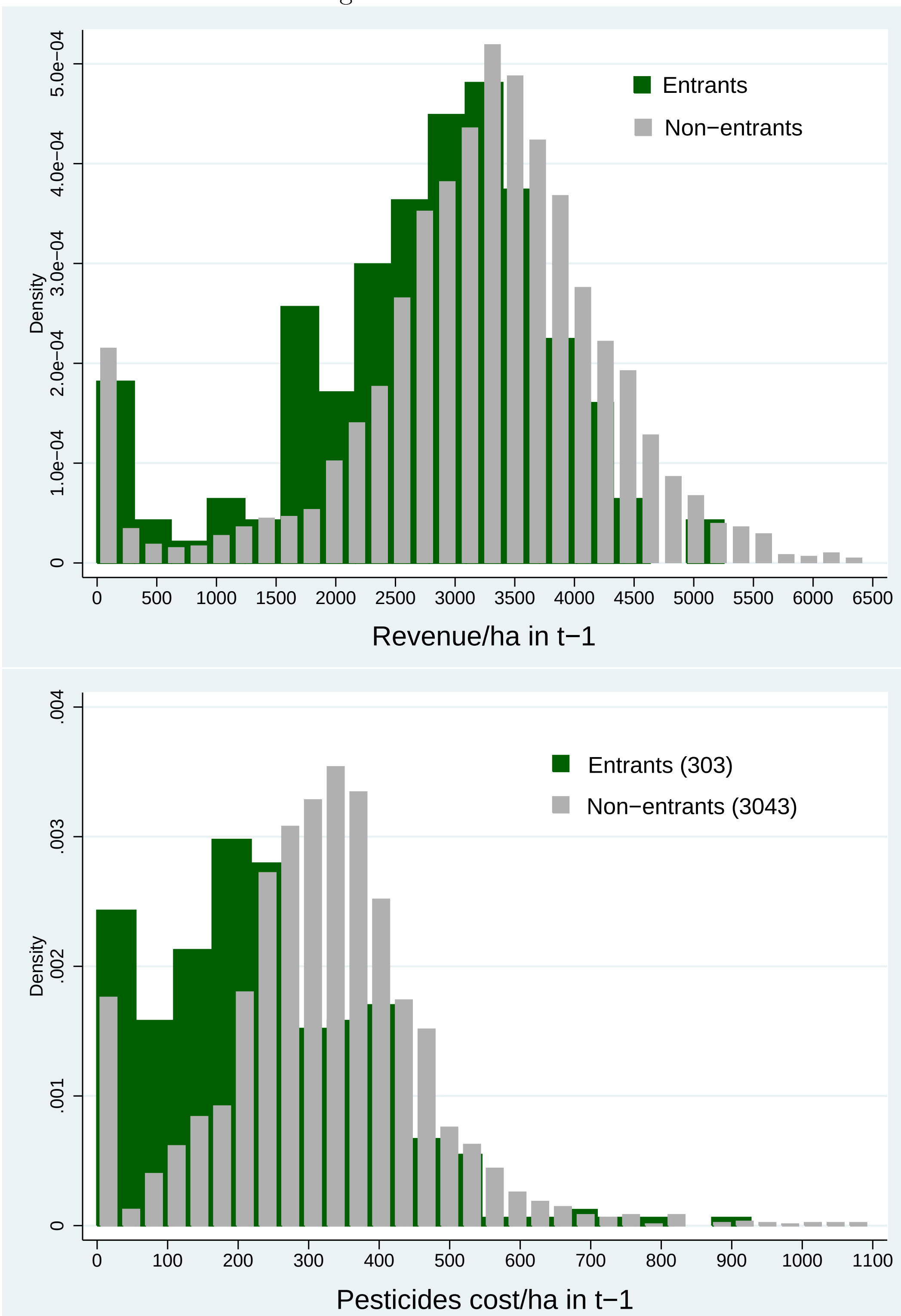
Sources: Swiss FADN for each variable, except FOS for good and bad land.

Secondly the pesticides cost is higher for rapeseed (414 CHF versus around 300 CHF for food and feed grains). It could explain the lower rate of participation in Extenso for rapeseed. If the farmers need more pesticides to cultivate rapeseed, they expect to lose more yield by giving up on pesticides than for food or feed grains.

Differences between the entrants and the non-entrants are also notable: the ratios revenue/ha, pesticides cost/ha and fertilizers cost/ha are lower for the entrants in t-1. The entrants receive also more CHF for other crops under Extenso in t-1 than the non-entrants. The differences in the revenue and pesticides cost in t-1 are the most important to test my hypothesis. Figure 3[12] displays the histograms for both variables for the food grains (figures 6 and 7 in the appendix for the feed grains and rapeseed). The non-entrants are in grey and the entrants in green. We see that the green part is always shifted towards the left, for both variables and the three types of crops. It means that the entrants have lower harvest revenues and used less pesticides *the year before they adopt Extenso* than the non-entrants. For the feed grains, the graph about the revenues is flatter on the left because of the internal consumption.

[12] Among the histograms presented, some have spaces between the bars; it is only for the readability of the figures, they are usual histograms.

Figure 3: **Food Grains**



Note: N=3346 (303 entrants and 3043 non-entrants). The entrants are characterised by lower revenue and pesticides cost per ha prior to their entry. *Source:* Swiss FADN.

4.2.6. Variations for the entrants and the outgoings

Here I briefly describe some variations in important variables for the entrants after they adopt Extenso and for the farmers exiting Extenso.

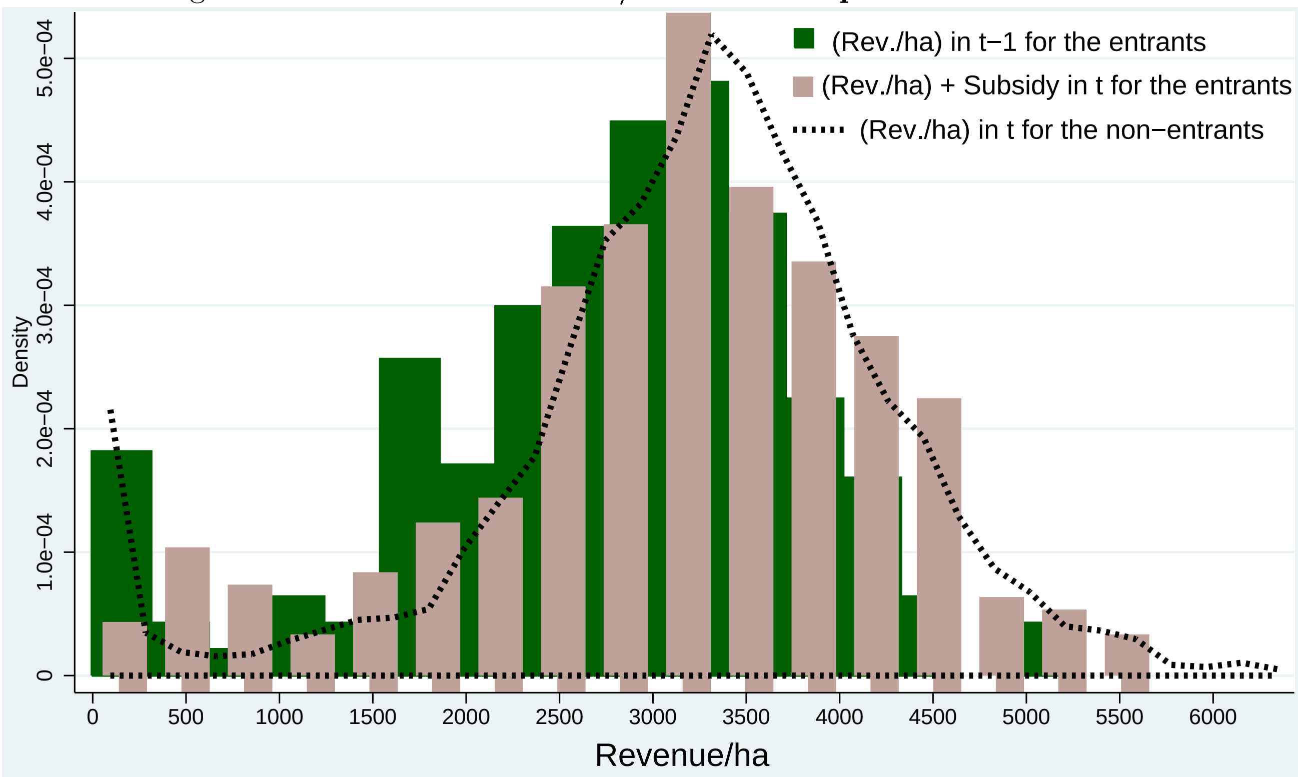
- On the ratio ($Revenue/ha$):

  After the entry, the ratio (revenue/ha) should diminish and for the outgoings increase after they stop Extenso. It is not always the case with the variations found in the panel. The problem is that I cannot separate the variations resulting from the adoption or the stopping of Extenso from other sources of variations. These other sources are a change in the price (not so important) and mainly a change in the yield due to weather conditions. Even across close regions the weather conditions can be disparate over a single year and lead to different yields. Specific studies are needed to examine the change in yield after adopting Extenso, and these studies report a loss of approximatively 5% to 30% of the yield. The average loss for wheat and barley, the two most important crops, is about 15%. I could not estimate these variations myself, nonetheless I contrast in figure 4 the revenue/ha received by the entrants in t-1 and the revenue/ha + the subsidy received in time t. We see that, after the adoption of Extenso, the revenue per ha increases slightly and the distribution becomes closer to the non-entrants (in dashes). The same pattern is apparent for rapeseed (appendix, figure 9), but less noticeable for the feed grains (appendix, figure 8).

- On the ratio ($Pesiticides\ cost/ha$):

  The sources of variations are less numerous for the pesticides cost than for the harvest revenues; the prices of pesticides are not very volatile and the quantity needed every year does not vary greatly as the quantity is prescribed for each pesticide. I can therefore examine the reduction in the use of pesticides due to the adoption of Extenso, and conversely the increase due to the stopping of Extenso.

Figure 4: **Food Grains: Before/after the adoption of Extenso**



Note: N=3346 (303 entrants and 3043 non-entrants). Once they adopted Extenso, the revenues of the entrants (harvest + subsidy) is closer to the revenues of the non-entrants. *Source:* Swiss FADN.

I find for the median farmer and namely for food grains, feed grains and rapeseed: -32% for the entrants (-1% for the non-entrants), -30% (-1%) and -23% (-1%). It is in line with the -31% found by Finger and El Benni (2013) for the farmers adopting Extenso for wheat in 1991. For the farmers stopping Extenso, the increase in the use of pesticides is of about the same magnitude: +27% for the food grains, +34% for the feed grains and +20% for rapeseed. A reduction of 30% could seem small, but herbicides are still allowed with Extenso and are a part of the pesticides. According to the FOS, herbicides accounted for 38% of all pesticides between 2006 and 2012. We could therefore expect a reduction in the pesticides of about 62% for the farms adopting Extenso. The reduction is in fact much lower, and it may suggest a substitution from pesticides to herbicides, i.e. the entrants use more herbicides once they adopt Extenso.

> Another explanation for the low reduction in pesticides is that the average of 38% of herbicides is for all the farms. Farms cultivating crops and concerned by Extenso (versus farms specialised in animal production) have possibly a higher % of herbicides in their pesticides.

Other substitution effects are possible, such as the use of more fertilizers to compensate for the reduction of pesticides. However I do not find a significant variation in the fertilizers cost between t-1 and t for the entrants. I keep this variable in t-1, but I could as well use it in t. Substitution towards more work or more capital (use of machines for weeding for instance) is also likely. About the work, the FOAG actually considers a decrease after the adoption of Extenso since less time is spent in the fields spraying pesticides. Anyway, if some substitutions of any kind exist, it is in time t, and it does not affect the time t-1 on which I focus.

No significant variations are found for the entrants and the outgoings in terms of: UAA, the proportion of the crops concerned by Extenso in the total UAA, and the proportion of each detailed crop (for instance wheat, rye and dinkel for the food grains) in their crop category.

