The demand for crop insurance: Combined approaches for France and Italy

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Abstract

The aim of this paper is to understand which factors affect crop insurance decision in France and in Italy. These neighbor countries are characterized by a changing insurance system from a public fund to private policies which are highly subsidized. Despite the stakes related to crop insurance - CAP reform, size of the market, implication of the governments -, few studies have been drawn on this topic. The literature in finance and in agricultural economics allows to build a two-stage empirical model which computes the elasticities of demand for crop insurance, and to define its key determinants. It appears that France and Italy present similar insurance systems in terms of products and of ability to indemnify. However, the farmers' sensitivity to insurance is most contrasted across the Alps. This leads to a discussion about the creation of an insurance market at the European scale.

Keywords: *Crop insurance, Insurance demand*
JEL Classification: *G22, Q14*

Introduction

The management of risk in agriculture and the role of insurance long have been the centre of attention for researchers and policymakers. A review of the literature on the subject consistently shows the failure of private markets for comprehensive (multiperil) agricultural insurances and their unsustainability in the absence of any public intervention. Even with strong public support, insurance demand is not often as high as could be expected.

Reasons for such failures are usually found in either supply or demand conditions. On the supply side, the most explored issues are asymmetric and incomplete information (Chambers 1989; Miranda 1991; Mahul 1999; Just, Calvin and Quiggin 1999; Bourgeon and Chambers, 2003), with the resulting problems of adverse selection, moral hazard and systemic risk. This may pose the most serious obstacle to the emergence of an independent private comprehensive crop insurance industry. Especially due to the systemic character of yield risks, reinsurance becomes very expensive. Without government subsidies or public reinsurance, insurers pass this high cost to the farmers' premiums (Doherty and Dionne 1993; Miranda and Glauber 1997; Mahul 2001).

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On the demand side, the inability of farmers to assess precisely the benefits derived from agricultural insurances is often cited as one possible reason for limited demand (Garrido and Zilberman 2008). Another explanation for the limited interest in multi-peril crop insurance is simply that the organizational structure of farming is such that farmers can use other private instruments - such as product diversification, credit, financial markets, and so on - to manage risk and therefore that the potential demand for crop insurance is lower than commonly believed (Wright and Hewitt 1994). We can also consider that massive government intervention in developed countries may also crowd out private markets.

Knowledge of factors affecting farmer purchases of crop insurance is essential for evaluating the soundness and profitability of insurance programs and the pertaining public support (Goodwin and Smith 1995). In spite of its importance, the demand for crop insurance has received little empirical attention in literature, mainly devoted for investigation focused on North American area. Gardner and Kramer (1986); Niewoudt et al. (1985); and Barnett et al. (1990) found that the expected rate of return to insurance was an important factor in determining the demand for insurance. Lower attention has been devoted to the possible impact of financial issue on this field (Enjolras and Sentis 2011).

Currently, for the European countries this lack of empirical evidence is exacerbated (Capitanio and Adinolfi, 2009). With this preliminary remarks, carrying out this analysis we wish to point out which factors could affect crop insurance decision in France and Italy, taking into account both agricultural and financial variables (De Castro et al, 2011)

The first part of this paper is devoted to a presentation of the French and Italian insurance systems. Then, the second part exposes the empirical modeling framework we use for the analysis. The choices of the variables and of the models are motivated in the third part. The fourth part details the results. The fifth part finally discusses the implications of the results on the creation of an insurance market at the European scale.

1. The agricultural insurance systems in France and in Italy

The French and Italian insurance systems in agriculture have been developed over the 40 previous years under the supervision of the governments and within the framework of the European Common Agricultural Policy (CAP). They have known similar developments over the last years due to reforms in the governments help motivated by various opportunities. First, an agricultural agreement by the World Trade Organization made it possible to classify public sector aid for insurance (non-commodity specific amber box) under de minimis conditions (Blandford and Josling 2007). Second, the development of aid for insurance in North America (United States, Canada) and Southern Europe (Spain, Italy, Greece) provided a certain amount of experience (European Commission 2006). Third, there was a global trend for the liberalization of agricultural policies, which was likely to increase volatility in agricultural prices and therefore the exposure of farmers to natural hazards (Trebilcok and Howse 2005). Therefore, this section exposes the French and Italian context in order to offer ways of interpretations to our main results.

