Farmer Participation, Entry and Exit Decisions in the Italian Crop Insurance Program

Introduction

Over the last several decades, risk management policies in agriculture have been significantly modified. In Italy, the *Fondo di Solidarietà Nazionale* (FSN) was developed in the 1970s and was intended to compensate farmers who had been affected by natural disasters. This policy, which has played a prominent role in Italian agriculture, is now mainly regulated by Legislative Decree No. 102/2004 which subsidizes insurance contracts (Cafiero *et al.*, 2007). The market for insurance in Italy is evolving rapidly and there is considerable interest in understanding the operation of the program and in monitoring farmers' participation over time. In fact, although the budget for the FSN has never been limited, the type of available contracts and the set of subsidized policies has increased over time. At the same time, participation has been stable over time.

Policymakers often act to encourage participation in crop insurance programs, most often through the use of large subsidies. However, such promotion requires an understanding of participation as well as entry and exit decisions. We investigate the demand for crop insurance using individual models of participation, entry and exit decisions. We seek to inform policymakers by providing an understanding of the determinants of turnover in insurance markets that may affect participation in crop insurance programs.

Contracts that cover losses from multiple risks have also increased in prominence around the world. Between 2003 and 2009, the share of single-peril insurance contracts, which mainly compensate losses from hail, has declined in Italy by fifty percent while the share of multiple risk contracts has increased substantially. Under the current Italian insurance program, farmers receive a premium subsidy of up to 80% to insure a farm's production against losses larger than thirty percent of the historical average level of production. In the EU, empirical evidence on the effects of subsidies on participation rates in insurance programs is not clear

(Garrido and Zilberman, 2008; Finger and Lehmann, 2012), and their effects are often debated (see, for example, Bakhshi and Gray, 2012; and Di Falco et al., 2014). The Italian case is of particular interest for a number of reasons. Participation is low despite the Italian government's subsidy being one of the highest in world (*cfr.* Mahul and Stutley, 2010). In Italy the vast majority of contracts are purchased by farms located in Northern Italy rather than in other parts of the country (European Commission, 2009; Enjolras *et al.*, 2012). This is a consequence of the structure of insurance premium rates in the North, where the typical loss ratio (the ratio of indemnity payments to premiums) is closer to unity. In contrast, the southern part of Italy has a loss ratio of about one half. While greater insurance returns to farmers may well explain greater participation in the north than in other regions, geographically-distinct farmers also face different sources of risk. Moreover, insurance contracts are far from being widely adopted as a stable tool of risk management in Italy. We observe that few farms carry insurance for more than two consecutive years. Understanding the factors underlying this high turnover rate has important implications for the operation of the programs since, despite large subsidies, participation in crop insurance is both limited and volatile. In order to increase participation it is important not only to stimulate entry but also to encourage insurance renewal and thus inhibit exits from the program. The determinants of these decisions have not been yet fully explored.

The demand for crop insurance in U.S. has received significant empirical attention in a large number of empirical studies (*e.g.* Goodwin, 1993, Goodwin and Smith, 2013; Skees and Reed, 1986; Smith and Goodwin, 1996; Sherrick *et al.* 2004). Goodwin (1993) shows that land size, land value, and a corporate farm structure have positive effects on insurance demand. Coble et al. (1997) conclude that the higher the expected return to insurance, the higher the adoption rate. Education, farm experience, debt and disaster payments have also been shown to be associated with the adoption of crop insurance (Goodwin and Kastens, 1993; Smith Baquet, 1996)[1].

[1] An extensive survey on the determinants of crop insurance adoption is provided by Knight and Coble (1997).

The empirical literature on crop insurance in EU Countries is also rich, though turnover has not been explicitly investigated. An important analysis by Garrido and Zilberman (2008) shows that premium subsidies are the leading factor that increases the probability of using insurance in Spain. In contrast, Finger and Lehmann (2012) show that support to farmers' incomes tends to decrease insurance adoption rates in Switzerland. Cabas *et al.* (2008) model the entry and exit decisions using panel data consisting of the total number of insured and uninsured farmers at the county level. They find that insured farmers are more sensitive than uninsured farmers to changes in the preceding year's yield. Moreover, participation is positively related to yield variability, entry and exit decisions are, respectively, positively and negatively affected. Their analysis of entry and exit decisions at an aggregate level provides an interesting benchmark. In an empirical study of insurance participation in France, Enjoras and Sentis (2011) show that the highest risk farms are more likely to purchase insurance. They also note that the existing empirical literature has largely focused on studies of aggregated data and highlight the potential importance of farm-level analyses.

A limited number of studies have analyzed the demand for crop insurance in Italy. Exploring the demand for insurance in Italy provides useful insights into policy interventions in Europe as a whole. In fact, lacking a common framework, European member states have autonomously adopted national policies for assisting farmers in dealing with production risks and natural disasters. These policy interventions, typically in the form of subsidies on crop insurance or agricultural solidarity funds, have been primarily adopted in the Southern EU countries (France, Greece, Italy and Spain). In contrast, public intervention in the United States and Canada aims at supporting farmers' management activities in a very broad sense by supporting farmers' revenue through hedge funds, revenue insurance programs, mutual funds, and weather indexes[2]. More important is the fact that the determinants of turnover (adopting and dropping coverage) have been given scant attention in the literature. The analysis conducted by Cabas *et al.* (2008) aims at filling this gap.

[2] Detailed summaries of these plans are provided by Knight and Coble (1997), Coble and Dismukes (2007), and Capitanio (2010).

However, the authors analyzed the phenomenon at an aggregate level, whereas we explicitly model farm-level decisions of whether to adopt, enter or exit the insurance market.

A better understanding of the factors driving participation, entry and exit decisions remains a pressing issue in order to enhance crop insurance coverage. Numerous questions arise. First, what are the frictions that limit participation in insurance contracts? Second, why are farmers reluctant to maintain continuous coverage in the program? Third, what factors drive the adoption and dropping of coverage in the Italian crop insurance program, where turnover is an especially striking feature?[3]

We have two objectives. First, we investigate the factors and farm characteristics that are associated with participation in the Italian crop insurance program. Second, we evaluate the dynamics of participation patterns over the recent past and investigate the factors that are associated with the different participation rates observed in Northern and Southern Italy.

Public Intervention in the Italian Crop Insurance Market

Public intervention in agricultural risk management in Italy dates back to1974, when the "Fondo di Solidarietà Nazionale in Agricoltura" (FSN) was instituted. The system has been reformed over time and currently conforms to the European Community guidelines for state aid in the agricultural sector concerning compensation for damages and insurance premium subsidies. Legislative Decree 102 in 2004 defined new operational rules for the FSN and determined regulations on financial tools for risk management and capitalization incentives that favor agricultural firms.

Under the current FSN, two services are supplied: subsidies on insurance policies and ex-post payments. The two interventions are mutually exclusive in that crops and damages that are deemed insurable are not entitled to ex-post disaster compensation financed by the FSN. The latter regulates *ad hoc*

[3] Our analysis does not explicitly model turnover, but it provides insights on how farmers' entry and exit decisions are influenced by several factors. For a broader discussion of turnover in the agricultural, financial and other sectors, the interested reader may refer to Bottazzi*et al.*(2011), Cefis and Marsili (2012), and Hirsch and Gschwandtner (2013).

compensation to farmers affected by damages. A key aspect of this policy intervention is that the occurrence of an exceptional event needs to be officially recognized by the central government prior to any compensation being made. Compensation is then calculated according to several criteria and usually reflects the availability of funds rather than the extent of damages[4]. During the last decade, actual losses and compensation paid to farmers have been poorly correlated. A further drawback of ex-post payments relates to the time lags between the occurrence of the damaging events and compensation. These weaknesses have pushed policymakers to shift the bulk of the FSN to subsidies on crop insurance.