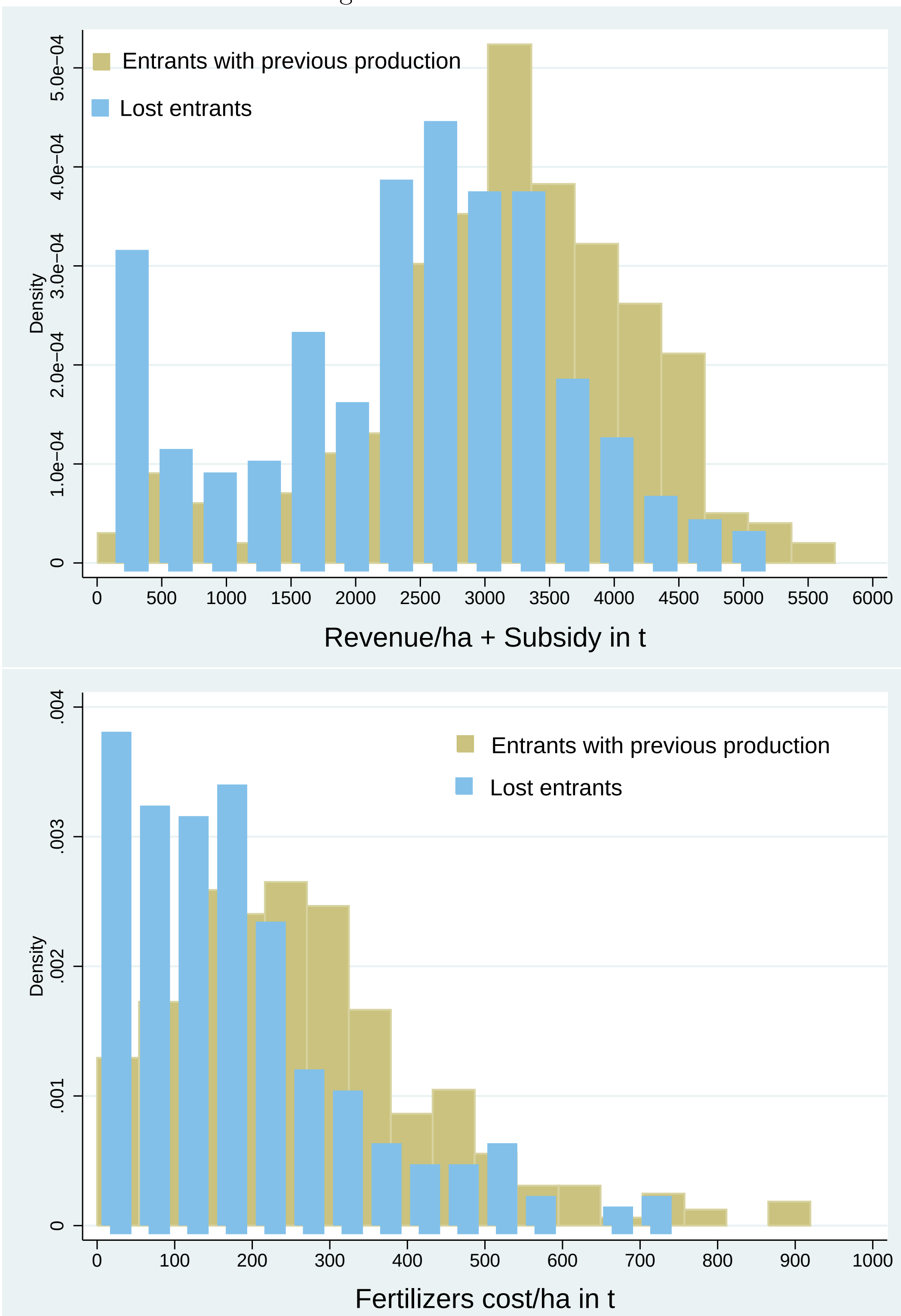
4.2.7. Lost entrants

The lost entrants are the farmers adopting Extenso who did not cultivate the crop in question in t-1. Thus all the variables in t-1 are missing for them. Since they account for approximately half of the entrants for the food and feed grains, and one fifth for rapeseed, they could have a noticeable impact on my conclusions if they are different from the entrants with previous production of the crop in question. The ”entrants with previous production” are the farmers entering Extenso and cultivating the crop in question in t-1, as previously defined.

I cannot compare the two groups of entrants on variables in t-1, therefore I look at variables in t. The lost entrants have one specificity: they seem to be less intensive producers than the entrants with previous production. It is based on two indicators: first, once the lost entrants adopt Extenso, their revenue (including the subsidy) is lower than the revenue of the entrants with previous production, and secondly the lost entrants use less fertilizers in time t. Figure 5 shows it for the food grains. The blue distribution (lost entrants) is shifted towards the left. It is slightly less apparent for the feed grains and for rapeseed (figures 10 and 11 in the appendix), for rapeseed because of the small number of lost entrants (only 37).

What is the impact on my analysis? It is not possible to know the revenue per ha in t-1 for the lost entrants, but in all likelihood it would be lower than for the entrants with previous production, idem for the pesticides cost in t-1. Hence if it was possible to include them, they would actually reinforce the hypothesis that the entrants have lower ratios (revenue/ha) and (pesticides cost/ha) in t-1.

Figure 5: **Food Grains**



Note: 303 entrants with previous production, 258 lost entrants. The lost entrants look like less intensive producers than the entrants with previous production. *Source:* Swiss FADN.

5. Econometric Models[13]

The specificity of my model is that the dependent variable $Y_{i,t}$ is binary (1 if entry, 0 if non-entry):

$Y_{i,t} = 1$ or $Y_{i,t} = 0$ with: $P_{i,t} = Pr(Y_{i,t} = 1)$

Where i denotes the individual farm and t denotes time. Applying a linear probability model would lead the probabilities to be outside the range of 0 and 1, so I apply a logit model. Results from a probit model confirm findings with the logit model and are therefore not reported. Results are available upon request from the author. I use the "xtlogit" command from STATA to perform the regressions. It is more efficient (lower standard errors) than a pooled logit model, because the pooled model assumes independence over i and t. These panel correlations are accommodated by the panel command. I use a random-effect (RE) model and a population averaged (PA) model. The PA model is useful to compute more easily the marginal effects than in the RE model. Finally a fixed effect (FE) model is not adapted because all the farms never entering Extenso are dropped, and they account for 50 to 75% of the observations. Furthermore these farms are of upper importance for the analysis, to compare them to the farms adopting Extenso, and it makes no sense to eliminate them.

The pooled logit model is:

$$Pr(Y_{i,t} = 1|\mathbf{x}_{i,t}) = \Lambda(\alpha + \mathbf{x}_{i,t}\beta) \tag{1}$$

where $P_{i,t} = \Lambda(Z_{i,t}) = e^{Z_{i,t}}/(1 + e^{Z_{i,t}})$ and $e^{Z_{i,t}} = P_{i,t}/(1 - P_{i,t})$, i.e. the odds ratio or the expected number of successes per failure. The vector $\mathbf{x}_{i,t}$ includes k explanatory variables. The unknown parameter β is a *k x 1* vector with elements corresponding to the explanatory variables. The error terms $e_{i,t}$ are assumed to follow a logistic standard distribution with

[13] I rely on chapter 10 "Dichotomous or binary responses" from Rabe-Hesketh and Skrondal (2008), chapter 18 "Nonlinear panel models" from Cameron and Trivedi (2009) and Szmaragd et al. (2013).

mean 0 and variance σ_e^2, which is approximately 3.29.

The logit model produces a linear model for the log of the odds:

$$ln(\frac{P_{i,t}}{1-P_{i,t}}) = Z_{i,t} = \alpha + \mathbf{x}_{i,t}\beta \tag{2}$$

If we add one unit to the regressor 1 (holding everything else constant), we must add β_1 to the log of the odds; so the value of the β is not easily interpreted, only its sign is. A positive β means that the probability of entry increases as the regressor rises, and vice-versa for a negative β. We must compute separately the marginal effect of the regressors on the probability of entry.

The RE logit model is:

$$Pr(Y_{i,t} = 1|\mathbf{x}_{i,t}, u_i) = \Lambda(\alpha + \mathbf{x}_{i,t}\beta + u_i) \tag{3}$$

where u_i is a random intercept and $u_i \sim N(0, \sigma_u^2)$. This random and individual intercept accounts for autocorrelation due to the omitted time-invariant variables for an individual subject. The marginal effects (MEs) depend on u_i, yet u_i is not estimated. We can evaluate the MEs at $u_i = 0$, but this can be a non representative point and may understate the MEs. Hence the MEs are more easily interpreted with a PA logit model in which there is no u_i.

The model I estimate called "RE logit" is:

$$\begin{aligned} Pr(Y_{i,t} = 1|\mathbf{x}_{i,t}, u_i) = \Lambda[&\alpha + \beta_1(REVENUE/HA)_{i,t-1} + \beta_2(PESTICIDES\ COST/HA)_{i,t-1} \\ &+ \beta_3(FERTILIZERS\ COST/HA)_{i,t-1} + \beta_4 GOOD\ LAND_{i,t} \\ &+ \beta_5 BAD\ LAND_{i,t} + \beta_6 AGE_{i,t} + \beta_7 EDUCATION_{i,t} + \beta_8 TENURE_{i,t} \\ &+ \beta_9(CHF\ PARTIC.\ IN\ t-1)_{i,t-1} + \beta_{10}(\%\ REV.\ DIRECT\ PAYM.)_{i,t} \\ &+ \beta_{11} UAA_{i,t} + \beta_{12} SPEC.\ CROP_{i,t} + \beta_{13} ALTITUDE_{i,t} + u_i] \end{aligned} \tag{4}$$

This model is for food grains and feed grains, for rapeseed the variable "good land" is dropped because applicable only to cereals.

The intra-class correlation (ICC), available for the RE model but not the PA model, is a measure of the extent to which the observations in a cluster are correlated. Clusters are the individual farms.

$$ICC = \rho_{RE} = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_e^2} = \frac{\sigma_u^2}{\sigma_u^2 + 3.29} \tag{5}$$

As Rodrıguez and Elo (2003) note, the ICC "turns out to represent the ratio of the variance of the random effect u_i to the total variance and thus can be interpreted as the proportion of variance explained by clustering."

The PA logit model is:

$$Pr(Y_{i,t} = 1|\mathbf{x}_{i,t}) = \Lambda(\alpha + \mathbf{x}_{i,t}\beta^{PA}) \tag{6}$$

Under the PA model, the odds ratio represents the odds of an *average* person. The β estimated are different from the RE model and I write β^{PA} for the PA model. The probabilities of $Y_{i,t} = 1$ are obtained by taking the mean of the RE model probabilities at each value of the regressors. The RE and PA coefficients are related by:

$$\beta^{PA} \approx \sqrt{\frac{3.29}{3.29 + \sigma_u^2}} * \beta^{RE} \tag{7}$$

The greater σ_u^2, the greater the β^{RE} coefficients are compared to the PA ones. It is also necessary to choose a structure for the correlations among the observed responses:

$$\rho_{t,s} = Cor[(Y_{i,t} - \Lambda(\mathbf{x}_{i,t}\beta^{PA}))(Y_{i,s} - \Lambda(\mathbf{x}_{i,s}\beta^{PA}))], s \neq t \tag{8}$$

Two correlation structures are usually used in the literature. I use the exchangeable structure. It assumes the same correlation for every pair of residuals on a subject, regardless of how many years apart the observations lie. Thus the parameter $\hat{\rho}_{t,s}$ is a constant. The other possibility would have been a structure in which residuals are assumed to be mutually independent. As Szmaragd et al. (2013) note, the standard errors will be too small unless there is no or very little autocorrelation.

The model I estimate called "PA logit" is:

$$\begin{aligned}
Pr(Y_{i,t} = 1|\mathbf{x}_{i,t}) = \Lambda[\alpha &+ \beta_1^{PA}(REVENUE/HA)_{i,t-1} + \beta_2^{PA}(PESTICIDES\ COST/HA)_{i,t-1} \\
&+ \beta_3^{PA}(FERTILIZERS\ COST/HA)_{i,t-1} + \beta_4^{PA}GOOD\ LAND_{i,t} \\
&+ \beta_5^{PA}BAD\ LAND_{i,t} + \beta_6^{PA}AGE_{i,t} + \beta_7^{PA}EDUCATION_{i,t} + \beta_8^{PA}TENURE_{i,t} \\
&+ \beta_9^{PA}(CHF\ PARTIC.\ IN\ t-1)_{i,t-1} + \beta_{10}^{PA}(\%\ REV.\ DIRECT\ PAYM.)_{i,t} \\
&+ \beta_{11}^{PA}UAA_{i,t} + \beta_{12}^{PA}SPEC.\ CROP_{i,t} + \beta_{13}^{PA}ALTITUDE_{i,t}] \qquad (9)
\end{aligned}$$

This model is for food grains and feed grains, for rapeseed the variable "good land" is dropped. I compute cluster-robust standard errors.

Expected sign of the coefficients:

The most important coefficients to test my hypothesis are β_1 and β_2. I expect both to be negative. I also expect β_3 and β_4 to be negative. β_5, β_9, β_{10} and β_{13} should be positive. Because of the mixed results presented in the literature review, I do not predict the sign of the other β (age, education, tenure, size and specialisation in crop).