1.1 Evolution of the French crop insurance system

Until 1964, there was no state-sponsored insurance program in France. After a series of droughts, a public indemnity mechanism called the National Guarantee Fund for farming calamities (FNGCA) was set up. It was financed jointly by the government budget and by taxes on the compulsory standard insurance policies taken out by farmers. It covered farming calamities, which were defined as "non insurable damage of exceptional extent due to abnormally intense variations in a natural hazard." The farms could receive an indemnity if their losses were over two thresholds: 30% of total harvest representing at least 13% of total farm production (Mortemousque 2007). For the period 2001-2008, the FNGCA redistributed about 200 million euros each year to 55,000 farms (Table 1). Drought and frost represented 50% of the damages and 80% of the costs. The mean indemnity reaches almost 4,000 € for each affected farm but there exist wide differences among the regions and the products: the southern areas suffered from major floods while arboriculture and wineyards are very sensitive to frost[4].

Table 1. Loads and resources of the French crop insurance system from 2003 to 2006.

	2003	2004	2005	2006
Premiums (P)	93	92	90	90
Indemnities (I)	422	407	90	236
State Contribution	249	197	8	121

Source: Mortemousque (2007)

To develop private insurance and to extend its coverage to a wider range of risks, the French Ministry of Agriculture decided to expand the range of its subsidization from hail to other catastrophic risks. The new policies have been widely developed starting from 2004 when the French government started to subsidy all insurance policies at a level of 35% of the premium (40% for young farmers). In practice, the insurers extended the range of covered perils and they kept the premia at the same level thanks to the subsidization. The farmers now benefit from a better flexibility in risk management as they can choose their coverage and deductible level. The government can also control its intervention by financing the policies ex-ante rather than paying the indemnities ex-post.

1.2 The Italian crop insurance system

Public intervention in agricultural risk management in Italy has a long tradition. The "Fondo di Solidarietà Nazionale in Agricoltura" (FSN) was instituted in 1974 with the aim of providing farmers the means to effectively manage their production risk. The system has evolved over the years with numerous reforms until recently, when Italy has received the European Community guidelines for state aid in the agricultural sector concerning compensation for damages and insurance premium subsidy, with the issue in 2004 of the Legislative Decree n° 102 on the 29th of March. The Decree defines new

[4] These data are issued from a French Senate report prior to a new bill for the reform of French agriculture in 2010.

operational rules for the FSN and disciplines on financial tools for risk management and capitalisation incentives in favour of agricultural firms.

The Italian FSN is composed of two different supply services: financing of insurance policy and ex-post payments, although this general principle is subject to many exceptions that will be described in the following paragraphs. The Law instituting the FSN states that, in case an exceptional event occurs, farmers are entitled to a compensation for the damages suffered. The discipline of the compensation aid has not changed much over time. In order to activate the compensation, the status of exceptional event needs to be officially recognized by the Central Government. To this aim, when an adverse event occurs (most commonly drought, flood and late frost) the involved regional Governments file a request to the Ministry of Agriculture which, after assessment of the actual extent of damages, issues the decree which entitled farmers to ask for compensation.

Compensations are then paid based on various criteria that are determined by the Ministry of Agriculture, mostly depending on the availability of funds, rather than on the actual extent of damages. As a matter of fact, over the years there has been a rather weak correlation between actual losses and compensations paid. Moreover compensations are usually paid several years after the occurrence of the damaging events. These drawbacks, coupled with the unpredictability of the budget cost due to ex-post compensation (Table 2), have led to several attempts at shifting the bulk of the interventions of the FSN toward subsidy to crop insurance.

Table 2. Loads and resources of the Italian crop insurance system from 2003 to 2006.

	2003	2004	2005	2006
Premiums (P)	277	268	268	262
Indemnities (I)	117	177	160	145
State Contribution	112	152	177	175

Source: our calculations on Ismea/Sicuragro data

2. Empirical modeling framework

The most widely used theoretical model of analysis of uncertainty on the economic behaviour is the so called expected utility framework. It is based on the definition of the individual agent's structure of preferences over lotteries, (L). In this view, the 'damage' caused by the presence of uncertainty could be, in principle, measured by the risk premium, RP(X,p), which is defined as the difference between the expected outcome of the lottery, E(X,p) and its certainty equivalent, C(X,p).