Currently, public intervention for crop insurance is also regulated by Legislative Decree No. 102/2004[5]. Insurance policies (for crops and damages[6]) covered by the Annual Insurance Plan have, on average, received subsidies of about forty percent of total premiums in recent years. State subsidies apply to single-peril, combined/named perils, and multi-peril policies. The annual insurance plan defines the level of state intervention on the basis of public budget availability and the demand for crop insurance. Since 2005, farmers have been required to take crop insurance for the whole area devoted to the insured that falls within the borders of their township. This regulation has stimulated the demand for crop insurance and in particular the subscription of collective policies through cooperatives and their operating consortiums, which operate as catalysts for demand.

Finally, under the current legislation farmers are allowed to create mutual funds in favor of specific crops and structures that are not included in the annual insurance plan. The payments from these funds are made only in the event of losses greater than thirty percent of total production.

---

[4] Recent findings suggest that governments may use agricultural disaster relief payments as a political tool to favor their core supporters (Chang and Zilberman, 2014). Strengthening participation in insurance programs maybe economically more efficient.

[5] The Legislative Decree 102 has been published in the Official Journal 95 on April the 23rd of 2004 and is available at www.camera.it.

[6] Starting in 2006, insurance policies on losses arising from cattle diseases are subsidized.

Post-reform data have shown a limited increase in crop insurance participation rates. More specifically, the growth in total area insured has not been matched by a proportional diffusion of insurance contracts across new producers. Rather, expansion has been mainly motivated by the obligation to insure the entire cropped area fora given product. During the last decade, the state contribution has been growing in nominal terms, mainly due to a sharp growth in combined perils policies for which premiums are subsidized by up to eighty percent[7]. On the other hand, the share of contracts providing coverage only against hail damages (single-peril insurance) decreased from 92.0% in 2004 to 50.2% in 2010 (Table 1).

TABLE 1 ABOUT HERE

Moreover, in recent years the loss ratio has been consistently below unity, such that the amount of premium collected, plus subsidies, largely exceeds the indemnities paid to farmers. Such a trend seriously questions the need for the current elevated level of subsidy. Significant geographical heterogeneity has also characterized the program. In 2011, almost eighty percent of contracts were taken by farmers located in Northern Italy (Table 2).

TABLE 2 ABOUT HERE

For an individual farmer, the functioning of the program involves insurers, regional specialists, and experts. A farmer that takes a contract with one of the existing insurance companies is protected against losses that exceed 30% of historical production, as determined and verified by regional specialists.

With the gradual phasing out of subsidies provided by the Common Agricultural Policy (CAP) to European farmers[8], the issue of risk management tools has acquired an increasingly significant profile that

---

[7]In particular, the subsidy is up to 80% of the cost of premium for policies against damages (reaching at least 30% of assured production) caused by adverse weather conditions and other natural disasters, and it is up to 50% of the cost of the premium if the insurance contract also covers other losses caused by adverse weather conditions that are not considered to be widespread natural disasters, or losses caused by animal or plant diseases.

[8]In particular we refer to the gradual elimination of subsidies due to the CAP reform that lead to decoupled payments (except for few products). The reform has fully changed farmers' crop choices from a pro-subsidy view to a pro-market one. Such a change has exposed farmers to major risks, and has led policymakers to design government interventions to support crop insurance and mutual funds as stabilization tools.

has resulted in a series of innovations that initially were part of the 2009 Health Check followed by the proposed Commission Regulation for rural development policy spanning from 2014 to 2020. In particular, a new measure, called the IST (Income Stabilization Tool), has been proposed (art. 39 of the EU Regulation 1305/2013). The IST is aimed at supporting income risk management for agricultural enterprises through the use of mutual funds. Although such a program could potentially create an effective safety net for farmers and "*lower income inequality […] by increasing lower quantiles of the income distribution*" (Finger and El Benni, 2014), it has not yet been implemented. Our analysis, limited to the period (2004-2007), cannot provide specific insights on the potential effects of the IST. This leaves crop insurance as an important and somewhat unique risk management mechanism.

Data and empirical modeling framework

We use farm level data extracted from the Farm Accounting Data Network (FADN), covering the period 2004 to 2007, in order to include only those farms belonging to the panel continuously, and so as to focus on the entry and exit decisions of individual farmers. The data are collected to be representative of the entire population of Italian farms.

Assuming that farmers are price-takers and markets are perfectly competitive, a household chooses to adopt crop insurance based on expected utility: $E[U(Insured)] > E[U(Uninsured)]$. An uninsured (insured) farmer will choose to enter (exit) in the crop insurance market if the expected utility from entering(exiting) is greater than the expected utility of not entering (not exiting).

Our empirical investigation is conducted through a variety of probit models. Our first specification assesses participation in crop insurance programs, which is modeled as a time-varying binary variable representing the discrete insurance participation decision. The remaining models consider entry and exit in the insurance program. In particular, the entry and exit decisions are modeled using two dichotomous variables. The variable "entry" is equal to one if the farmer was not insured in time *t-1*, but purchased an insurance contract in time *t*. The model is estimated only for those observations for which the variable "insurance" had value equal to zero at time *t-1*. This model considers all farmers that were not insured and thus explains why some uninsured farmers purchased insurance in time *t*, while others did not. The variable "exit" is equal to one if the farmer purchased insurance in time *t-1* and did not purchase insurance in time *t.* This model is estimated only for those farmers that were insured in time *t-1*. These models allow us to focus on the entry and exit decisions individually and thus permit farm and operator characteristics to have different effects on the entry and exit decisions[9].

In order to take into account for the panel nature of our dataset, we condition on unobserved effects in estimation using the methods outlined by Wooldridge (2002):

$$(1)\quad \Pr(y_{it} = 1|\boldsymbol{x}_i, \alpha_i) = \Pr(y_{it} = 1|\boldsymbol{x}_{it}, \alpha_i) = \Phi(\alpha_i + \boldsymbol{x}'_{it}\beta) \qquad \text{with } t = 1, \dots, T,$$

where the first equality states that the explanatory variables are exogenous, conditional on unobserved effects (α_i) so that the unobserved effects can be excluded from the RHS. The assumption allows us to omit lagged variables. The second equality is the standard assumption of probit models. We adopt a random effects (RE) probit estimators and a fixed effects (FE) for each j model ($j = \text{participation, entry, exit}$). The RE model assumes that the individual effects are normally distributed, that is $\alpha_i|\boldsymbol{x}_i \sim N(0, \sigma_\alpha^2)$:

$$(2)\quad P_j\left(Y_{ij,t} = 1\middle|X_{ij}, Z_{ij,t}, \alpha_{ij}\right) = \Phi_j(X_{ij}{}'\beta_j + Z_{ij,t}{}'\gamma_j + \alpha_{ij})$$

where $Y_{i,t}$ is a binary dependent variable, X_{ij} represents a set of i^{th} firm-specific, time-invariant variables and $Z_{ij,t}$ reflects firm-specific time-varying variables, and $\Phi(\cdot)$ is the standard normal *cdf*. The FE model, which does not require distributional assumptions, has been estimated following the approach proposed by Mundlak (1978): we added as additional explanatory variables the within-group means of the time-varying covariates ($Z_{i,t}$) to capture the correlation between the unobserved heterogeneity (c_i) and the covariates. The resulting specification is estimated as a random effects model:

[9] Note that, due to the relatively low participation rate in the insurance programs, the data set used to model the exit decision is smaller than that used to model the entry decision.

$$(3)\ P_j\left(Y_{ij,t}=1\middle|X_{ij},Z_{ij,t},c_{ij}\right)=\Phi_j(X_{ij}'\beta_j+Z_{ij,t}'\gamma_j+\bar{Z}_i'\delta)$$

where $E[c_i|X_i]=\bar{Z}_i'\delta$. The three probit models consider the insurance participation decision, the decision of an uninsured farmer in *t-1* to enroll in the program (entry) in time t, and the decision of an insured farmer in time *t-1* to drop coverage in time *t* (exit). This approach implies that the entry and exit models are estimated on subsets of the entire sample.[10] We suspect that exogenous factors may have different influences on entry and exit decisions and thus our specification allows for such differences.