6. Results

In this part I first present t-tests performed on the means of the harvest revenues and pesticide costs for the entrants and non-entrants, then I estimate the equations (4) and (9) and the marginal effects, and finally I test the robustness of these results.

6.1 T-tests on means

Tables 4 and 5 show the difference in the ratios $(Revenue/ha)_{t-1}$ and $(Pesticides\ cost/ha)_{t-1}$ for the entrants and non-entrants for the food grains. Tables for the feed grains and rapeseed are in the appendix (tables 13 to 16). To test the significance of the difference I used a t-test with equal or unequal variance depending on the years (I previously tested for the equality of the variances). For the food grains, for all years the entrants have a lower harvest revenue in t-1 than the non-entrants. The difference is significant eight years out of ten. For the pesticides cost, the ratio is also always lower for the entrants and significant nine years out of ten.

Obviously we need to control the effect by including other variables, which is done in the next part, but these t-tests already show that the opportunity cost seems to be taken into account by the farmers. Those who have a lower revenue, and hence have to give up less in terms of harvest revenue, are more likely to adopt the scheme. The entrants are also characterised by a lower utilisation of pesticides in t-1. The more pesticides they use, the higher the variation in yield they expect by adopting Extenso, and the more chances the subsidy will not cover their loss. In the end, the farmers polluting more participate less often than the farmers who produced already less intensively before their entry.

For the feed grains the difference in the use of pesticides is significant for all years and for rapeseed for seven years. For the ratio $(revenue/ha)_{t-1}$ it is less often significant (only 4 years and 6 years respectively). It comes for the feed grains in all likelihood from the construction of the variable, with the internal consumption not taken into account. For rapeseed the limited number of entrants explains the lack of significance. Since 2003 the % of hectares of rapeseed under Extenso has fallen from 34% to 13%. In this context the number of entrants in the dataset is not high for rapeseed.

Table 4: **Food grains: Difference in (Revenue/ha) in year $t-1$**

Year	**Entrants (n)**	**Non-entrants (n)**	**Significance of the difference**	**P-value**
2004	2’910 CHF (31)	3’120 CHF (257)		0.1462
2005	3’110 CHF (30)	3’520 CHF (312)	**	0.0269
2006	2’720 CHF (36)	3’185 CHF (329)	***	0.0059
2007	2’580 CHF (31)	2’980 CHF (340)	**	0.0211
2008	2’390 CHF (31)	3’105 CHF (342)	***	0.0013
2009	2’725 CHF (27)	3’580 CHF (361)	***	0.0001
2010	2’835 CHF (29)	3’310 CHF (318)	***	0.0044
2011	2’700 CHF (37)	2’785 CHF (274)		0.3136
2012	2’965 CHF (27)	3’395 CHF (265)	**	0.0445
2013	2’330 CHF (24)	2’910 CHF (245)	**	0.0110

Note: Reading the first line: those who entered Extenso in 2004 had a mean revenue of 2’910 CHF per ha in 2003. Those who did not enter Extenso in 2004 had a mean revenue of 3’120 CHF per ha in 2003. * $p < .1$, ** $p < .05$, *** $p < .01$

Table 5: **Food grains: Difference in (Pesticides cost/ha) in year $t-1$**

Year	**Entrants (n)**	**Non-entrants (n)**	**Significance of the difference**	**P-value**
2004	210 CHF (31)	315 CHF (256)	***	0.0000
2005	225 CHF (30)	325 CHF (311)	***	0.0003
2006	265 CHF (36)	345 CHF (328)	***	0.0044
2007	215 CHF (30)	345 CHF (339)	***	0.0000
2008	235 CHF (31)	340 CHF (342)	***	0.0001
2009	305 CHF (27)	330 CHF (360)		0.2673
2010	240 CHF (29)	305 CHF (318)	**	0.0342
2011	255 CHF (37)	295 CHF (274)	*	0.0701
2012	195 CHF (27)	280 CHF (264)	***	0.0002
2013	175 CHF (24)	275 CHF (245)	***	0.0001

Note: On the first line: those who entered Extenso in 2004 had a mean of 210 CHF of (pesticides cost/ha) in 2003. Those who did not enter Extenso in 2004 had a mean of 315 CHF of (pesticides cost/ha) in 2003. * $p < .1$, ** $p < .05$, *** $p < .01$

6.2 Estimation of equations (4) and (9)

The equation (4) is estimated by maximum likelihood and the equation (9) by generalized estimating equations (GEE). The results for the food grains are presented in table 6, feed grains and rapeseed are in the appendix in tables 17 and 18. Recall that only the sign is easily interpretable in the table and not the value of the coefficients. I add in table 6 the regressions without the first five variables used to test my hypothesis. It is to control whether the "traditional" variables are significant in that case. Finally I also estimate both equations with the expanded number of entrants (including the lost entrants). In that case I drop the revenue and pesticide costs per ha in t-1, and use the fertilizers cost per ha in t instead of t-1 as the adoption of Extenso has no significant impact on the use of fertilizers. The results are reported in table 19 in the appendix.

When the full model is estimated (columns b of table 6), three variables, in grey in the table, display consistent (same sign) and significant results for the three types of crops: $(Revenue/ha)_{t-1}$, $(Pesticides\ cost/ha)_{t-1}$ and *CHF from partic. in t-1*. These three variables have the expected sign. $(Revenue/ha)_{t-1}$ is significant at the 1% level for the food grains and rapeseed, but only at the 10% level for the feed grains, which is explained by the internal consumption. As the ratio increases (holding everything else constant), the probability of entry decreases. It is the same for the pesticides cost in t-1, which is significant at the 1% level for the three types of crops. The conclusions that the farmers take the opportunity cost into account and that the more intensive farmers participate less hold when controlling for other variables.

β_3, β_4 and β_5 also have the expected sign, although they are not always significant. These coefficients support my hypothesis, the probability of entry is lower if: the farmers use more fertilizers in t-1, the farm is located in a municipally with a high share of "good" land. On the opposite, as the share of "bad" land increases, the probability of entry increases too.

Table 6: **Food Grains: Estimation of equations (4) and (9)**

	(1a) RE Logit	(1b) RE Logit	(2a) PA Logit	(2b) PA Logit
$(Revenue/ha)_{t-1}$	-	-0.0004***	-	-0.0002***
		(0.00009)		(0.00005)
$(Pesticides\ cost/ha)_{t-1}$	-	-0.0043***	-	-0.0031***
		(0.00072)		(0.00053)
$(Fertilizers\ cost/ha)_{t-1}$	-	-0.0003	-	-0.0002
		(0.00065)		(0.00042)
Good land	-	-0.6972	-	-0.4233
		(0.62855)		(0.36112)
Bad land	-	0.3226	-	0.2293
		(0.75144)		(0.43185)
Age	-0.0031	-0.0148	-0.005	-0.0136*
	(0.0118)	(0.01294)	(0.0058)	(0.00763)
Education	0.0193	-0.1079	0.0403	-0.0617
	(0.1564)	(0.16936)	(0.0816)	(0.10356)
Tenure	0.0048	0.0014	0.0024	0.0006
	(0.0041)	(0.00445)	(0.0021)	(0.00254)
CHF from partic. in (t-1)	0.0011***	0.0006***	0.0007***	0.0004***
	(0.0001)	(0.00018)	(0.0001)	(0.00010)
% revenue from dir. paym.	6.3748***	4.3237***	3.2485***	1.9940***
	(1.1979)	(1.35951)	(0.7473)	(0.77501)
UAA	-0.0335***	0.0104	-0.0226***	0.0052
	(0.0105)	(0.01097)	(0.0058)	(0.00692)
Spec. crop	-1.9299***	-0.5277	-1.2477***	-0.2604
	(0.4375)	(0.48714)	(0.2587)	(0.28832)
Altitude	0.0032***	-0.0009	0.0016***	-0.0006
	(0.0009)	(0.00116)	(0.0005)	(0.00072)
Constant	-4.4737***	-0.2197	-2.189***	0.1537
	(1.0359)	(1.14775)	(0.5067)	(0.66593)
N (# of entrants)	3851 (561)	3147 (286)	3851 (561)	3147 (286)
% c.p. non-e (e)		0.89 (0.33)		0.62 (0.72)
sigma_u	2.818	2.308		
ICC from (5)	0.707	0.618		
$\rho_{t,s}$ from (8)			0.225	0.082
Log likelihood	-1288	-839		
Wald chi2	145.67	88.13	135.07	120.81
Prob > chi2	0.000	0.000	0.000	0.000

Note: Standard errors in parentheses for RE, semi-robust s.e. for PA. C.p. stands for correctly predicted, non-e for the non-entrants and e for the entrants. % estimated at $u_i = 0$ for RE. Cut-off at $\hat{Y}_{i,t} \geq 0.099$.
* $p < .1$, ** $p < .05$, *** $p < .01$

Two other variables present a consistent sign, but lack significance. It is the % of the revenues received from the direct payments (always positive, as expected) and the specialisation in crop production (always negative). This negative sign makes sense; since farms specialised in crop production are in all likelihood more productive to cultivate crops than to raise animals, they tend to participate less as they would lose more by participating than less productive and non-specialised farms. Altitude is positive and significant for the feed grains and rapeseed, which supports the evidence that when the farmers have to give up less yield (higher altitude) they tend to participate more often. Finally the variables age, education, tenure and UAA display non-consistent and hardly ever significant coefficients.

The two columns a, when the OC variables are not included, contrast this conclusion: UAA and crop specialisation become very significant for the food and feed grains. I show that this result is not robust to the addition of variables testing for the opportunity costs. Yet the correlations between UAA or crop specialisation and the OC variables are rather low. The highest is with the fertilizers cost: 0.23 (UAA) and 0.36 (spec. crop.) for the entrants, 0.17 (UAA) and 0.27 (spec. crop.) for the non-entrants for the food grains. For the feed grains it is 0.28 (UAA) and 0.23 (spec. crop.) for the entrants, 0.15 (UAA) and 0.26 (spec. crop.) for the non-entrants. The crop specialisation is also slightly positively correlated with the revenue in t-1 for the food and feed grains, between 0.23 and 0.33 for the entrants and non-entrants.

Other statistics are also reported in the table. N is slightly lower than in the t-test tables, because the variables good and bad land are missing for some observations. Sigma_u is the estimated residual standard deviation of the random intercept and $\rho_{t,s}$ shows that the correlation between the residuals in a cluster in the PA model is close to zero. The standard errors are semi-robust for the PA model, but this option is not possible for the RE model. Instead I computed the standards errors for the RE model with the bootstrapping option, but as the s.e. are very similar without this option I kept normal s.e.. Despite this difference on the s.e., the results are consistent between the RE and PA models, the coefficients have the same sign and are related as described in equation (7).

In terms of the % of non-entrants and entrants correctly predicted, the PA model is better to predict the entrants (72% versus only 33% in the RE model). In the RE model, the u_i are set to zero to estimate these proportions. The usual cut-off for a correct prediction of $Y_{i,t} = 1$ is $\hat{Y}_{i,t} \geq 0.5$; and $\hat{Y}_{i,t} < 0.5$ for a correct prediction of $Y_{i,t} = 0$. As Cramer (1999) shows, it is not applicable when the sample is unbalanced between the two outcomes, and here the entrants represent only 9.9% of the sample. I therefore apply a cut-off at $\hat{Y}_{i,t} \geq 0.099$ for a correct prediction of $Y_{i,t} = 1$, as recommended by Cramer. In the robustness part I compute a balanced sample between the non-entrants and the entrants by randomly drawing the non-entrants and the % correctly predicted are more reliable.

To summarize, the significant variables to explain the adoption or not of Extenso are those reflecting the opportunity cost of entry and the past participation to Extenso (here the previous year). As the revenue per ha in t-1 increases, the probability of entry decreases, idem for the pesticides cost in t-1. When the opportunity cost is considered, the traditional variables size and crop specialisation are non-significant. These conclusions hold when the lost entrants are included (table 19 in the appendix): the ratio (Fertilizers cost/ha) in t (negative sign), the proportion of good land (negative sign) and the altitude (positive sign) are highly significant. With the lost entrants, the variables UAA and crop specialisation are again significant in the absence of the variables in t-1.

A variable reflecting the concern about the environment is missing due to lack of data. Yet such a variable may already be present in the variables *% of overall revenues from the direct payments* and *CHF from participation in t-1*. Moreover Wilson and Hart (2001), in a study on the participation to an ecological scheme in the UK, ask the farmers why they enter the scheme. 87% of them answer "for financial reasons", while only 23% say they "wish to promote environmental conservation" (multiple answers were possible). Besides, a quarter of the participants could enter Extenso for one or two other crop types but do not; environmental concerns do therefore not seem to be the main driving force for the entry.