Notice that the risk premium is a function of the entire distribution of outcomes and it depends on the full structure of preferences. While it is possible, in principle, to measure it for a given individual facing a given risky prospect of which the probability distribution is known, and assuming a given structure of preferences, it is virtually impossible to estimate it in a theoretically consistent credible way from observed choices: there will simply never be enough data to be able to identify both the preference structure and the probability distribution.

The expected utility framework has been used also to provide a formal characterization of risk aversion based on the notion of risk premium. Essentially, an economic agent is said to be risk averse if her or his preferences over risky prospects express strictly positive risk premiums. The structure of the individual's preferences will naturally determine also the 'degree' of aversion towards a given risk prospect, degree which would, in principle, imply a strongly idiosyncratic component.

To measure the degree of risk aversion, the coefficient of (local) absolute risk aversion, rA, is defined as the negative ratio between the second and the first derivative of the VNM utility function:

(1) $r_A(X) = - U''(X)/U'(X)$

and the coefficient of (local) relative risk aversion as:

(2) $r_R = X\, r_A$ (Pratt, 1964).

The advantage of using relative instead of absolute risk aversion stands in the fact that the former does not depend on the units of measure of X, and therefore could allow, for example, for comparison between measures obtained for monetary outcomes measured in different currencies.

Notice that both coefficients are local measures, that is, they are evaluated at a point in the range of outcome values, and they are functions, which means that their value is possibly different for different levels of X, even for the same individual. In practice, to know the coefficient of absolute risk aversion function is equivalent to know the entire preference structure over lotteries as postulated by the Von Neumann – Morgenstern theorem. This, which may seem an advantage of the expected utility framework, is in truth a dangerous aspect in applied analyses if we duly consider the meaning of the converse of the reasoning just made: to select a specific form for the coefficient of risk aversion (as for example to select a constant relative risk aversion, as is common in the literature) amounts at imposing a heavy structure on the preferences over the entire range of values of X.

In other words, for example, to maintain that an individual has a constant coefficient of relative risk aversion means to assume that her or his preferences have a precise structure over all possible values of X, which implies, among other things, the fact of being always risk averse, or always risk loving, no matter what the 'riskiness' of the prospect one is facing. This is an observation that has generated strong criticisms to the validity of many expected utility analyses: they are based on the fact that even casual introspection would demonstrate that the propensity toward risk usually depends on the amount at stake[5].

In most cases, an economic analysis of a risky situation is performed as follows: A certain functional form is chosen for the VNM utility function, usually taken from a class of functions that would allow for a simple characterization of the coefficients of risk aversion, one or two parameters defining the degree of risk aversion are assumed,

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[5] Most people would exhibit a certain degree of risk loving behaviour when the amounts at hand are very small, as for example when buying a lottery ticket for which the expected outcome is much lower than the price of the ticket, and at the same time would reveal sizeable risk aversion when buying car-theft insurance (see Friedman and Savage 1948)

justified on the basis of the limited number of studies that have claimed to have empirically assessed them; then, the risky prospect that needs to be assessed is described by only a limited number of parameters (usually just the mean and the variance) and the analysis is performed by calculating the value of the risk premium associated to the particular prospect, taking it as an indication of the welfare cost of the risk.

The relevance of the points raised before may be discussed when we critically review the procedures that are usually followed by analysts engaged in risk assessments. Therefore, we can identify the three following mistakes:

- Incorrect specification of the distribution of outcomes,
- Incorrect choice of the utility function, and
- Incorrect choice of the argument of the utility function.

It should be clear that the figure that comes out of such a kind of analysis, if any, is mainly the result of the assumptions maintained by the analyst rather than a credible indicator of the social cost imposed by the presence of risk. Unfortunately, the assumptions are almost invariably kept in the background and therefore an assessment of the real value of the analyses is made difficult. In the following sections, we will list some of the most common mistakes that could be made in conducing risk analysis and might have an effect on risk coverage. This insight might also be useful for a critical review of the discussions on the role of risk in the conditions of the reformed European agriculture.

3. Empirical settings

3.1 The data

The study used a survey of farmers in France and Italy belonging to the Farm Accountancy Data Network (FADN). Since the data owned by the insurer are not freely accessible even if policies are subsidized by the government, at this stage, this dataset represents the only viable opportunity offered to researchers to investigate on crop insurance policies. In each country, data are accounted for each year from a representative sample of farms, the size of which can be considered commercial.