Several control variables that are conceptually relevant to the insurance decisions are considered. We include the entrepreneur's main characteristics (I), such as age, sex and level of education, and structural variables (II) related to the farms' location, organization and farming systems[11]. We also consider financial factors (III) reflected in a farm's capital, financial leverage, and other relevant financial variables. Finally, we include two variables related to parameters of the insurance programs (IV) and two alternative risk management strategies[12] (V).

TABLE 3 ABOUT HERE

"Farms' capital" is the sum of farm assets net of current liabilities (net worth). "Financial leverage" is the farm's debt-to-equity ratio which is defined as the ratio of total farm liabilities over equity (i.e. owned capital). "Expected premia" is computed by averaging within regions and farming systems the (crop-specific) total premia. The variable "Expected loss ratio" is the ratio of total indemnities per hectare over premia per hectare: the expected loss ratio is the average of the farm-specific loss ratio across region and farming

[10] As suggested by a referee, given our 4 year panel data and because entry/exit equations are independent it seems more appropriate to stress once more that we are modeling entry and exit decisions, whereas complete turnover (i.e. entry-exit-entry) is not directly modeled in our framework.

[11] An anonymous referee has noted that insurance decisions may be affected by crop rotation choices. We essentially assume that crop choice decisions are pre-determined relative to the insurance decision in that modeling the endogeneity of crop choice decisions would require a different econometric strategy and is beyond the scope of the present analysis. The interested reader may refer to Lacroix and Thomas (2011) and Carpentier and Letort (2012) for recent applications considering these issues.

[12] Understanding how farmers cope with risks by adopting alternative strategies such as irrigation and crop diversification is an important issue. Recent studies suggest that farmers, on average, are risk averse and adopt strategies to manage risk. Additional details on these risk management strategies are provided by Di Falco and Perrings (2005), Foudi and Erdlenbruch (2012), and Finger (2013).

system. Due to data limitations, the loss ratio considers all indemnities, regardless of the type of insurance contract. Aggregated data provide a better representation of expected returns per dollar paid in premium since indemnity payments are highly variable in any single year at the farm level. An aggregate premium provides a valid representation of expected premia for all farms of a given type and in a specific region. As noted, farms are quite heterogeneous. For example, large variation is observed in farms' capital, cultivated areas and numbers of crops across the sample (Table 3).

In order to investigate decisions of exit or entry with respect to changes in selected strategies (cultivated area, irrigated area, and crop diversification) we have included variables' in first differenced form. We include positive and negative changes in key variables in order to identify asymmetric effects on entry and exit decisions. In particular we have introduced the variables "Increase in cultivated area", "Increase in irrigated area", and "Increase in crop diversification", as well as the correspondent "Decrease" variables. The underlying assumption is that farmers that are experiencing land expansion (or contraction), increases (or decreases) in irrigated land, or changes in the number of cultivated crops face different situations that may influence their decisions on crop insurance[13]. In particular, changes in the structure of a farm operation may lead to changes in risk management strategies, which are represented by, among other things, entry or exit from the crop insurance program. We distinguish increases from decreases in key variable to allow for asymmetric responses to changes of opposite signs. Note that a symmetric response would be implied if the coefficients are of the same magnitude but of opposite sign. To the best of our knowledge, this approach is original in modeling exit and entry decisions in crop insurance markets.

TABLE 4 ABOUT HERE

Empirical results

[13] Finally we have introduced variables to capture substantial changes (in either direction) of cultivated area, irrigated area and crop diversification. Large changes are likely to influence entry and exit decisions. The results confirms previous findings and are provided in the appendix.

We computed likelihood ratio tests to select which estimator (random effects or Mundlak's fixed effects) and set of variables would best fit our sample. For the participation model a FE specification is preferred, while the entry and exit models are best estimated using a RE estimator. Results for the model of insurance participation are shown in the first column of table 5, while the entry and exit model results are shown in the 2nd and 3rd columns of the table. Our models seem to fit well, with McFadden (1974) pseudo R-square values ranging from 0.36 to 0.54. The percentages of correct predictions are also satisfactory at about 65% for the entry and exit models and as high as 94% for the participation model.

TABLE 5 ABOUT HERE

Part of the heterogeneity in participation, entry and exit decisions is captured by geographical location. At least one of the dummy variables defined as "North West", "Centre", and "South" (with North East as the default omitted category) is statistically significant in all three models. Three factors may help explain important geographic differences. In the Northern regions there is a strong presence of producer organizations and cooperatives that have aggregated the demand for crop insurance. Such a phenomenon is largely absent in the South. Second, crop insurance in Italy has been established to help farmers cope with damages from hail, a hazard that is much more relevant in the North, where grapes and fruits are cultivated, than in the South. Third, the defense consortia, which aggregate the vast majority of the demand for insurance and process reimbursements to farmers when losses occur, are much more effective in the North than in the South.

Previous studies have found mixed results in terms of the effect of education on the adoption of risk management tools (Van de Ven and Van Praag, 1981; Mishra and El-Osta, 2002; Enjolras and Sentis, 2011). On theoretical grounds, Shapiro and Brorsen (1988) suggest that farmers may become less risk averse as they gain education, with more educated farmers being less likely to adopt risk management strategies such as crop insurance contracts, consistent with the human capital theories developed by Welch (1970) and Schultz (1972). We find that farmer education does not significantly affect participation (other than negatively at the highest level) or entry and exit decisions.

As for firm characteristics, “High altitude” and “Cultivated area” are significant in explaining participation (controlling for regions). Greater participation of farms located at higher altitudes reflects important risk differences that correspond to altitude, such as risks of hail, low temperatures, frosts, and excessive wind, which tend to increase with altitude (Mahoney et al., 2012). This result agrees with previous studies (Enjolras et al., 2012) that have also found a positive correlation between altitude and adoption of crop insurance.

Larger farms, either in terms of economic size or by total area under cultivation, are more likely to participate in crop insurance. These findings are consistent with the results of previous studies (Goodwin, 1993; Smith and Goodwin, 1996; Enjolras and Sentis, 2011; Singerman *et al.*, 2012; Di Falco et al., 2014), suggesting that farmers' endowments are a key driver for crop insurance decisions (Harrington and Niehaus, 1999). The fixed costs associated with enrollment in insurance schemes may inhibit operators of small farms as well as insurance agents and companies that service these small farms which thereby can be expected to limit participation.

The “Expected Loss Ratio” is statistically significant in the participation and exit models. However, contrary to prior expectations, higher expected loss ratios correspond to a lower likelihood of participation and to a higher likelihood of exit. This may reflect the aggregated nature of loss-ratios and premiums and the large heterogeneity across regions, and thus may reflect other unobserved, aggregate factors[14]. To investigate this further, we included the interaction terms of “Expected Loss Ratio” and regional dummies. We find a negative correlation with the entry decision for Northeast and Northwest, and a positive correlation with the exit decision only for Northwest. In the North the “Expected Loss Ratio” is close to one.

[14] Analyzing these issues is beyond the scope of the present analysis and data and is left as an important item for future research.

In other respects, the apparent inconsistency is limited only to the North and may be partially explained by the time lag (usually 1 year) occurring between the compensation and the assessment of the damage (Enjolras et al., 2012). In all other cases either the expected sign is either confirmed or the variables are not statistically significant. A limitation of our variable is that it is constructed only from insured farmers, for which we observe data on indemnities and premiums. As shown by Just et al. (1999), loss ratios may be significantly higher for insured than for non-insured farmers due to adverse selection.