Marginal Effects

To interpret the value of the coefficients more easily, the marginal effects (MEs) must be separately computed. The PA model is preferred to interpret the MEs, as in the RE model the MEs depend on u_i, which is not estimated. It is possible to evaluate the MEs at $u_i = 0$, but this may understate them. Hence I present here the MEs for the food grains for the PA model. For the RE model and for the feed grains and rapeseed, the tables are in the appendix (tables 20 to 24).

MEs are calculated as the average marginal effects (AMEs), i.e. it is the mean of the MEs of all the observations:

$$\Delta(x_k|x_{i,t}) \equiv \frac{\partial Pr(Y_{i,t} = 1|x_{i,t})}{\partial x_k} = \beta_k \cdot \frac{exp(\alpha + x_{i,t}\beta)}{[1 + exp(\alpha + x_{i,t}\beta)]^2} \tag{10}$$

$$AME(x_k|x_{i,t}) = \frac{1}{N}\Sigma_{i=1}^{N}\Delta(x_k|x_{i,t}) \tag{11}$$

where $u_i = 0$ for the RE model; and β stands for β^{PA} for the PA model.

Table 7 shows the AMEs for food grains and the PA model. The AMEs for the RE model are indeed lower than for the PA model, for the three types of crops. The AMEs for the three consistent and significant variables are: an increase in the revenue of 500 CHF per ha in t-1 decreases the probability of entry by 1% ; an increase of 100 CHF in the pesticides cost per ha in t-1 reduces the probability of entry by 2.8% ; an increase of 500 CHF in the past participation for other crops raises the probability of entry by 1.85%.

These marginal effects seem rather low. Why? First the AMEs are an average over all the observations, and as the number of entrants is much lower than the non-entrants, the average represents more the non-entrants. Second the $Pr(Y_{i,t} = 1)$ estimated by the PA model for the entrants is on average only 16.2% for the food grains, 15.2% for the feed grains and 13.2% for rapeseed (versus 10.1%, 8.9% and 7.8% for the non-entrants). This low % could explain the low AMEs. These problems are reduced by using a balanced sample between the non-entrants and the entrants, which I do in the next part.

Table 7: **Average Marginal Effects for Food Grains, PA model**

Variable	**dy/dx**	**Std. Err.**	**z**	**P > z**
$(Revenue/ha)_{t-1}$	-0.00002	4.63E-06	-4.26	0.000
$(Pesticides\ cost/ha)_{t-1}$	-0.00028	4.82E-05	-5.74	0.000
$(Fertilizers\ cost/ha)_{t-1}$	-0.00002	3.79E-05	-0.50	0.619
Good land	-0.0379	3.23E-02	-1.17	0.241
Bad Land	0.0205	3.86E-02	0.53	0.595
Age	-0.0012	6.83E-04	-1.78	0.076
Education	-0.0055	9.25E-03	-0.60	0.551
Tenure	0.00005	2.28E-04	0.22	0.824
CHF from partic. in t-1	0.000037	8.93E-06	4.13	0.000
% revenue dir. paym.	0.1785	6.90E-02	2.57	0.010
UAA	0.0005	6.19E-04	0.75	0.451
Spec. crop.	-0.0233	2.58E-02	-0.90	0.366
Altitude	-0.00006	6.47E-05	-0.89	0.374

Note: An increase of 1 CHF in the revenue per ha decreases the probability of entry by 0.002%.

6.3 Robustness Checks

6.3.1. Random drawings of the non-entrants

To test the robustness of my results I compute balanced samples, i.e. with the same number of non-entrants and entrants. When computing more balanced samples, we must determine how many zeros to take into account. King and Zeng (2001) show that, for rare events data (coded as 1), Pr(Y = 1) is underestimated, and Pr(Y = 0) is overestimated. They suggest to collect the same number of zeros and one if the standard errors and confidence intervals are narrow enough. It is the case with my dataset, so it means for the food grains to keep 286 non-entrants out of 2861, for the feed grains 276 out of 3028, and for rapeseed 152 out of 1940. The non-entrants are randomly selected. The average coefficients and average standard errors over 100 random drawings are reported in table 8 for the RE and PA models.

There is only a slight variation in the coefficients of the significant variables compared to the full model. One difference is that now the revenues per ha are non-significant for the feed grains, which is most probably explained by the internal consumption. The % of non-entrants and entrants correctly predicted are this time very similar between the RE and PA models, and vary between 65 and 69%.

Table 9 displays the average marginal effects from the 100 random drawings, to check whether the AMEs are higher than with the unbalanced panel, and they indeed are. Only the variables which were significant for at least two crop types are kept. The variation in the probability of entry for a change of roughly the standard deviation is computed, and the AMEs are reported in parenthesis in the table. For instance, for the food grains, by increasing the revenue per ha by 500 CHF, the probability of entry decreases by 4.2% in the RE model and by 3.1% in the PA model.

Table 8: **Estimation of equations (4) and (9) for 100 random drawings of the non-entrants**

	Food G. RE	**Food G. PA**	**Feed G. RE**	**Feed G. PA**	**Rapes. RE**	**Rapes. PA**
$(Revenue/ha)_{t-1}$	-0.0004***	-0.0003***	-0.0001	-0.00009	-0.0011***	-0.0006***
	(0.00015)	(0.00009)	(0.0001)	(0.00007)	(0.0004)	(0.0002)
$(Pesti.\ cost/ha)_{t-1}$	-0.0046***	-0.0032***	-0.0034***	-0.0023***	-0.0021*	-0.0013*
	(0.0011)	(0.0007)	(0.0010)	(0.0007)	(0.0013)	(0.0007)
$(Ferti.\ cost/ha)_{t-1}$	-0.0003	-0.0002	-0.0024**	-0.0015**	-0.0019*	-0.0010*
	(0.0009)	(0.0007)	(0.0011)	(0.0007)	(0.0011)	(0.0006)
Good land	-0.4091	-0.2638	-0.3430	-0.1766	-	-
	(0.7190)	(0.4692)	(0.7811)	(0.4930)		
Bad land	0.5226	0.3257	1.7556*	1.1686**	-0.0609	-0.0279
	(0.9188)	(0.6196)	(0.8975)	(0.5309)	(1.2981)	(0.7209)
Age	-0.0265	-0.0185*	0.0039	0.0009	0.0026	-0.0002
	(0.0163)	(0.0109)	(0.0176)	(0.0113)	(0.0276)	(0.0159)
Education	-0.1387	-0.0871	-0.5367**	-0.3602**	0.0701	0.0252
	(0.2001)	(0.1280)	(0.2473)	(0.1530)	(0.3349)	(0.2055)
Tenure	0.0008	0.0006	0.0062	0.0040	-0.0011	-0.0007
	(0.0056)	(0.0038)	(0.0062)	(0.0038)	(0.0093)	(0.0052)
CHF partic. in (t-1)	0.0007***	0.0005**	0.0006***	0.0004***	0.0004 **	0.0002***
	(0.0003)	(0.0002)	(0.0002)	(0.0001)	(0.00015)	(0.00008)
% revenue dir. paym.	4.6276 **	3.2612**	3.2927	2.2346*	0.5226	0.2885
	(2.0802)	(1.4541)	(2.1036)	(1.3153)	(2.9353)	(1.6556)
UAA	0.0014	0.0029	-0.0047	-0.0039	-0.0067	-0.0030
	(0.0134)	(0.0092)	(0.0147)	(0.0092)	(0.0211)	(0.0118)
Spec. crop	-0.397	-0.2555	-0.6905	-0.4450	-0.4634	-0.2012
	(0.6079)	(0.4012)	(0.6794)	(0.4261)	(0.9089)	(0.4993)
Altitude	-0.0006	-0.0003	0.0040**	0.0025***	0.0047*	0.0028**
	(0.0015)	(0.0011)	(0.0016)	(0.0009)	(0.0026)	(0.0014)
Constant	3.8371 **	2.4389**	0.0168	0.1865	1.5458	0.7495
	(1.5042)	(0.9972)	(1.6021)	(1.0297)	(2.6746)	(1.4972)
N	572	572	552	552	304	304
% c.p. non-entrants	0.65	0.66	0.68	0.67	0.68	0.69
% c.p. entrants	0.68	0.68	0.67	0.67	0.68	0.69

Note: Standard errors in parentheses for RE, semi-robust s.e. for PA. C.p. stands for correctly predicted, % estimated at $u_i = 0$ for RE. Cut-off at $\hat{Y}_{i,t} \geq 0.5$.

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 9: **Average Marginal Effects from the random drawings**

	△ (∼ one s.d.)	**Food G. RE**	**Food G. PA**	**Feed G. RE**	**Feed G. PA**	**Rapes. RE**	**Rapes. PA**
$(Revenue/ha)_{t-1}$	+500 CHF	-4.2% (-0.000083)	-3.1% (-0.000061)	n.s.	n.s.	-9.5% (-0.00019)	-6.5% (-0.00013)
$(Pesti.\ cost/ha)_{t-1}$	+100 CHF	-8.7% (-0.00087)	-6.8% (-0.00068)	-6.2% (-0.00062)	-4.8% (-0.00048)	-3.6% (-0.00036)	-2.7% (-0.00027)
$(Ferti.\ cost/ha)_{t-1}$	+100 CHF	n.s.	n.s.	-4.4% (-0.00044)	-3.2% (-0.00032)	-3.2% (-0.00032)	-2.2% (-0.00022)
$(CHF\ partic.)_{t-1}$	+500 CHF	+6.5% (0.00013)	+5% (0.0001)	+6% (0.00012)	+4.5% (0.00009)	+3% (0.00006)	+2% (0.00004)
Altitude	+100 m	n.s.	n.s.	+7.3% (0.00073)	+5.3% (0.00053)	+7.9% (0.00079)	+5.8% (0.00058)

Note: Average over the 100 drawings, i.e. in parenthesis $1/100[\Sigma(dy/dx)]$. For the RE model, at $u_i = 0$.

6.3.2. Panel divided into two periods

To further test the robustness of the results, I divided the panel into two sample periods of five years each, from 2004 to 2008 and from 2009 to 2013. Table 10 displays the results for the RE model. Since the results are very similar for the PA model, I do not show them. The revenue per ha is not significant in two sub-samples between 2009 and 2013, for the feed grains and rapeseed. This lack of significance was already observed with the t-tests for these years and these crops. The pesticides cost and the CHF from participation in t-1 are still negative and significant in every sub-sample. The first five variables testing my hypothesis display consistent sign (except for the revenue in one sub-sample for the feed grains).

Finally the results are also robust to a probit specification. The coefficients, level of significance and marginal effects are very close to the logit specification. It was expected because logit and probit lead to similar results, and it may be interesting to test a different model, without any assumption on the distribution of the random effect as a non-parametric model.

Table 10: **Robustness for RE Model: Two Periods**

	Food Grains		**Feed Grains**		**Rapeseed**	
	04-08	**09-13**	**04-08**	**09-13**	**04-08**	**09-13**
$(Revenue/ha)_{t-1}$	-0.0003**	-0.0004***	-0.0003**	0.00005	-0.0007**	-0.0003
	(0.00015)	(0.0001)	(0.00013)	(0.0001)	(0.0003)	(0.0003)
$(Pesti.\,cost/ha)_{t-1}$	-0.0065***	-0.0027***	-0.0035***	-0.0036 ***	-0.0020*	-0.0018*
	(0.0012)	(0.0007)	(0.0009)	(0.0010)	(0.0011)	(0.0010)
$(Ferti.\ cost/ha)_{t-1}$	-0.00003	-0.0009	-0.0048***	-0.0004	-0.0002	-0.0023**
	(0.0013)	(0.0011)	(0.0014)	(0.0009)	(0.0009)	(0.0010)
Good land	-1.1894	-1.1894	-0.2945	-0.6226	*not applicable*	
	(0.9821)	(0.9821)	(0.8602)	(0.9077)		
Bad Land	0.6699	0.7318	1.5828*	2.1057**	0.3254	-2.1862
	(1.1496)	(1.1514)	(0.9405)	(0.9638)	(1.1586)	(1.3947)
Age	-0.0132	-0.0283*	0.0213	-0.003	0.0082	0.027
	(0.0202)	(0.0149)	(0.0186)	(0.0186)	(0.0229)	(0.0275)
Education	0.1716	-0.2380	-0.4434*	-0.5302**	-0.1134	0.6424*
	(0.2780)	(0.2670)	(0.2545)	(0.2530)	(0.2959)	(0.3756)
Tenure	-0.0024	0.0028	0.0062	0.0011	-0.0023	-0.014
	(0.0070)	(0.0090)	(0.0065)	(0.0066)	(0.0079)	(0.0098)
CHF partic. in t-1	0.0006**	0.0008***	0.0004**	0.0006***	0.0004***	0.0004***
	(0.0003)	(0.0003)	(0.00016)	(0.0002)	(0.0001)	(0.0001)
% revenue dir. paym.	9.4563***	1.0953	7.0747***	1.3702	-1.6009	6.488**
	(2.7624)	(0.9765)	(2.5601)	(2.0849)	(2.8115)	(2.9973)
UAA	-0.0152	-0.0152	-0.0274	0.0061	-0.0063	0.0034
	(0.0198)	(0.0148)	(0.0179)	(0.0146)	(0.0195)	(0.0202)
Spec. crop.	-2.207**	0.3834	-0.4609	-1.0162	1.0466	-2.2087**
	(0.9255)	(0.2954)	(0.7499)	(0.7415)	(0.7805)	(1.0103)
Altitude	-0.0006	-0.0013	0.0043**	0.0033**	0.0052**	0.0053**
	(0.0019)	(0.0017)	(0.0017)	(0.0016)	(0.0021)	(0.0026)
N	1636	1511	1743	1561	889	1203

Note: Standard errors in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$.