Within the original databases, we selected only farms that had continuously belonged to the sample between 2002 and 2007. We also restricted analysis to farms that cultivated at least one crop. The same criteria apply for the two countries. Our sample finally included 9,306 farms among which 2.998 are French and 6.308 are Italian. Among these farms, 1602 are insured (1136 in France and 466 in Italy).

3.2 The variables

In the following subsections, we detail the main explanatory variables that enter into the analysis. In line with the literature, we chose a wide range of potential factors, including financial and meteorological variables.

3.2.1 Measurements of the insurance decision

Many approaches can be used to provide a measure of insurance decision, whether discrete or continuous. Their selection depends on the scale that is chosen for the analysis. Focusing at an individual level, a common approach to measuring risk hedging consists in a dummy variable indicating whether the farm took out a private crop insurance policy. This discrete indicator can be found in our databases for the years 2002 to 2007, which define the scope of our analysis in time.

For the same period, the database also provides a continuous measurement of hedging, i.e., the price of the premiums and claims. This allows to compute returns to insurance for the producers who decided to insure. Starting from the characteristics of insurance products in France and Italy and the financial situation of each farm, we also estimate the liability of the farmers. This offers a way to measure the level of insurance through a continuous variable. In order to avoid endogeneity issues, e.g. with acreage decisions (Goodwin, 1993), the continuous variables are lagged.

3.2.2 Agricultural decisions in their context

As stated in section 2, insurance decision is motivated by the farmer's aversion towards risk. Therefore, only the most high-risk farms should take out insurance. The risk level of farms can be evaluated in several ways in terms of weather exposure and geographic situation. The FADN database offers direct ways of determining the location and altitude of the farm. We can then associate each place with past weather indicators that are considered relevant by the literature. Weather data come from Météo France and Meteo Italia.

We notably refer to annual mean temperature and annual cumulated precipitation, which are the most common climatic indicators. Starting from the original variables, we converted them by taking the square deviation from their average the year before taking out insurance. This allows to measure the farmers' sensitivity to excessive variations of the climate. The farmer can undergo the climate but he can also take strategic decisions such as organic farming. In this case, yield volatility is increased and insurance is only provided if the farmer complies with some regulations (Hanson et al., 2004).

3.2.3 Economic and financial characteristics of the farm

The farmer's behavior regarding its decision to insure is also motivated by the intrinsic characteristics of its activities and by its own performance. One of the first criterions that can define the farm is its size. It can be calculated with four proxies: total and cultivated area, annual turnover and invested capital. Such variables offer the opportunity to measure both the exposition of the farm to risk and its ability to face it.

That is the reason why we add additional criteria regarding the diversification of the farm, which can either constitute a substitute or a complement to insurance. We measure it through the farm’s crop portfolio (i.e. the number of cultivated crops) and its technical economic-activity specialization (vegetables, cattle, or both). Irrigation is also perceived as a mean of hedging crop risk because it increases yield return and reduces crop diseases (Dalton et al. 2004).

The result of the farmers' operations can be measured through the yield of the farm, its return on equity and the leverage. A farm which sustains a lot of debts may be willing to insure in order to preserve its activity.

3.2.4 Control variables

We can expect that some other variables will have an influence on the decision to take out insurance, especially individual indicators, such as the age, the sex and the education of the farmer. The status of the farm may also matter depending on whether the farm is operated by one farmer alone (or with members of his family) or if it is operated with external partners.

3.2.5 Standardization of the data

As the size of the farm may have an influence on decision to insure, it appears necessary to control its influence on other variables. Therefore, most variables are standardized by dividing them by the cultivated surface. Moreover, we lagged many variables in order to avoid endogeneity issues (Table 3).