We interacted the variable "Expected Premia" with dummies for geographical location (Northwest, Northeast, Center and South) in order to control for heterogeneity at the regional level: therefore the table shows four variables (E[premia]*Northwest; E[premia]*Northeast; E[premia]*Center; E[premia]*South). It is likely that risk is more homogeneous within macro-regions than between macro-regions. The approach is similar to that followed by Goodwin (1993). We find that the higher the expected premium, the lower the participation in Northwest and Center. Conversely, in "Northeast" the higher is the expected premium, the greater is participation in insurance programs. The results are not surprising considering that "Expected Premia" is lower in the Northeast, while participation is very significant. The combination of higher premiums and lower loss ratios in the "Northeast" suggest that exposure to systemic risk (Miranda and Glauber, 1997) may be an issue for this particular region, where apple and grape production is prevalent. In fact, the indemnities paid in the "Northeast" are three to eight times as large as in the rest of Italy (Table 2). As a result, the higher is the "Expected Premia" (which reflects a higher level of underlying risk), the higher is the participation in crop insurance program.

Coefficients of variables related to alternative strategies for risk management show that farmers who are more diversified or have irrigation are less likely to purchase insurance (although only at the 5% significance level). These results suggest that both diversification and irrigation can be substitute for insurance—a result that is consistent with Smith and Goodwin, 1996; Blank and McDonald, 1996; Di Falco and Chavas, 2009; Enjolras and Sentis, 2011; and Di Falco et al., 2014. The negative signs for "Crop diversification" may also reflect a form of moral hazard (Smith and Goodwin, 1996), where insured farmers do not use alternative risk-coping strategies, such as crop diversification. In addition, farmers that decrease diversification tend to enter the insurance market, possibly to manage the risks associated with the new activities[15].

The results on the determinants of farmers' insurance market entry and exit decisions (2nd and 3rd columns, table 5) merit additional discussion. First, the results are not always symmetric, with the determinants of the entry decision often differing substantially from those of the exit decision. As expected, the entry decision model corresponds rather closely with the participation model, showing the same regional pattern as the participation model. The larger the decrease in cultivated area or irrigated area, the lower is the probability of adopting insurance for farms that are uninsured.

"Irrigation" is statistically significant in the participation model, and is not statistically significant for entry and exit decisions. Participation varies in a positive manner with irrigation, suggesting that increases in irrigation tend to be associated with a higher probability of participation in insurance programs. Foudi and Erdlenbruch (2012) found that irrigation technology serves as self-insurance in that buying "insurance decreases the probability of adopting irrigation", p.454. The coefficient for "Decrease in irrigated area" is statistically significant, and negative, in the model of the entry decision, indicating that uninsured farms (at t-1) that reduce their irrigation systems (in time t-1) are less likely to sign up for insurance (in time t).

Crop diversification is significantly inversely correlated with participation, as expected, and not significant for entry. However, "Decrease in crop diversification" is statistically significant and positive for entry. This suggests that uninsured farms that reduce the number of cultivated crops are more likely to sign up for insurance. Following Cabas et al., 2008 and Bezabih and Sarr, 2012, we may assume that risk aversion

[15] Farmers that increase diversification are more likely to exit. This result is statistically significant in one specification at the 10% level. Farmers that decrease the irrigated area are less likely to enter in the insurance market.

and crop diversification are correlated, such that risk-averse farmers, as well as non-specialized farms, are less likely to be insured. However, farmers that decrease the number of cultivated crops tend to enter into a crop insurance contract.

High values of the expected loss ratio appear to favor entry decisions. Specifically, higher values of the “Expected Loss Ratio” are likely to correspond to farms producing riskier crops in riskier regions, favoring insurance decisions. It is also apparent that higher loss ratios correspond to higher returns to insurance, a factor that also tends to favor entry into the insurance program.

It is important to evaluate the role of insurance premia on dynamics in insurance markets. In “Northwest”, “Center” and “South” high insurance premia tend to lower the probability of entry by uninsured farmers, and to increase the probability of exit by insured farmers[16]. Though not always statistically significant, the results tend to suggest that the demand for insurance is downward sloping with respect to premia, a result consistent with adversely selected participants in crop insurance programs in that the larger the premium the lower the attractiveness of the contract.

Concluding Remarks

We consider three important aspects of the decision to insure crops in Italy. These include the question of participation, and also the decisions to enter and to exit from an insurance scheme. The decisions are related but individual models of entry and exit provide additional information about factors affecting participation in crop insurance. Beyond understanding participation patterns, policymakers have a keen interest in understanding the dynamics of insurance participation. This interest is substantiated by the significant investment of public funds to support such schemes and the oft-repeated goal of increasing

[16]We discuss the signs of the coefficients, but it is worth noting that in many cases the coefficients are statistically not significant: for example the variables “E[premia]*Northeast”, “E[premia]*Center”, and “E[premia]*South” are statistically not significant in the entry decision equation (column 2, table 5).

participation. We investigate these dynamics by focusing on the entry decision of uninsured farmers and the exit decision of insured farmers. We use a dynamic specification that considers how changes in cultivated area, irrigation and crop diversification are related to entry and exit decisions. We allow these changes to be asymmetric in that increases do not necessarily correspond to an opposite adjustment for decreases in the same variable. We find that farm and market characteristics have different impacts on these individual aspects of insurance demand, and that increasing or decreasing the cultivated and irrigated area, and the crop diversification tend to have different effects on insurance uptake.

Although subsidized crop insurance programs continue to proliferate around the world, participation remains sporadic and not well understood in many cases. If policymakers intend to use subsidized crop insurance as an important mechanism for agricultural risk management, they are likely to be concerned with the factors that lead a farmer to adopt insurance and to remain insured. To the extent that farm and operator characteristics differ across those farmers that enter and exit crop insurance schemes, policies intended to support participation may take different approaches for farmers that are already insured than for farmers that do not currently insure. Targeted technical support is usually recommended to enhance the participation in agricultural insurance programs (Mahul and Stutley, 2010). For example, education and outreach programs may adopt different approaches toward encouraging insured farmers to maintain coverage than what might be optimal in encouraging uninsured farmers to enroll in insurance programs.

We find that education and farm size are determinants of participation in insurance markets, confirming the earlier findings of Enjolras and Sentis (2011), Finger and Lehmann (2012), and Singerman *et al.*, 2012, among others. Our analysis also explicitly models the entry and exit decisions at the farm level. We find that entry and exit decision are driven by different factors and that adjustments to changes may reflect asymmetric patterns of adjustment, with increases in key variables implying different adjustments that would be the case for corresponding decreases. Our results are consistent with previous studies in this regard (see, for example, Smith and Goodwin, 1996; and Singerman *et al.*, 2012). The negative correlation that we found for crop diversification (and irrigated area) in the participation equation suggests that farmers tend to adopt crop diversification (and irrigation) and insurance contracts as alternate risk management strategies. These factors are certainly alternative mechanisms for managing risk and thus would be expected to serve as substitutes for insurance participation.

A few caveats are relevant to this study. First, our data were collected over a four year period. This reflects that fact that our focus on entry and exit decisions required observing individual farms over multiple periods. We thus included only those farms continuously observed during the period. Although we rely on a large set of data made up of more than three-thousand farms, our results do not capture more recent developments in the continually-changing insurance program and markets. Another drawback of our study is that detailed, farm-level data on crop insurance in Italy (such as characteristics of individual insurance contracts, realized losses, etc.) are largely unavailable. Even if such data were collected by surveys, we may not be able to observe the parameters associated with insurance offerings to uninsured farmers. To the extent that promotion of participation in insurance programs is a key objective of the European Commission Agenda, empirical work on the dynamics and turnover in insurance markets represents a promising and fruitful area for additional future research.