7. Discussion

What are the policy consequences of having shown that farmers look at their opportunity cost to decide on the adoption or not of Extenso? How to use the results to increase the participation rate? First of all, a flat subsidy of 400 CHF per hectare is not an ideal solution. It may be easier to implement, but it is the only ecological payment with a flat subsidy. The other payments are differentiated according to the region (flatland, hills or mountains). A flat subsidy was chosen for Extenso because the concerned crops are mainly cultivated in the flatland, and indeed a different subsidy for the three regions makes no sense. My advice to increase the participation rate is to apply different subsidies according to the potential yield, because the subsidy should reflect the loss in revenue. It means for the policy makers to have a good cartography of the potential yields of the food grains, feed grains and rapeseed, but the related data exist and maybe even such a cartography.

A second advantage of subsidies based on the potential yield is to induce the farmers polluting more (using more pesticides) to participate too. The fact that the bigger polluters do not participate to voluntary ecological schemes is a result of many studies (for instance Finger and Lehmann (2012), Mann (2005b) for Switzerland), however nothing has been done in Switzerland to improve the situation. The effect of the ecological voluntary schemes is diminished if only the farmers who were already producing rather extensively participate. Applying different subsidies based on the potential yield is a solution. To base the subsidy on the amount of pesticides used before the adoption is not a solution; it would give an incentive to use even more pesticides prior to the entry and would "reward" the most polluting farmers.

Applying different subsidies means also decreasing them for some farmers, which could be difficult to implement. Yet at the very beginning of Extenso, in the 1990s, the subsidy was 800 CHF per ha, then reduced to 400 CHF per ha, without diminishing too much the participation rate. The difficulty is how to find the most accurate "reservation subsidy" for each farmer (the minimum subsidy he would accept to participate) to avoid going lower than this threshold.

One feature of Extenso is the very low participation rate for rapeseed. It is currently only 14% of all the hectares of rapeseed, while it was almost three times higher ten years ago. Clearly the subsidy is not high enough. It is critical to raise it to increase the participation for two reasons: firstly because rapeseed is more cultivated every year since 2001 and secondly because more pesticides are used to cultivate it than for food or feed grains, so the ecological impacts would be large enough. An easy target are the farmers already participating for food or feed grains and not for rapeseed, though they cultivate rapeseed. They already know well the scheme and have at first sight at least some kind of concern about environment. If they do not participate for rapeseed, it is certainly because they estimate the subsidy is not high enough to compensate for their loss. Then why not propose them a bonus if they cultivate all their concerned crops under Extenso? Such a bonus can be proposed to all the farmers to incite them to fully participate to Extenso. In the panel, 27.8% of the participants would be concerned, which is consequent.

The Agricultural Policy for 2014-2017 brought some changes to Extenso, but not on the flat subsidy and no bonus for a full participation was introduced. On the contrary, the crop categories are even more divided than before; it is now possible for a farmer to cultivate his wheat under Extenso wihtout cultivating his rye or dinkel under Extenso. No incentive at all is given to the farmers to participate to every category they could. Extenso is also now expanded to three new crop categories: sunflowers, protein rich peas and field beans, which is positive.

8. Conclusion

The subject of the study is the participation of farmers to one agri-environmental scheme in Switzerland, Extenso. The objective of the scheme is to reduce the amount of pesticides, by giving a subsidy of 400 CHF/ha to farmers who stop using them for their food grains, feed grains and/or rapeseed. Using the Swiss FADN data and a logit model for panel data, I study what determines farmers' participation by comparing the entrants (adopters of the scheme) and the non-entrants, i.e. those who do not adopt it, but could. One important factor to explain the participation is not often considered in the literature, namely the opportunity cost (OC) of participation. It is how much farmers could receive in terms of revenue if they were not participating. The more the farmers could receive, the more costly their participation actually is, which makes it less probable for them to adopt the scheme. To measure the OC I use the revenue per hectare and the pesticides cost per ha *the year before the adoption* of the scheme, defined as t-1, as well as two measures of the suitability of the soil for agriculture. I add other variables usually used to explain the participation as age, education, size, etc.

I show that the key factors to explain the participation are the revenue (from the harvest) per ha in t-1, the pesticides cost per ha in t-1, and the past participation to Extenso. It means that farmers take their OC into account and participate if the subsidy is high enough to cover their loss. Those incurring a higher loss, because they have a high revenue or because they use a lot of pesticides, have a lower probability to adopt Extenso. The consequence is that the most polluting farmers participate less often, which diminishes the environmental impact of the scheme. These conclusions are robust to many checks.

A better design of Extenso is possible to improve the participation rate and induce the most intensive farmers to participate too. First a flat subsidy of 400 CHF/ha is probably not the most appropriate, the subsidy should be based on the potential yield which reflects the OC. Secondly a bonus could be introduced for farmers participating to all the crop types they could. About one quarter of the participants do not, they cultivate for instance their food grains under Extenso, but not their feed grains. Thirdly the subsidy for rapeseed should be augmented, as the current level of hectares under Extenso is only 14% and farmers use more pesticides to cultivate rapeseed than to grow food or feed grains.

The study is limited in the sense that I examine only the determinants of the participation, and I assume that a higher participation rate is better for society. We could perform a cost-benefit analysis for the scheme, to compare what is paid by society to what is gained from it. I also do not study the farmers quitting Extenso, who are as informative as the entrants. However understanding the motivations of participants to any voluntary ecological program is certainly the key to implement successful measures, and I show that the opportunity costs of participation is a fundamental motivation which should be taken into consideration in the formulation of any agri-environmental schemes.

Glossary

Food grains: Céréales panifiables / Brotgetreide

- Wheat: Blé / Weizen
- Rye : Seigle / Roggen
- Dinkel: Epeautre / Dinkel

Feed grains: Céréales fourragères / Futtergetreide

- Barley: Orge / Gerste
- Oats: Avoine / Hafer
- Triticale: le triticale (hybride de blé et de seigle) / Triticale

Rapeseed: Colza / Raps

Sunflower: Tournesol / Sonnenblumen

Protein rich peas: Pois protéagineux / Eiweisserbsen

Field beans: Féveroles / Ackerbohnen

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Appendix

Table 11: **Representativeness of the dataset**

	UAA					**Region**			**Proportion UAA**		
	<10ha	10-<20ha	20-<30ha	30-<50ha	>50ha	Flat.	Hills	Mount.	Food gr.	Feed gr.	Rapes.
Switz-erland	33%	33%	19%	11%	3%	45%	27%	28%	8%	4%	2%
Dataset	3%	34%	35%	22%	4%	44%	30%	26%	6%	4%	1%

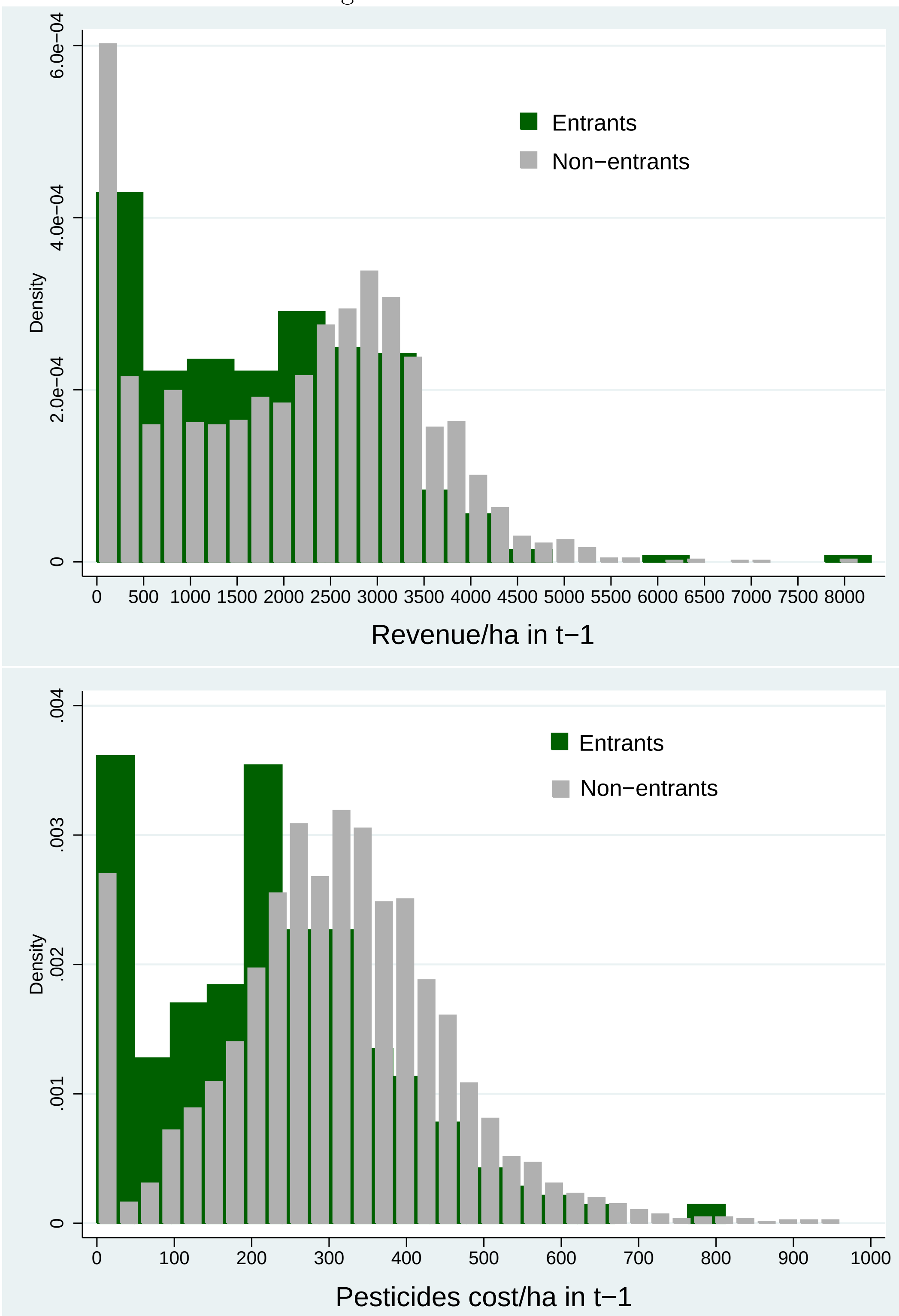
Sources: For Switzerland, Federal Office for Statistics, Stat-tab.
Note: Mean values over the 11 years of the dataset. N=60'722 farms for Switzerland, and N=3'099 farms for the dataset.
"Proportion UAA" is the ha of food grains, feed grains or rapeseed over the UAA.