References

- Blank, S. C., and McDonald, J. (1996). Preferences for crop insurance when farmers are diversified. *Agribusiness*, 12(6), pp. 583-592.
- Bottazzi, G., Grazzi, M., Secchi, A., and Tamagni, F. (2011). Financial and economic determinants of firm default. *Journal of Evolutionary Economics*, 21(3), pp. 373-406.
- Bakhshi, S., and Gray, R. S. (2012). Acreage Response to Whole Farm Income Stabilisation Programs. *Journal of Agricultural Economics*, 63(2), pp. 385-407.
- Cabas, J. H., Leiva, A. J., and Weersink, A. (2008). Modeling exit and entry of farmers in a crop insurance program. *Agricultural and Resource Economics Review*, 37(1), pp.92.
- Cafiero, C., Capitanio, F., Cioffi, A. and Coppola, A. (2007) Risk and crises management in the reformed European Agricultural crises policy. *Canadian Journal of Agricultural Economics*. Special Issue, December 2007.

- Capitanio, F. (2010) The increase in risk exposure of the European farmers: a comparison between EU and North American tools looking at the CAP post 2013. *Briefing note for European Parliament* (Directorate-General for internal policies).
- Bezabih, M., and Sarr, M. (2012). Risk preferences and environmental uncertainty: Implications for crop diversification decisions in Ethiopia. *Environmental and Resource Economics*, 53(4), 483-505.
- Carpentier, A., and Letort, E. (2012). Accounting for heterogeneity in multicrop micro-econometric models: implications for variable input demand modeling. *American Journal of Agricultural Economics*,94 (1): 209-224.
- Cefis, E., and Marsili, O. (2012). Going, going, gone. Exit forms and the innovative capabilities of firms. *Research Policy*, 41(5), pp.795-807.
- Chang, H. H., and Zilberman, D. (2014). On the political economy of allocation of agricultural disaster relief payments: application to Taiwan. *European Review of Agricultural Economics*, doi: 10.1093/erae/jbt037
- Coble, K.H., T.O. Knight, R.D. Pope, and J.R. Williams. (1997) An Expected Indemnity Approach to the Measurement of Moral Hazard in Crop Insurance. *American Journal of Agricultural Economics,*pp.79
- Di Falco, S., and Chavas, J. P. (2009). On crop biodiversity, risk exposure, and food security in the highlands of Ethiopia. *American Journal of Agricultural Economics*, 91(3),pp. 599-611.
- Di Falco, S., and Perrings, C. (2005). Crop biodiversity, risk management and the implications of agricultural assistance. *Ecological Economics*, 55(4), pp.459-466.
- Di Falco, S., Adinolfi, F., Bozzola, M., and Capitanio, F. (2014). Crop Insurance as a Strategy for Adapting to Climate Change. *Journal of Agricultural Economics*, 65(2), pp.485-504.
- Enjolras, G. and Sentis, P. (2011). Crop insurance policies and purchases in France. *Agricultural Economics,* 42,pp. 475-486.
- Enjolras, G., Capitanio F. and Adinolfi, F. (2012).The demand for crop insurance: Combined approaches for France and Italy. *Agricultural Economic Review,* 13:1.
- European Commission (2009). Income variability and potential cost of income insurance for EU. *DG Agri L.1/L.3*.Bruxelles 4 May 2009.
- Finger, R., and El Benni, N. (2014). A note on the effects of the Income Stabilisation Tool on income inequality in agriculture. Journal of Agricultural Economics, 65(3), pp. 739-745.
- Finger, R., and Lehmann, N. (2012). The influence of direct payments on farmers' hail insurance decisions. *Agricultural economics*, 43(3), pp.343-354.
- Finger, R. (2013). Investigating the performance of different estimation techniques for crop yield data analysis in crop insurance applications. *Agricultural Economics*, *44*(2), pp. 217-230.
- Foudi, S., and Erdlenbruch, K. (2012). The role of irrigation in farmers' risk management strategies in France. *European Review of Agricultural Economics*, 39(3), pp.439-457.
- Garrido, A. and Zilberman, D. (2008) Revisiting the demand of agricultural insurance: the case of Spain. *Agricultural Finance Review*, 68, pp.43–66.

- Goodwin, B.K. (1993).An empirical analysis of the demand for multiple peril crop insurance. *American Journal of Agricultural Economics,* 75, pp.425-434.
- Goodwin, B.K., and Kastens, T.L. (1993), Adverse Selection, Disaster Relief, and the Demand for Multiple Peril Crop Insurance. *Contract report for the Federal Crop Insurance Corporation*
- Goodwin, B. K., & Smith, V. H. (2013). What Harm Is Done By Subsidizing Crop Insurance?. *American Journal of Agricultural Economics*, 95(2), pp.489-497.
- Harrington S.E. and Niehaus G.R. (Eds.) (1999). Risk Management and Insurance, Irwin/McGraw-Hill, 674p.
- Hellerstein, D., Higgins, N., and Horowitz, J. (2013). The predictive power of risk preference measures for farming decisions. *European Review of Agricultural Economics*, 40 (5), pp.807-833.
- Hirsch, S., and Gschwandtner, A. (2013). Profit persistence in the food industry: evidence from five European countries. *European Review of Agricultural Economics*, 40 (5), pp.741-759.
- INEA (2013). L'agricoltura italiana conta. Available at: www.inea.it (Accessed on 9 June 2014).
- Just, R. E., Calvin, L., and Quiggin, J. (1999). Adverse selection in crop insurance: Actuarial and asymmetric information incentives. *American Journal of Agricultural Economics*, 81(4), pp.834-849.
- Knight, T. O., and Coble, K. H. (1997). Survey of US multiple peril crop insurance literature since 1980. *Review of Agricultural Economics*, 19(1), pp.128-156.
- Lacroix, A., and Thomas, A. (2011). Estimating the environmental impact of land and production decisions with multivariate selection rules and panel data. *American Journal of Agricultural Economics*, 93(3), 784-802.
- Mahul, O., and Stutley, C. J. (2010). Government support to agricultural insurance: challenges and options for developing countries. *World Bank Publications*.
- Mahoney, K., Alexander, M. A.*, Thompson, G., Barsugl*i, J. J., and Scott, J. D. (2012). Changes in hail and flood risk in high-resolution simulations over Colorado's mountains. Nature Climate Change, 2(2), pp. 125-131
- McFadden D. (1974). Conditional logit analysis of qualitative choice analysis. In *Frontiers in Econometrics*, ed. P. Zarembka. New York: Academic Press. pp.105-142.
- Miranda, M. J., and Glauber, J. W. (1997). Systemic risk, reinsurance, and the failure of crop insurance markets. *American Journal of Agricultural Economics*, 79(1), pp.206-215.
- Mishra, A.K., and H.S. El-Osta. (2002) Managing Risk in Agriculture through Hedging and Crop Insurance: What Does a National Survey Reveal? Agricultural Finance Review 62(2002):135–48
- Mundlak, Y. (1978). On the pooling of time series and cross section data. Econometrica, 56, 69-86.
- Schultz, T. W. (1972). The Increasing Economic Value of Human Time. American Journal of Agricultural Economics. 54 (1972):843S50.
- Shapiro, B. I., and B. W. Brorsen. Factors Affecting Farmers' Hedging Decisions. North Central Journal of Agricultural Economics. 10(1988):145S53
- Sherrick, B. J., Barry, P. J., Ellinger, P. N. and Schnitkey, G. D. (2004). Factors influencing farmers' crop insurance decisions. *American Journal of Agricultural economics*86, pp.580-589.

- Singerman, Ariel and Hart, Chad E. and Lence, Sergio H., (2012). Revenue Protection for Organic Producers: Too Much or Too Little? *Journal of Agricultural and Resource Economics*, vol. 37(3), pp.415-434.
- Skees, J. R. and Reed, M. R. (1986). Rate-making and farm level crop insurance: implications for adverse selection. *American Journal of Agricultural Economics* 68, pp.653-659.
- Smith, V.H. and Goodwin, B.K. (1996). Crop Insurance, moral hazard and agricultural chemical use. *American Journal of Agricultural Economics* 78, pp.189-201.
- Smith, V.H. and Bacquet, A. E. (1996). The Demand for Multiple Peril Crop Insurance: Evidence from Montana Wheat Farms. *American Journal of Agricultural Economics* 78, pp.428-438.
- Van de Ven, W. P. and Van Praag, B. (1981). The demand for deductibles in private health insurance: A probit model with sample selection. *Journal of econometrics* 17, pp.229-252.
- Welch, F. (1970) Education in Production. Journal of Political Economy 78,35S59
- Wooldridge J. (2002) Econometric analysis of cross section and panel data. *The MIT Press*.

Tables

Table 1 - Crop insurance market in Italy (2004-2012)

			2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
(a)	Certificates	.000	212	212	211	237	265	226	208	208	214
(b)	Insured land	.000 ha	982	1074	1125	1051	1450	1355	1153	1164	*na*
(c)	Insured value	M €	3.710	3.810	3.789	4.380	5.436	5.131	5.313	6.145	6.826
(d)	Total premia	M €	177	269	265	293	338	317	285	287	321
(e)	Indemnities	M €	152	159	149	184	272	234	169	171	231
	Public contribution *	%	56.8	65.9	66.6	66.8	66.3	67.0	66.4	66.1	*na*
(c/a)	Average certificate value	.000 €	17.5	18.0	18.0	18.5	20.5	22.7	25.5	29.5	31.9
(e/d)	Loss ratio		0.66	0.59	0.55	0.64	0.81	0.75	0.60	0.58	0.72
	Monorisk policies (%)+		92.0	*na*	77.4	*na*	53.7	*na*	50.2	*na*	*na*
	Pluririsks policies (%)+		7.7	*na*	19.6	*na*	40.0	*na*	46.6	*na*	*na*
	Multirisks policies (%)+		0.3	*na*	2.9	*na*	6.3	*na*	3.3	*na*	*na*

(*)premiums/insured value. *na* indicates not available.

(+) The statistic refers to the percentage of the total insured value.

Source: Our elaboration on data from the Istituto di Servizi per il mercato agricolo alimentare (Ismea)

Table 2 - Geographical distribution of crop insurance contracts in Italy (2011)

		Units	North East	North West	Middle	South	Italy
(a)	Certificates	k	108	68	15	33	2824
(b)	Insured Value	M €	2.396	1.486	419	754	1656
(c)	Total premia	M €	178	69	20	40	471
(d)	Indemnities	M€	142	33	17	38	865
(e)	Percent of agriculture gross value	%	34.0	29.5	19.5	17.0	100.0
(c/a)	Average certificate value	k €	22.19	21.85	27.93	22.85	22.56
(d/c)	Loss ratio		0.80	0.48	0.85	0.95	0.75

K and M indicate thousand and million.

Source: Ismea data

Table 3 – Definition of variables and descriptive statistics

Variable	Description	Mean	Std. Dev.
(I) Entrepreneur’s characteristics			
Age	Entrepreneurs’ age	54.6	13.6
Sex	One for male entrepreneurs	93.7%	
Education level [1]	One for middle school, zero otherwise	29.3%	
Education level [2]	One for high school degree, zero otherwise	52.6%	
Education level [3]	One for bachelor degree, zero otherwise	11.9%	
Education level [4]	One for post-graduate, zero otherwise	1.8%	
(II) Structural variables			
Organic farms	One if organic firm, zero otherwise	2.8%	

Crop and livestock farms	One if producing both livestock and crops	43.8%	
High altitude	One if located 600 meters above sea level	20.7%	
Less favored areas	One if located in disadvantage areas	0.39%	
Corporations	One for corporations	0.47%	
Land size	Cultivated hectares (ha)	32.4	66.3
(III) Financial determinants			
Farms' capital	Millions of Euros in real terms	0.13	0.40
Financial leverage	Liabilities / equity	0.60	3.90
Return on equity	Net income / equity	0.08	0.14
Crop revenue	Thousands of Euros in real terms	42.1	186.4
Crop revenue per hectare	Thousands of Euros per hectare in real terms	4.47	58.7
(IV) Insurance markets			
E[Premia]	Average premia (k €/ha), by regions and crops	0.11	0.09
E[LossRatio]	Average loss ratios, by regions and crops	0.76	1.59
(V) Alternative risk management strategies			
Irrigation	Irrigated hectares (ha)	2.6	8.1
Crop diversification	Number of cultivated crops in one year	2.92	1.75

Table 4 – Summary statistics by category of participant

	Units	Participant	Not participant	Entry	Exit
Observations	Num.	3000	22358	14773	2152
Age	Years	53.1	54.8	55.0	53.4
Sex - male	%	94.7	93.6	93.6	94.7
Education level [1]	%	29.4	29.3	29.3	29.1
Education level [2]	%	53.0	52.5	52.5	53.5
Education level [3]	%	11.4	11.9	11.9	11.4
Education level [4]	%	0.9	1.9	1.9	0.8

Organic farms	%	2.8	2.8	2.8	2.6
Crop and livestock farms	%	44.1	43.8	43.8	44.2
High altitude	%	28.0	19.8	19.6	28.6
Less favored areas	%	47.1	38.3	38.3	47.3
Corporations	%	51.5	46.5	46.5	51.6
Farms' capital	M €	0.33	0.10	0.10	0.34
Financial leverage		0.57	0.60	0.60	0.63
Return on equity		0.07	0.08	0.08	0.07
Crop revenue	k €	116.3	29.5	88.1	91.8
Crop revenue per hectare	k €	2.4	4.0	2.6	2.4
Land size	ha	5.76	2.90	2.89	6.06
Irrigation	%	0.34	0.25	0.25	0.35
Crop diversification	Num. crops	2.81	2.94	2.94	2.85
E[Premia]	k €/ha	0.12	0.11	0.11	0.12
E[LossRatio]		0.46	0.80	0.81	0.46
North West	%	37.5	34.0	34.1	37.0
North East	%	34.4	13.2	13.0	35.2
Centre	%	9.2	15.5	15.4	9.7
South	%	18.9	37.4	37.5	18.0

Table 5 – Adoption, entry and exit decisions in crop insurance market

	Participation (FE omitted)	Entry (RE omitted)	Exit (RE omitted)
Age	-0.003	0.006	0.041
	(4.06)**	(0.30)	(1.17)
Age[2]		-0.000	-0.000
		(0.16)	(1.03)
Sex	0.127	-0.070	0.301
	(2.53)*	(0.51)	(0.91)
Education level [1]	-0.092	0.101	-0.092
	(1.60)	(0.52)	(0.34)
Education level [2]	-0.088	0.056	-0.190
	(1.59)	(0.29)	(0.72)
Education level [3]	-0.062	-0.068	-0.173
	(0.98)	(0.31)	(0.57)
Education level [4]	-0.388	-0.217	0.222
	(3.39)**	(0.54)	(0.31)
Organic firms	0.082	0.012	-0.351
	(1.20)	(0.05)	(0.85)
Crop and livestock farms	0.053	-0.043	-0.011
	(1.99)*	(0.51)	(0.07)
High altitude	0.093	0.159	0.069
	(2.69)**	(1.51)	(0.39)
Less favored areas	0.076	-0.033	-0.156
	(2.74)**	(0.38)	(1.04)
Corporations	0.081	0.091	-0.023
	0.053	(1.25)	(0.19)
Cultivated area(10 ha)	0.017	0.001	0.012
	(10.23)**	(0.09)	(1.77)+
Increase in cultivated area		-0.029	-0.047
		(1.36)	(0.77)
Decrease in cultivated area		-0.045	0.117