Table 12: **Number of Entrants and Non-entrants per year**

		2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Food grains	Entrants	56	53	57	51	60	51	59	69	58	47
	Non-Entrants	284	329	356	366	380	388	342	294	286	271
Feed grains	Entrants	55	60	65	58	57	63	59	59	70	46
	Non-Entrants	286	356	359	421	421	388	356	316	336	284
Rapeseed	Entrants	15	16	26	35	26	9	26	19	18	13
	Non-Entrants	119	163	190	226	247	267	283	260	264	250

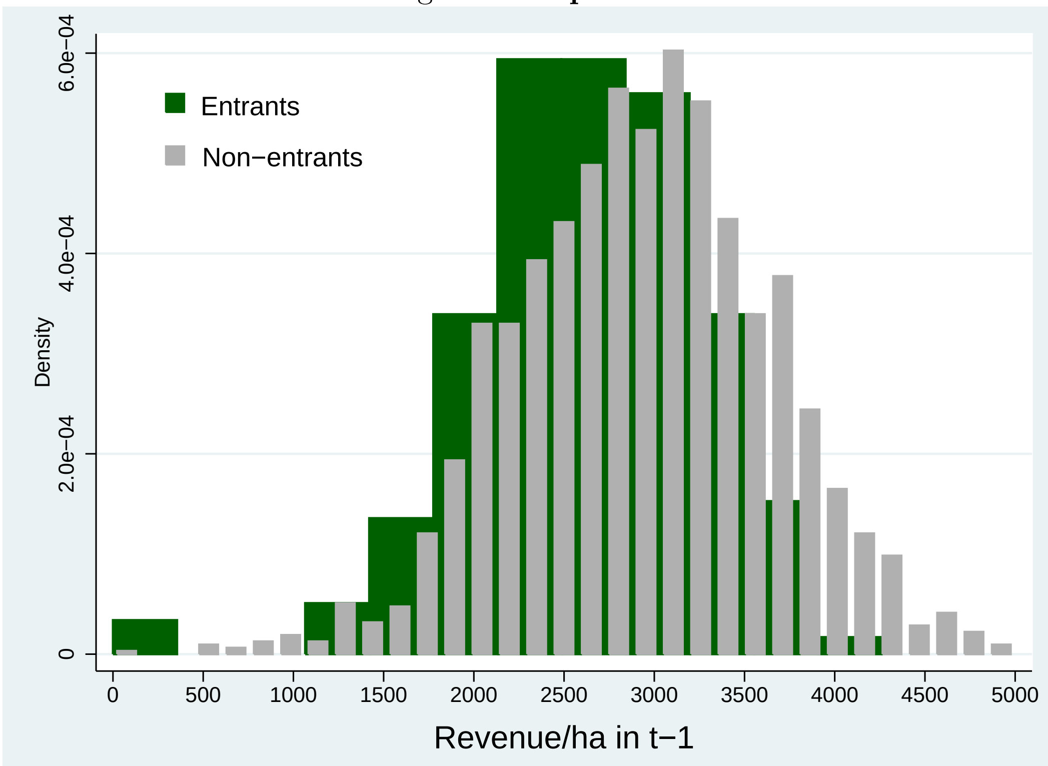
Note: Not excactly the same number in 2013 than in table 1 because in this table and always after I drop the organic farms.
Source: Swiss FADN.

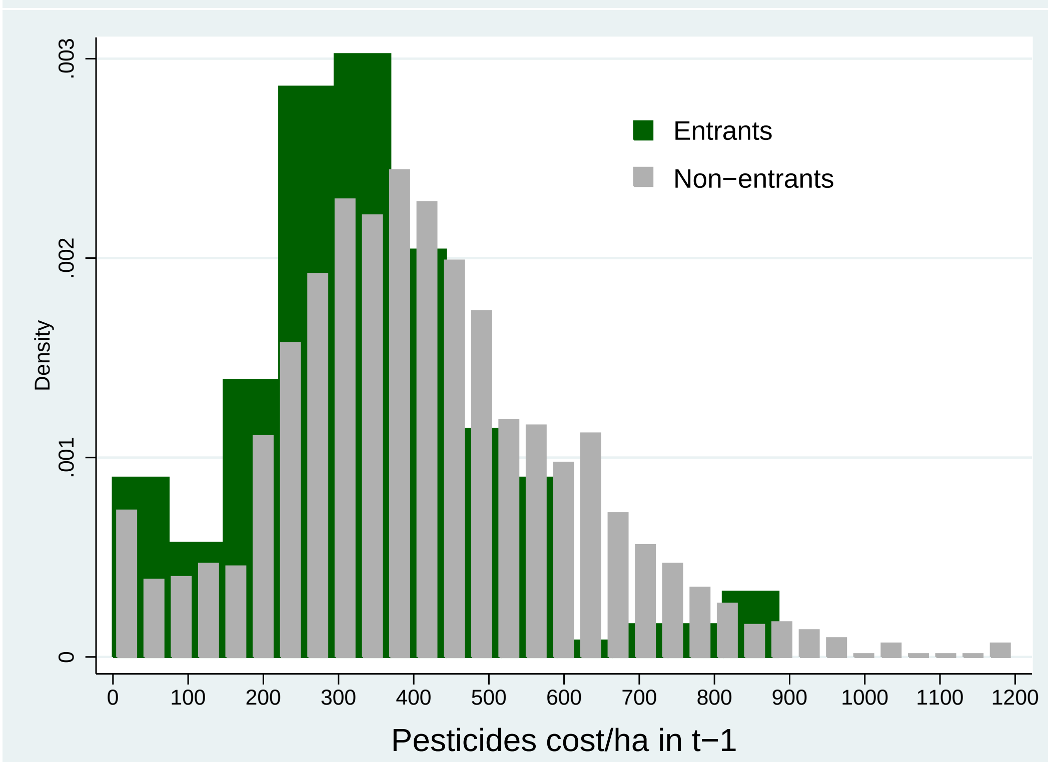
Figure 6: **Feed Grains**



Note: N=3518 (297 entrants and 3221 non-entrants). The entrants are characterised by lower revenue and pesticides cost per ha prior to their entry. *Source:* Swiss FADN.

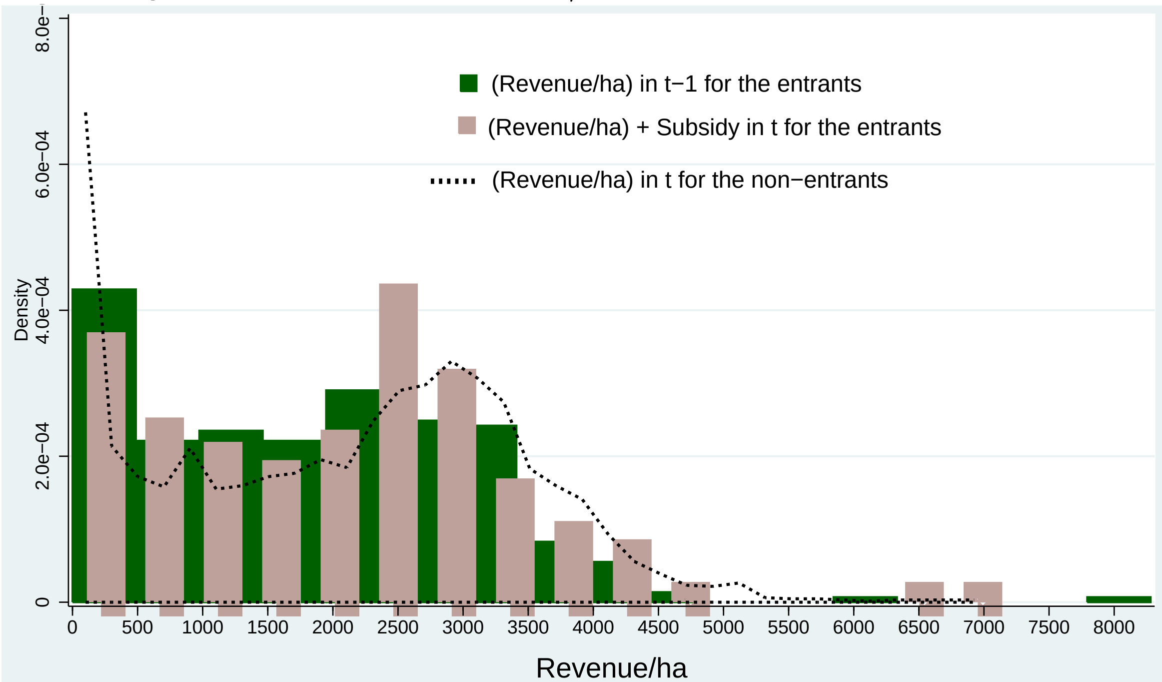
Figure 7: **Rapeseed**





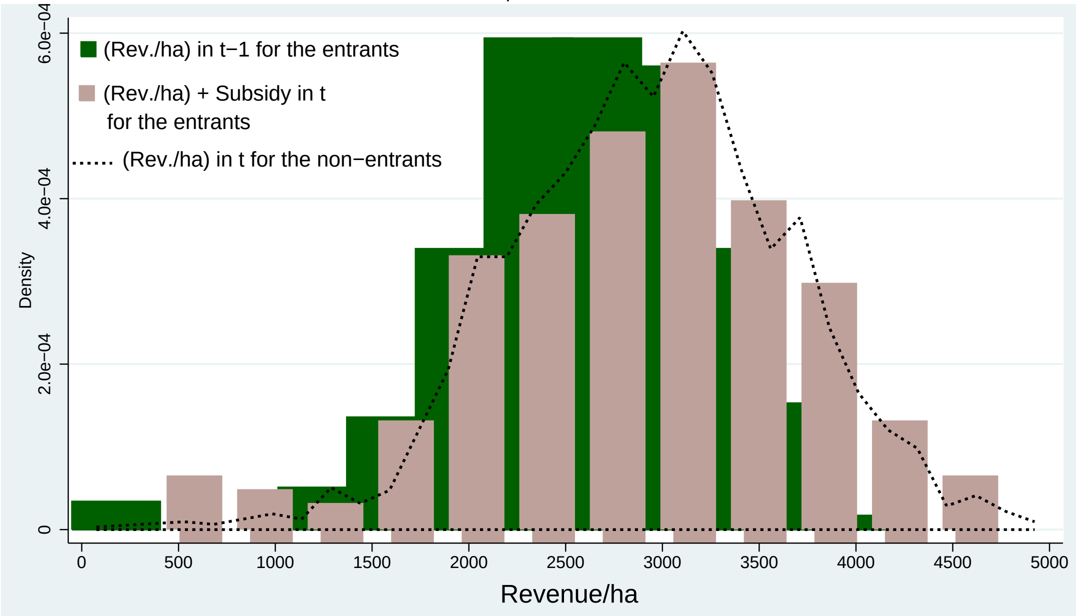
Notes: N=2257 (166 entrants and 2091 non-entrants). The entrants are characterised by lower revenue and pesticides costs per ha prior to their entry. *Source:* Swiss FADN.

Figure 8: **Feed Grains: Before/after the adoption of Extenso**



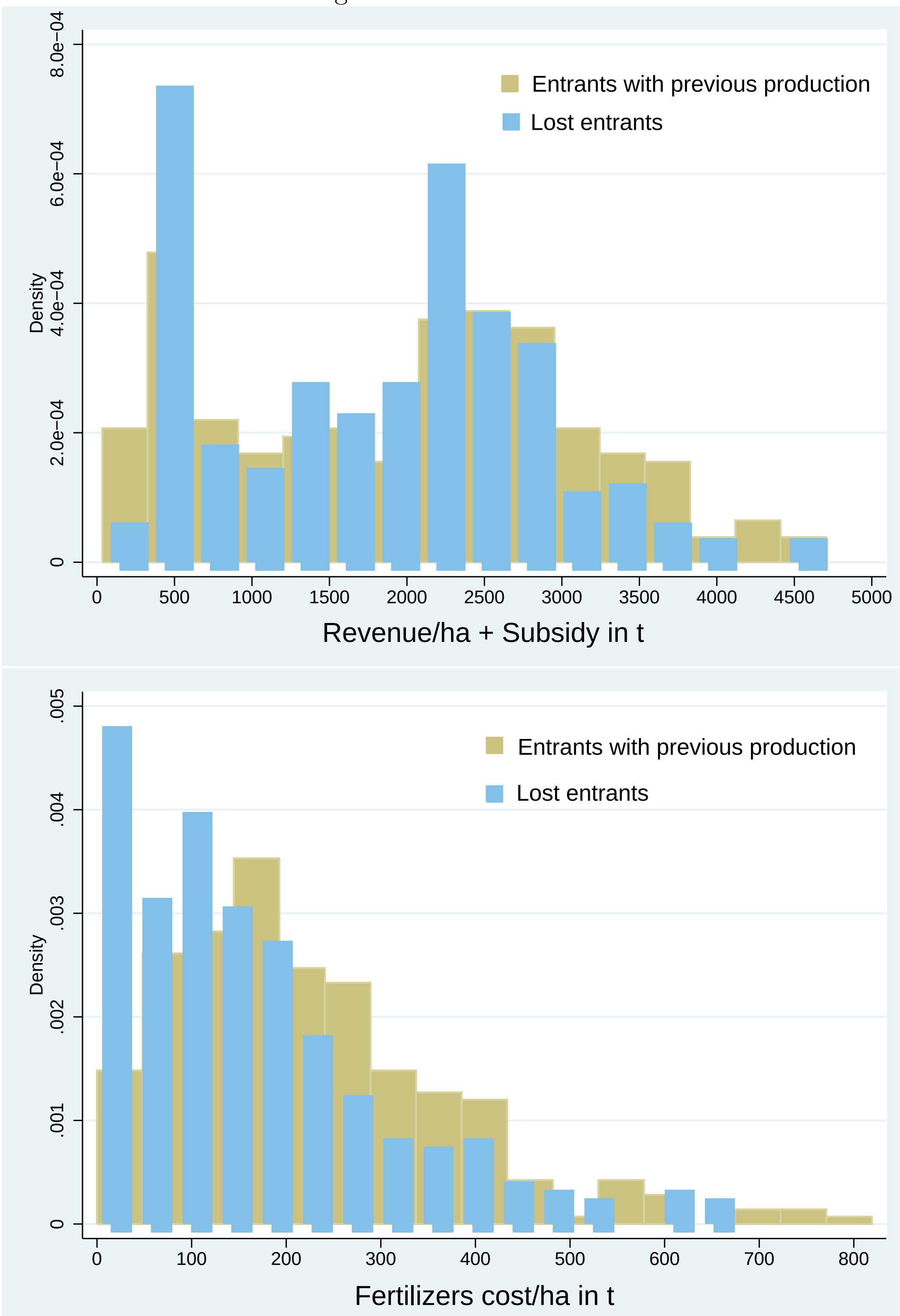
Note: N=3518 (297 entrants and 3221 non-entrants). Once they adopted Extenso, the revenues of the entrants (harvest + subsidy) is closer to the revenues of the non-entrants. *Source:* Swiss FADN.