		(3.84)**	(0.99)
Farms' capital	0.260	0.038	0.001
	(10.31)**	(0.35)	(0.01)
Financial leverage	0.001	-0.008	0.012
	(0.02)	(0.82)	(1.10)
Return on equity	0.165	-0.286	0.513
	(2.05)*	(0.73)	(1.20)
Crop revenue	0.197	0.029	0.075
	(3.51)**	(0.14)	(0.48)
Crop revenue per hectare	-4.987	-0.234	0.597
	(3.60)**	(0.13)	(0.05)
Irrigated area	-0.028	0.004	0.048
	(2.16)*	(0.09)	(0.72)
Crop diversification	-0.016	0.010	0.024
	(2.22)*	(0.46)	(0.68)
Increase in irrigated area		0.230	1.307
		(0.67)	(1.06)
Decrease in irrigated area		-0.853	
		(3.31)**	
Increase in crop diversification		0.016	0.310
		(0.17)	(1.66)+
Decrease in crop diversifcation		0.354	0.105
		(1.80)+	(0.40)
E[LossRatio]	-0.034	-0.035	0.335
	(2.89)**	(1.09)	(2.33)*
E[premia]*NorthWest	-5.210	-2.952	0.383
	(10.99)**	(2.49)*	(0.10)
E[premia]*NorthEast	4.650	0.781	-1.865
	(15.54)**	(0.76)	(1.28)
E[premia]*Centre	-5.999	-0.585	3.190

	(7.85)**	(0.24)	(0.62)
E[premia]*South	-0.244	-1.443	3.277
	(0.90)	(1.35)	(1.33)
NorthWest	0.878	0.415	-0.022
	(12.03)**	(1.87)+	(0.05)
South	0.132	-0.144	-1.142
	(1.93)+	(0.66)	(2.54)*
Centre	0.802	-0.210	-0.281
	(8.47)**	(0.62)	(0.59)
Time dummy: 2004	0.036		
	(1.12)		
Time dummy: 2005	-0.032		
	(0.98)		
Time dummy: 2006	0.018		
	(0.56)		
Constant	-1.576	-2.653	-1.596
	(13.96)**	(4.42)**	(1.82)+
Correct predictions	94.4%	66.82%	64.38%
McFadden Pseudo R^2	0.47	0.37	0.55
Observations	22,415	14116	1,517

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

Online Appendix – Not intended for publication

We have compared two estimators: RE and the FE (as per Mundlak (1978), cfr. Greene, 2008, p.210). We added, as additional explanatory variables, the within-group means of the time-varying covariates ($\bar{x}'_{it}$) to capture the correlation between the unobserved heterogeneity and the covariates. This spefication makes the random effects model consistent:

$$\begin{aligned} y_{it} &= x'_{it}\,\beta + c_i + \varepsilon_{it} \\ &= x'_{it}\,\beta + \bar{x}'_{it}\,\gamma + (c_i - E[c_i|X_i]) + \varepsilon_{it} \\ &= x'_{it}\,\beta + \bar{x}'_{it}\,\gamma + \varepsilon_{it} \end{aligned}$$

where $E[c_i|X_i] = \bar{x}'_{it}\,\gamma$

The above specification is then estimated as a random effects probit model. The likelihood ratio tests for the FE model and the (nested) RE model are, respectively, 9910.5, 0.0412 and 17.8 for the adoption, entry, and exit models. The results support a FE estimator for the adoption model, and a RE for the entry and exit models.

For the participation model, we report several estimates to show how we have proceeded to select the final model and the appropriate estimator. We included fixed time effects, eliminated the delta variables, and dropped the "Vegetable revenue" variable (to assess if the potential collinearity with "Cultivated area" is an issue. We report the selected model in the last column of table A.

For the entry and exit models, the RE estimator is preferred. The estimates are not significantly different from the FE model and the likelihood ratio tests do not favor the FE estimator. In addition the FE estimates are not difficult to implement and interpret for the entry and exit models that are estimated on subsamples of the entire dataset. Specifically, we cannot include the time dummies for four years because of the peculiar nature of the entry and exit subsamples. The entry subset excludes observations for which the dependent variable (Insurance) is 1 at time t and at time t-1 and observations for which the dependent variable is 1 at time t and 0 at time t-1. The exit subset excludes observations for which the dependent variable (Insurance) is 0 at time t and at time t-1 and observations for which the dependent variable is 0 at time t and 1 at time t-1. In this light, we have maintained the previous specification of the entry and exit models.

References

Greene, W. H. (2008). Econometric analysis. Pearson Education India.

Mundlak, Y. (1978). On the pooling of time series and cross section data. Econometrica, 56, pp. 69-86.

Table A – Particpation model

	RE	RE	RE	RE	FE a là Mundlak
Age	-0.007	-0.006	-0.005	-0.005	-0.003
	(1.98)*	(1.71)+	(1.99)*	(2.02)*	(4.06)**
Sex	0.224	0.234	0.182	0.183	0.127
	(0.99)	(1.02)	(1.01)	(1.02)	(2.53)*
Educ1	-0.338	-0.337	-0.304	-0.300	-0.092
	(1.25)	(1.24)	(1.46)	(1.44)	(1.60)
Educ2	-0.239	-0.240	-0.318	-0.314	-0.088
	(0.91)	(0.92)	(1.57)	(1.55)	(1.59)
Educ3	-0.202	-0.203	-0.329	-0.328	-0.062
	(0.69)	(0.69)	(1.43)	(1.43)	(0.98)
Educ4	-1.033	-1.031	-0.919	-0.921	-0.388
	(1.95)+	(1.95)+	(2.22)*	(2.23)*	(3.39)**
Organic:0/1	0.135	0.131	0.250	0.256	0.082

	(0.43)	(0.41)	(1.00)	(1.02)	(1.20)
Veg=0/Veg+Anim=1	0.122	0.127	0.173	0.187	0.053
	(1.00)	(1.03)	(1.82)+	(1.96)*	(1.99)*
Altitude:High=1	0.311	0.301	0.246	0.244	0.093
	(1.98)*	(1.90)+	(1.90)+	(1.89)+	(2.69)**
Less fav. areas:0/1	0.169	0.175	0.194	0.195	0.076
	(1.32)	(1.36)	(1.87)+	(1.89)+	(2.74)**
Organization:Group=1	0.163	0.164	0.221	0.221	0.081
	(1.51)	(1.52)	(2.59)**	(2.59)**	(3.50)**
Capital Employed(mln€)	1.331	1.352	0.608	0.628	0.260
	(5.83)**	(7.58)**	(6.69)**	(6.95)**	(10.31)**
Vegetal revenue(mln€)	0.113	0.133	0.231		0.197
	(0.62)	(0.81)	(1.98)*		(3.51)**
Vegetal revenue(mln€)/ha	-11.650	-11.743	-2.731	-2.056	-4.987
	(2.05)*	(2.05)*	(0.97)	(0.79)	(3.60)**
Financial leverage(%)	0.005	0.005	0.001	0.000	0.000
	(0.44)	(0.47)	(0.08)	(0.02)	(0.02)
ROE	0.462	0.487	0.182	0.187	0.165
	(1.88)+	(1.98)*	(1.03)	(1.05)	(2.05)*
Cultivated area(10 ha)	0.060	0.064	0.039	0.040	0.017
	(5.98)**	(4.41)**	(6.67)**	(6.89)**	(10.23)**
Irrigated area(10 ha)	-0.093	-0.100	0.009	0.009	-0.028
	(1.44)	(1.53)	(0.19)	(0.20)	(2.16)*
Different crops	-0.068	-0.069	-0.046	-0.046	-0.016
	(1.96)*	(2.03)*	(1.84)+	(1.83)+	(2.22)*
E_primepaNorthWest	-21.452	-21.192	-16.379	-16.460	-5.210
	(9.72)**	(9.51)**	(9.49)**	(9.56)**	(10.99)**
E_primepaNorthEast	18.238	18.665	12.936	12.905	4.650
	(12.14)**	(12.47)**	(9.71)**	(9.68)**	(15.54)**
E_primepaCentre	-11.316	-10.814	-12.699	-12.731	-5.999
	(3.10)**	(2.86)**	(4.05)**	(4.08)**	(7.85)**
E_primepaSouth	-0.055	-0.043	-0.272	-0.248	-0.244
	(0.05)	(0.04)	(0.28)	(0.26)	(0.90)
E[LossRatio]	-0.054	-0.034	-0.067	-0.066	-0.034
	(0.98)	(0.61)	(1.12)	(1.16)	(2.89)**

NorthWest	3.561	3.607	2.799	2.797	0.878
	(10.14)**	(10.31)**	(9.83)**	(9.83)**	(12.03)**
South	1.025	1.074	0.432	0.416	0.132
	(3.23)**	(3.39)**	(1.63)	(1.57)	(1.93)+
Centre	2.482	2.486	1.962	1.952	0.802
	(5.32)**	(5.27)**	(5.21)**	(5.19)**	(8.47)**
Delta-Different crops	0.051	0.051			
	(0.79)	(0.80)			
d2005		0.183	0.118	0.125	0.036
		(2.67)**	(2.10)*	(2.23)*	(1.12)
d2006		-0.072	-0.052	-0.044	-0.032
		(1.05)	(0.92)	(0.77)	(0.98)
d2004			0.083	0.089	0.018
			(1.50)	(1.61)	(0.56)
Constant	2.942	2.902	1.900	1.902	-1.576
	(77.09)**	(74.92)**	(42.47)**	(42.78)**	(13.96)**
Observations	22,415	22,415	22,415	22,415	22,415

Table B – Entry and exit models

RE vs FE specification	Entry model		Exit model	
	RE	FE a là Mundlak	RE	FE a là Mundlak
Age	-0.001	-0.001	0.002	-0.001
	(0.53)	(0.53)	(0.20)	(0.19)
Sex	-0.150	-0.149	0.354	0.260
	(1.53)	(1.52)	(0.58)	(0.64)
Educ1	-0.045	-0.045	0.176	0.188
	(0.34)	(0.34)	(0.33)	(0.54)
Educ2	-0.076	-0.076	-0.035	0.051
	(0.60)	(0.59)	(0.07)	(0.15)
Educ3	-0.106	-0.106	0.333	0.340
	(0.72)	(0.72)	(0.57)	(0.91)
Educ4	-0.306	-0.306	-5.556	
	(1.12)	(1.12)	(0.00)	

Organic:0/1	0.060	0.060	-8.461	
	(0.36)	(0.36)	(0.00)	
Veg=0/Veg+Anim=1	0.041	0.043	-0.033	-0.057
	(0.65)	(0.69)	(0.11)	(0.30)
Altitude:High=1	-0.032	-0.032	-0.091	-0.138
	(0.36)	(0.36)	(0.26)	(0.63)
Less fav. areas:0/1	0.004	0.004	0.104	0.048
	(0.05)	(0.06)	(0.38)	(0.28)
Organization:Group=1	0.114	0.114	-0.071	-0.054
	(2.10)*	(2.10)*	(0.32)	(0.38)
Capital Employed(mln€)	-0.055	-0.050	0.243	0.158
	(0.44)	(0.41)	(1.76)+	(1.93)+
Vegetal revenue(mln€)	0.042		0.152	0.104
	(0.21)		(0.52)	(0.51)
Vegetal revenue(mln€)/ha	0.586	0.607	-30.112	-13.554
	(0.56)	(0.58)	(0.78)	(0.59)
Financial leverage(%)	-0.008	-0.008	0.020	0.016
	(1.43)	(1.44)	(0.51)	(0.62)
ROE	-0.412	-0.406	0.350	0.512
	(1.36)	(1.35)	(0.50)	(1.09)
Cultivated area(10 ha)	0.001	0.001	0.008	0.008
	(0.12)	(0.17)	(0.59)	(0.95)
Irrigated area(10 ha)	-0.001	-0.001	0.082	0.053
	(0.03)	(0.04)	(0.72)	(0.81)
Different crops	0.034	0.034	-0.023	-0.039
	(2.28)*	(2.28)*	(0.34)	(0.88)
E_primepaNorthWest	-0.806	-0.810	3.926	3.228
	(1.42)	(1.42)	(0.58)	(0.81)
E_primepaNorthEast	0.250	0.244	-1.915	-1.472
	(0.29)	(0.28)	(0.69)	(0.81)
E_primepaCentre	-3.870	-3.869	6.933	4.743
	(2.08)*	(2.08)*	(0.90)	(0.98)
E_primepaSouth	-0.930	-0.927	0.862	0.624
	(1.25)	(1.25)	(0.18)	(0.21)
E[LossRatio]	-0.001	-0.001	-0.196	-0.097

	(0.07)	(0.07)	(0.53)	(0.41)
NorthWest	0.108	0.107	-0.409	-0.276
	(0.64)	(0.63)	(0.50)	(0.55)
South	-0.260	-0.262	-0.406	-0.368
	(1.53)	(1.55)	(0.47)	(0.64)
Centre	0.148	0.145	-0.937	-0.687
	(0.62)	(0.61)	(0.99)	(1.11)
Constant	-2.035	-2.035	-2.794	-1.976
	(7.89)**	(7.89)**	(2.28)*	(2.56)*
Observation	14,773	14,773	1,516	1,516

Table C – Estimates from alternative specifications for the entry and exit models

	Entry model		Exit model	
	1	2	1	2
Increase in cultivated area	-0.030		-0.050	
	(1.41)		(0.84)	
Decrease in cultivated area	-0.048		0.104	
	(4.12)**		(0.89)	
Increase in irrigated area	0.290		0.938	
	(0.87)		(0.87)	
Decrease in irrigated area	-0.911			
	(3.51)**			
Increase in crop diversification	0.028		0.287	
	(0.29)		(1.56)	

Decrease in crop diversifcation	0.333		0.141	
	(1.73)+		(0.54)	
E[Premia]	-1.167	-1.277	-1.343	-1.350
	(1.93)+	(2.09)*	(1.05)	(1.09)
E[Loss Ratio]*NorthWest	-0.061	-0.043	0.877	0.903
	(1.65)+	(1.35)	(3.93)**	(4.29)**
E[Loss Ratio]*NorthEast	-0.701	-0.696	0.203	0.196
	(3.05)**	(3.04)**	(0.63)	(0.63)
E[Loss Ratio]*Centre	-0.017	-0.066	0.090	0.110
	(0.04)	(0.15)	(0.13)	(0.17)
E[Loss Ratio]*South	0.148	0.141	-0.157	-0.162
	(1.79)+	(1.71)+	(0.89)	(0.95)
Large change in cultivated area		-0.042		0.001
		(3.64)**		(0.02)
Large change in irrigated area		0.264		0.245
		(0.79)		(0.22)
Large change in crop diversification		0.103		0.486
		(1.24)		(2.24)*

We control for all factors included in pervious specifications (age, education, organic farm, ROE, size, geographic location, etc.).