Figure 9: **Rapeseed: Before/after the adoption of Extenso**



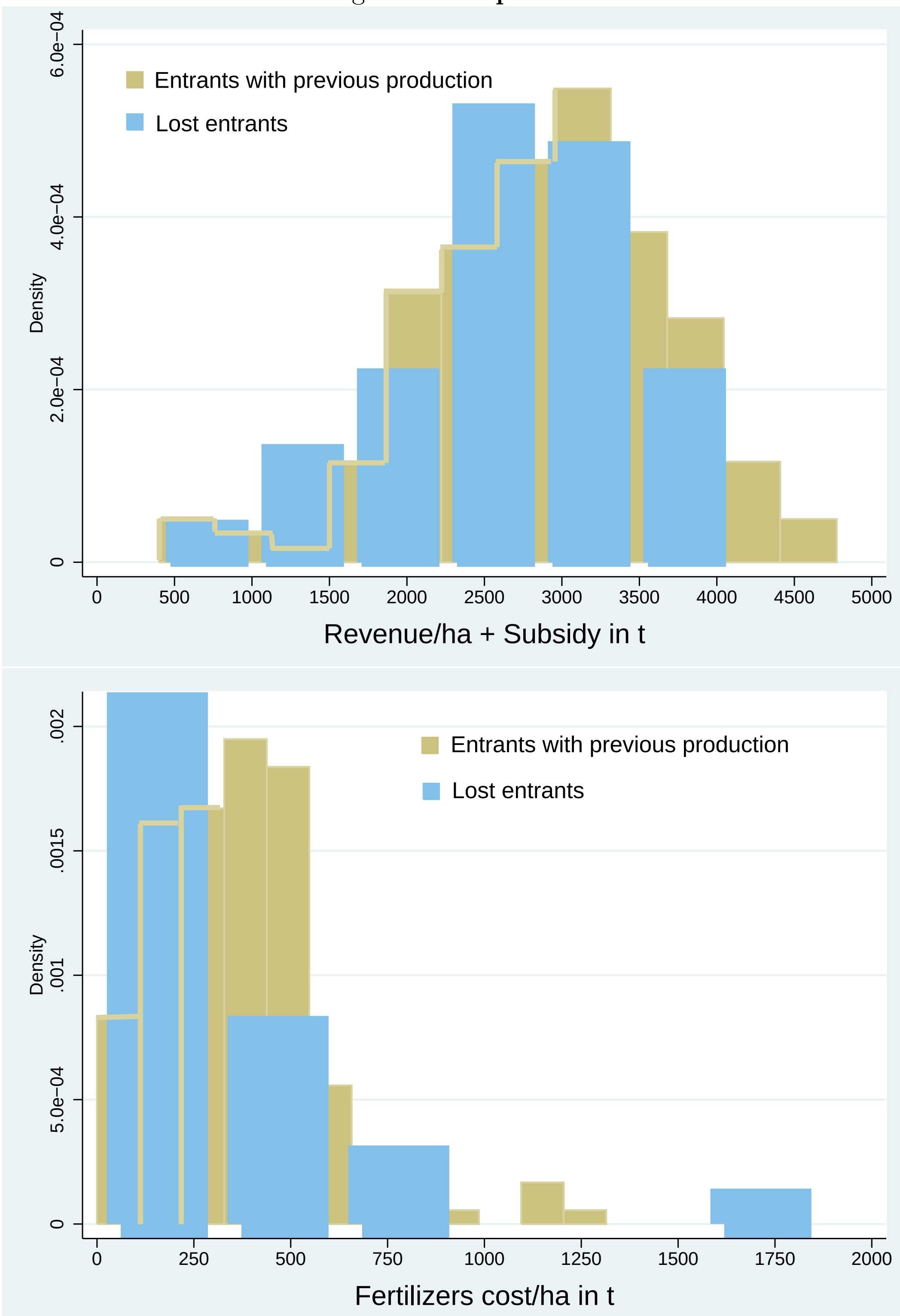
Note: N=2257 (166 entrants and 2091 non-entrants). Once they adopted Extenso, the revenues of the entrants (harvest + subsidy) is closer to the revenues of the non-entrants. *Source:* Swiss FADN.

Figure 10: **Feed Grains**



Note: 297 entrants with previous production, 295 lost entrants. The lost entrants look like less intensive producers than the entrants with previous production. *Source:* Swiss FADN.

Figure 11: **Rapeseed**



Note: 166 entrants with previous production, 37 lost entrants. The lost entrants look like less intensive producers than the entrants with previous production. *Source:* Swiss FADN.

Table 13: **Feed grains: Difference in (Revenue/ha) in year $t-1$**

Year	Entrants (n)	Non-entrants (n)	Significance of the difference	P-value
2004	1'815 CHF (27)	1'815 CHF (268)		0.5010
2005	1'870 CHF (24)	2'220 CHF (327)		0.1329
2006	1'740 CHF (44)	2'080 CHF (315)	*	0.0502
2007	1'420 CHF (40)	2'050 CHF (396)	***	0.0033
2008	1'675 CHF (31)	2'105 CHF (389)	**	0.0390
2009	1'625 CHF (24)	2'120 CHF (363)	**	0.0409
2010	1'795 CHF (26)	2'130 CHF (321)		0.2956
2011	1'750 CHF (26)	1'845 CHF (284)		0.3229
2012	2'085 CHF (36)	2'080 CHF (306)		0.5044
2013	1'885 CHF (19)	2'090 CHF (252)		0.2734

Note: Reading the first line: those who entered Extenso in 2004 had a mean revenue of 1'815 CHF per ha in 2003. Those who did not enter Extenso in 2004 had also a mean revenue of 1'815 CHF per ha in 2003.
* $p < .1$, ** $p < .05$, *** $p < .01$

Table 14: **Rapeseed: Difference in (Revenue/ha) in year $t-1$**

Year	Entrants (n)	Non-entrants (n)	Significance of the difference	P-value
2004	2'395 CHF (13)	2'365 CHF (110)		0.5953
2005	2'735 CHF (11)	3'090 CHF (149)	*	0.0878
2006	2'540 CHF (19)	2'780 CHF (169)	**	0.0168
2007	2'290 CHF (33)	2'490 CHF (196)	**	0.0200
2008	2'475 CHF (21)	2'820 CHF (232)	**	0.0117
2009	3'020 CHF (6)	3'425 CHF (248)	*	0.0857
2010	3'055 CHF (22)	3'025 CHF (258)		0.5848
2011	2'495 CHF (15)	2'685 CHF (245)		0.1213
2012	2'790 CHF (16)	3'360 CHF (251)	**	0.0131
2013	2'995 CHF (10)	3'010 CHF (233)		0.4675

Note: Reading the first line: those who entered Extenso in 2004 had a mean revenue of 2'395 CHF per ha in 2003. Those who did not enter Extenso in 2004 had a mean revenue of 2'365 CHF per ha in 2003.
* $p < .1$, ** $p < .05$, *** $p < .01$

Table 15: **Feed grains: Difference in (Pesticides cost/ha) in year $t-1$**

Year	Entrants (n)	Non-entrants (n)	Significance of the difference	P-value
2004	230 CHF (27)	290 CHF (267)	**	0.0396
2005	215 CHF (24)	290 CHF (326)	***	0.0038
2006	200 CHF (44)	315 CHF (313)	***	0.0000
2007	280 CHF (40)	335 CHF (395)	*	0.0921
2008	240 CHF (31)	320 CHF (388)	***	0.0060
2009	255 CHF (24)	310 CHF (360)	**	0.0372
2010	225 CHF (26)	300 CHF (320)	**	0.0136
2011	215 CHF (26)	305 CHF (284)	***	0.0019
2012	195 CHF (36)	285 CHF (303)	***	0.0006
2013	195 CHF (19)	290 CHF (252)	***	0.0029

Note: On the first line: those who entered Extenso in 2004 had a mean of 230 CHF of (pesticides cost/ha) in 2003. Those who did not enter Extenso in 2004 had a mean of 290 CHF of (pesticides cost/ha) in 2003. * $p < .1$, ** $p < .05$, *** $p < .01$

Table 16: **Rapeseed: Difference in (Pesticides cost/ha) in year $t-1$**

Year	Entrants (n)	Non-entrants (n)	Significance of the difference	P-value
2004	410 CHF (13)	405 CHF (109)		0.5258
2005	260 CHF (11)	400 CHF (149)	***	0.0075
2006	380 CHF (19)	425 CHF (167)		0.1712
2007	325 CHF (33)	415 CHF (193)	***	0.0008
2008	330 CHF (21)	425 CHF (230)	**	0.0149
2009	275 CHF (6)	404 CHF (247)	*	0.0865
2010	330 CHF (22)	440 CHF (256)	**	0.0266
2011	410 CHF (15)	405 CHF (244)		0.5098
2012	245 CHF (16)	430 CHF (249)	***	0.0000
2013	310 CHF (10)	430 CHF (233)	**	0.0108

Note: On the first line: those who entered Extenso in 2004 had a mean of 410 CHF of (pesticides cost/ha) in 2003. Those who did not enter Extenso in 2004 had a mean of 405 CHF of (pesticides cost/ha) in 2003. * $p < .1$, ** $p < .05$, *** $p < .01$

Table 17: **Feed Grains: Estimation of equations (4) and (9)**

	(1a) RE Logit	(1b) RE Logit	(2a) PA Logit	(2b) PA Logit
$(Revenue/ha)_{t-1}$	-	-0.0002*	-	-0.00009*
		(0.00009)		(0.00005)
$(Pesticides\ cost/ha)_{t-1}$	-	-0.0032***	-	-0.0026***
		(0.0007)		(0.0005)
$(Fertilizers\ cost/ha)_{t-1}$	-	-0.0016**	-	-0.0013**
		(0.0007)		(0.0005)
Good land	-	-0.3603	-	-0.3322
		(0.6584)		(0.4445)
Bad land	-	1.9880***	-	0.9963**
		(0.7034)		(0.3972)
Age	0.0023	0.0084	0.00006	0.0003
	(0.0123)	(0.0133)	(0.0058)	(0.0078)
Education	-0.4311***	-0.5045***	-0.1785**	-0.2771**
	(0.1660)	(0.1826)	(0.0781)	(0.1080)
Tenure	0.0490	0.0045	0.0026	0.0028
	(0.0044)	(0.0048)	(0.0021)	(0.0029)
CHF from partic. in (t-1)	0.0007***	0.0005***	0.0004***	0.0003***
	(0.0001)	(0.0001)	(0.00007)	(0.00008)
% revenue from dir. paym.	6.9419***	2.4465	3.8045***	1.2961
	(1.3210)	(1.5432)	(0.7040)	(1.2989)
UAA	-0.0397***	-0.0087	-0.0235***	-0.0053
	(0.0114)	(0.0118)	(0.0060)	(0.0079)
Spec. crop	-1.4563***	-0.6493	-0.9687***	-0.3518
	(0.4652)	(0.5397)	(0.2588)	(0.3572)
Altitude	0.0067***	0.0036***	0.0030***	0.0020***
	(0.0010)	(0.0012)	(0.0005)	(0.0007)
Constant	-5.7857***	-3.44361***	-2.7425***	-1.71409**
	(1.1085)	(1.2480)	(0.5148)	(0.7088)
N (# of entrants)	4115 (592)	3304 (276)	4115 (592)	3304 (276)
% c.p. non-e (e)		0.91 (0.32)		0.59 (0.72)
sigma_u	3.301	2.418		
ICC from (5)	0.768	0.640		
$\rho_{t,s}$ from (8)			0.241	0.083
Log likelihood	-1363	-826		
Wald chi2	151.46	86.07	115.47	88.57
$Prob > chi2$	0.000	0.000	0.000	0.000

Note: Standard errors in parentheses for RE, semi-robust s.e. for PA. C.p. stands for correctly predicted, non-e for the non-entrants and e for the entrants. % estimated at $u_i = 0$ for RE. Cut-off at $\hat{Y}_{i,t} \geq 0.083$.
$p < .1$, ** $p < .05$, *** $p < .01$

Table 18: **Rapeseed: Estimation of equations (4) and (9)**

	(1a) RE Logit	**(1b) RE Logit**	**(2a) PA Logit**	**(2b) PA Logit**
$(Revenue/ha)_{t-1}$	-	-0.0007***	-	-0.0005***
		(0.0002)		(0.00009)
$(Pesticides\ cost/ha)_{t-1}$	-	-0.0014***	-	-0.0012***
		(0.0007)		(0.0004)
$(Fertilizers\ cost/ha)_{t-1}$	-	-0.0012**	-	-0.0010***
		(0.0006)		(0.0004)
Bad land	-	0.1079	-	-0.1462
		(0.8590)		(0.6249)
Age	-0.0148	-0.0037	-0.002	0.0022
	(0.0165)	(0.0168)	(0.0090)	(0.0106)
Education	0.2666	0.1050	0.1830	0.0981
	(0.2202)	(0.2209)	(0.1488)	(0.1681)
Tenure	-0.0073	-0.0045	-0.0052	-0.0033
	(0.0058)	(0.0060)	(0.0037)	(0.0041)
CHF from partic. in (t-1)	0.0002***	0.0003***	0.0002***	0.0002***
	(0.00008)	(0.00008)	(0.00004)	(0.00005)
% revenue from dir. paym.	3.4123**	0.4749	2.0061*	0.1922
	(1.6727)	(1.8096)	(1.1049)	(1.2362)
UAA	-0.0185	-0.0075	-0.0116	-0.0033
	(0.0133)	(0.0137)	(0.0080)	(0.0088)
Spec. crop	-0.7202	-0.1940	-0.5399*	-0.0927
	(0.5345)	(0.5598)	(0.3259)	(0.3340)
Altitude	0.0054***	0.0038**	0.0029***	0.0024***
	(0.0015)	(0.0015)	(0.0008)	(0.0009)
Constant	-7.0451***	-3.1693*	-4.3846***	-2.0794*
	(1.5549)	(1.6362)	(0.9290)	(1.0759)
N (# of entrants)	2472 (203)	2092 (152)	2472 (203)	2092 (152)
% c.p. non-e (e)		0.89 (0.98)		0.58 (0.80)
sigma_u	2.547	2.161		
ICC from (5)	0.664	0.587		
$\rho_{t,s}$ from (8)			0.148	0.11
Log likelihood	-607	-466		
Wald chi2	34.45	48.19	43.30	94.06
Prob > chi2	0.000	0.000	0.000	0.000

Note: Standard errors in parentheses for RE, semi-robust s.e. for PA. C.p. stands for correctly predicted, non-e for the non-entrants and e for the entrants. % estimated at $u_i = 0$ for RE. Cut-off at $\hat{Y}_{i,t} \geq 0.073$.
$p < .1$, ** $p < .05$, *** $p < .01$

Table 19: **Estimation of equations (4) and (9) with the lost entrants**

	Food G. RE	**Food G. PA**	**Feed G. RE**	**Feed G. PA**	**Rapes. RE**	**Rapes. PA**
$(Ferti.\ cost/ha)_t$	-0.0020***	-0.0015***	-0.0027***	-0.0020***	-0.0019***	-0.0015***
	(0.0006)	(0.0003)	(0.0006)	(0.0003)	(0.0006)	(0.0004)
Good land	-1.4168**	-0.9121***	-2.3049***	-1.2932***	-	-
	(0.5843)	(0.3245)	(0.6247)	(0.3833)		
Bad land	3.9284*	1.9261**	-0.5659	-0.1162	2.0972	1.1322
	(2.0208)	(0.9359)	(1.8447)	(0.7817)	(1.5716)	(0.7804)
Age	-0.0036	-0.0066	0.0062	0.0017	-0.0019	0.0040
	(0.0120)	(0.0059)	(0.0124)	(0.0061)	(0.1621)	(0.0091)
Education	-0.0253	0.0160	-0.4406***	-0.1990**	0.1883	0.1549
	(0.1590)	(0.0867)	(0.1683)	(0.0845)	(0.2164)	(0.1607)
Tenure	0.0058	0.0027	0.0044	0.0021	-0.0022	-0.0023
	(0.0042)	(0.0022)	(0.0045)	(0.0023)	(0.0057)	(0.0038)
CHF partic. in (t-1)	0.0011***	0.0007***	0.0007***	0.0004***	0.0003***	0.0002***
	(0.0002)	(0.0001)	(0.0001)	(0.00007)	(0.00008)	(0.00005)
% revenue dir. paym.	5.9571***	3.0110***	6.3609***	3.91***	1.7831	1.0872
	(1.2188)	(0.7418)	(1.3409)	(0.7659)	(1.6939)	(1.1403)
UAA	-0.0274**	-0.0173***	-0.0313***	-0.0185***	-0.0273**	-0.0171**
	(0.0107)	(0.0061)	(0.0117)	(0.0064)	(0.0137)	(0.0087)
Spec. crop	-1.5151***	-0.8948***	-1.0434**	-0.7049***	-0.4329	-0.2974
	(0.4567)	(0.2652)	(0.4816)	(0.2656)	(0.5442)	(0.3336)
Altitude	0.0027***	0.0014**	0.0059***	0.0027***	0.0053***	0.0030***
	(0.0010)	(0.0006)	(0.0010)	(0.0005)	(0.0015)	(0.0009)
Constant	-3.4612***	1.6339***	-4.6129***	-2.1992***	-6.2324***	-3.9919***
	(1.0616)	(0.5382)	(1.1301)	(0.5567)	(1.5411)	(0.9681)
N (# of entrants)	3627 (524)	3627 (524)	3871 (544)	3871 (544)	2303 (185)	2303 (185)
sigma_u	2.725		3.073		2.335	
ICC from (5)	0.693		0.742		0.624	
$\rho_{t,s}$ from (8)		0.191		0.19		0.13
Log likelihood	-1201		-1250		-555	
Wald chi2	151.12	154.46	157.73	143.58	42.45	50.42
$Prob > chi2$	0.000	0.000	0.000	0.000	0.000	0.000

Standard errors in parentheses for RE, semi-robust s.e. for PA.* $p < .1$, ** $p < .05$, *** $p < .01$

Table 20: **Average Marginal Effects for Food Grains, RE model**

Variable	**dy/dx**	**Std. Err.**	**z**	**P > z**
$(Revenue/ha)_{t-1}$	-0.000017	4.63E-06	-3.58	0.000
$(Pesticides\ cost/ha)_{t-1}$	-0.00019	4.01E-05	-4.87	0.000
$(Fertilizers\ cost/ha)_{t-1}$	-0.00001	2.97E-05	-0.44	0.658
Good land	-0.0318	2.88E-02	-1.10	0.270
Bad Land	0.0147	3.42E-02	0.43	0.668
Age	-0.0007	6.02E-04	-1.12	0.261
Education	-0.0049	7.71E-03	-0.64	0.524
Tenure	0.00006	2.03E-04	0.31	0.759
CHF from partic. in t-1	0.000027	8.91E-06	3.06	0.002
% revenue from dir. paym.	0.1971	6.24E-02	3.16	0.002
UAA	0.0005	5.01E-04	0.95	0.343
Spec. crop.	-0.0241	2.22E-02	-1.08	0.279
Altitude	-0.00004	5.30E-05	-0.75	0.454

Note: An increase of 1 CHF in the revenue per ha decreases the probability of entry by 0.0017%. AMEs at $u_i = 0$.

Table 21: **Average Marginal Effects for Feed Grains, PA model**

Variable	**dy/dx**	**Std. Err.**	**z**	**P > z**
$(Revenue/ha)_{t-1}$	-0.0000072	3.95E-06	-1.83	0.067
$(Pesticides\ cost/ha)_{t-1}$	-0.00021	3.84E-05	-5.36	0.000
$(Fertilizers\ cost/ha)_{t-1}$	-0.0001	3.96E-05	-2.56	0.011
Good land	-0.0267	3.57E-02	-0.75	0.454
Bad Land	0.0802	3.20E-02	2.50	0.012
Age	0.00002	6.30E-04	0.03	0.974
Education	-0.0223	8.74E-03	-2.55	0.011
Tenure	0.0002	2.34E-04	0.96	0.338
CHF from partic. in t-1	0.000023	6.41E-06	3.64	0.000
% revenue from dir. paym.	0.1043	1.04E-01	1.00	0.318
UAA	-0.0004	6.36E-04	-0.68	0.500
Spec. crop.	-0.0283	2.87E-02	-0.99	0.324
Altitude	0.00017	5.67E-05	2.85	0.004

Note: An increase of 1 CHF in the revenue per ha decreases the probability of entry by 0.00072%.

Table 22: **Average Marginal Effects for Feed Grains, RE model**

Variable	**dy/dx**	**Std. Err.**	**z**	**P > z**
$(Revenue/ha)_{t-1}$	-0.0000057	2.94E-06	-1.92	0.054
$(Pesticides\ cost/ha)_{t-1}$	-0.00011	2.85E-05	-3.85	0.000
$(Fertilizers\ cost/ha)_{t-1}$	-0.00006	2.65E-05	-2.09	0.037
Good land	-0.0123	2.26E-02	-0.54	0.586
Bad Land	0.068	2.52E-02	2.70	0.007
Age	0.00029	4.56E-04	0.63	0.530
Education	-0.0173	6.60E-03	-2.62	0.009
Tenure	0.00015	1.65E-04	0.92	0.357
CHF from partic. in t-1	0.000016	4.27E-06	3.71	0.000
% revenue from dir. paym.	0.0837	5.31E-02	1.58	0.115
UAA	-0.0003	4.06E-04	-0.73	0.464
Spec. crop.	-0.0222	1.87E-02	-1.19	0.234
Altitude	0.00012	4.33E-05	2.88	0.004

Note: An increase of 1 CHF in the revenue per ha decreases the probability of entry by 0.00057%. AMEs at $u_i = 0$.

Table 23: **Average Marginal Effects for Rapeseed, PA model**

Variable	**dy/dx**	**Std. Err.**	**z**	**P > z**
$(Revenue/ha)_{t-1}$	-0.000033	6.83E-06	-4.90	0.000
$(Pesticides\ cost/ha)_{t-1}$	-0.000083	3.15E-05	-2.64	0.008
$(Fertilizers\ cost/ha)_{t-1}$	-0.000075	2.89E-05	-2.58	0.010
Bad Land	-0.0105	4.49E-02	-0.23	0.815
Age	0.0001	7.62E-04	0.21	0.835
Education	0.007	1.21E-02	0.58	0.559
Tenure	-0.00024	2.96E-04	-0.80	0.425
CHF from partic. in t-1	0.000013	3.79E-06	3.34	0.001
% revenue from dir. paym.	0.0138	8.88E-02	0.16	0.876
UAA	-0.0002	6.34E-04	-0.38	0.707
Spec. crop.	-0.0067	2.40E-02	-0.28	0.781
Altitude	0.00017	6.62E-05	2.61	0.009

Note: An increase of 1 CHF in the revenue per ha decreases the probability of entry by 0.0033%.

Table 24: **Average Marginal Effects for Rapeseed, RE model**

Variable	**dy/dx**	**Std. Err.**	**z**	**P > z**
$(Revenue/ha)_{t-1}$	-0.000018	6.36E-06	-2.86	0.004
$(Pesticides\ cost/ha)_{t-1}$	-0.000038	2.08E-05	-1.82	0.069
$(Fertilizers\ cost/ha)_{t-1}$	-0.000034	1.85E-05	-1.84	0.066
Bad Land	0.003	2.36E-02	0.13	0.900
Age	-0.0001	4.59E-04	-0.22	0.825
Education	0.0029	6.09E-03	0.47	0.636
Tenure	-0.00012	1.66E-04	-0.75	0.454
CHF from partic. in t-1	0.000007	2.69E-06	2.61	0.009
% revenue from dir. paym.	0.013	4.97E-02	0.26	0.793
UAA	-0.0002	3.77E-04	-0.55	0.584
Spec. crop.	-0.0053	1.54E-02	-0.35	0.730
Altitude	0.0001	4.79E-05	2.16	0.031

Note: An increase of 1 CHF in the revenue per ha decreases the probability of entry by 0.0018%. AMEs at $u_i = 0$.