Table 3. List of variables

Variable	Time	Scale	Description
Dependent variables			
Liability per ha	-4 → -1	€/ha	Liability per planted ha
Insured	-1/0	0/1	Insured or not
Independent variables			
Premium rate	0	%	Premiums / Liability
Premium per ha	0	€/ha	Premiums / Cultivated area
Premium charge	0	%	Premiums / Crop revenue
Loss ratio	-1	%	Indemnities / Premiums
Claim per ha	-1	€/ha	Claim / Cultivated Area
Turnover	-1	€	Revenue of the farm (size)
Total assets	-1	€	Total assets of the farm (size)
Total area	-1/0	ha	Total area of the farm
Cultivated area	-1/0	%	Cultivated area / Total area
Irrigated area	-1/0	%	Irrigated area / Cultivated area
Cultivated crops	-1/0	-	Number of cultivated crops / Cultivated area
Yield	-1	€/ha	Crop Yield / Cultivated Area
Leverage	-1	-	Financial leverage
ROCE	-1	-	Return on capital employed
Temperature	-1	-	Deviation between individual and mean temperature
Precipitations	-1	-	Deviation between individual and mean precipitations
Altitude	0	-	Altitude of the farm (3 classes)
Age	0	-	Age of the farmer
Sex	0	-	Sex of the farmer
Education	0	-	Education of the farmer (5 classes)
Status	0	0/1	Farmer alone or group with external partners
Specialization	0	0/1	Main activity of the farm (crops / animals)
Organic farming	0	0/1	Organic farming

3.3 The models

Using our set of data, we are able to develop two kinds of models that aim at capturing the determinants of the purchase of crop insurance policies. In the first one adapted from Goodwin (1993), we measure insurance demand through the liability, which is a continuous variable. Then we only consider the population of insured farmers. In the second one, insurance demand is measured using a dummy variable defining whether a policy is purchased or not (Smith and Baquet 1996; Sherrick et al. 2004). We can then study the whole population of farmers.

3.3.1 Elasticities of demand for crop insurance

The first model measures some elasticities of demand for crop insurance at the individual scale. This supposes to estimate a log-log model, so that the coefficients can be interpretated as elasticities, i.e. a percentage change in a dependant variable resulting from a one percent change in the value of an independent variable. Reasoning at the farm scale differs from Goodwin (1993) who worked at the county level and it allows to be more precise for the agricultural and the financial parameters.

The following model assumes the farmer's i objective is to maximize the expected utility of its yield profit. Then, he will purchase insurance following its risk attitude which can be observed through independent variables X_{it} observed during five years. We then assume the demand for crop insurance can be written using a log-log model which takes the following form:

$$(3)\quad y_{it} = \alpha + X_{it}\beta + \varepsilon_{it}$$

Where y_{it} is the optimal choice for insurance which maximizes the farmer's expected utility, α is the intercept of the model (it has no interpretation in a log-log model), β is the vector of the price-elasticities associated to each variable and ε_{it} is a random error.

3.3.2 The determinants of crop insurance purchase

The former approach can be complemented with logistic regressions which directly measure the impact of our studied variables on crop insurance purchase denoted as a dummy variable *Insurancei*. The analysis is also performed using a panel data analysis (Coble et al. 1996) but it is more flexible than the former as all formats of variables are accepted. We can then introduce a set of agricultural decisions, economic and financial characteristics of the farm and some control variables. The model takes the following form:

$$(4)\quad Insurance_i = \alpha + X_{it}\beta + \upsilon_{it}$$

Where $Insurance_i$ defines whether the farmer subscribes or not insurance, α is the intercept, β is the vector of the estimated coefficients and υ_{it} is a random error.

Following Velandia *et al.* (2009), we also compute the marginal effect of a particular explanatory variable on the probability to subscribe crop insurance.

4. The results

4.1 Comparison of loss ratios and premium charges in France and in Italy

Our study considers the scope of time when the French and Italian insurance regimes move from public to private insurance. One aim of this study is to understand if this change is in favor of the insurer or of the insured. Therefore, this analysis is only performed on the sub-sample of insured farms. The loss ratio is defined as the ratio between claims and premia. The premium charge is the ratio between premia and crop revenue.

Table 4 indicates that for the period 2003-2006, the loss ratio moves in favor of the French insured farmers in the long run while the premium charge increases. This result is correlated to the introduction of private crop insurance. It may indicate an adverse selection as the new policies introduced in 2005 could be subscribed without control ex-ante. As a result, farmers at risk may have bought crop insurance contracts.

Table 4. Comparison of the loss ratios and premium charges in France

Loss ratio (Indemnities / Premia)			Premium Charge (Premia / Crop revenue)		
Year	Mean	Median	Year	Mean	Median
2003	67.07%	0.00%	**2003**	6.96%	2.73%
2004	80.61%	0.00%	**2004**	14.40%	2.76%
2005	76.61%	0.00%	**2005**	15.74%	3.02%
2006	231.58%	0.00%	**2006**	25.61%	2.61%
All years	115.05%	0.00%	**All years**	15.80%	2.77%

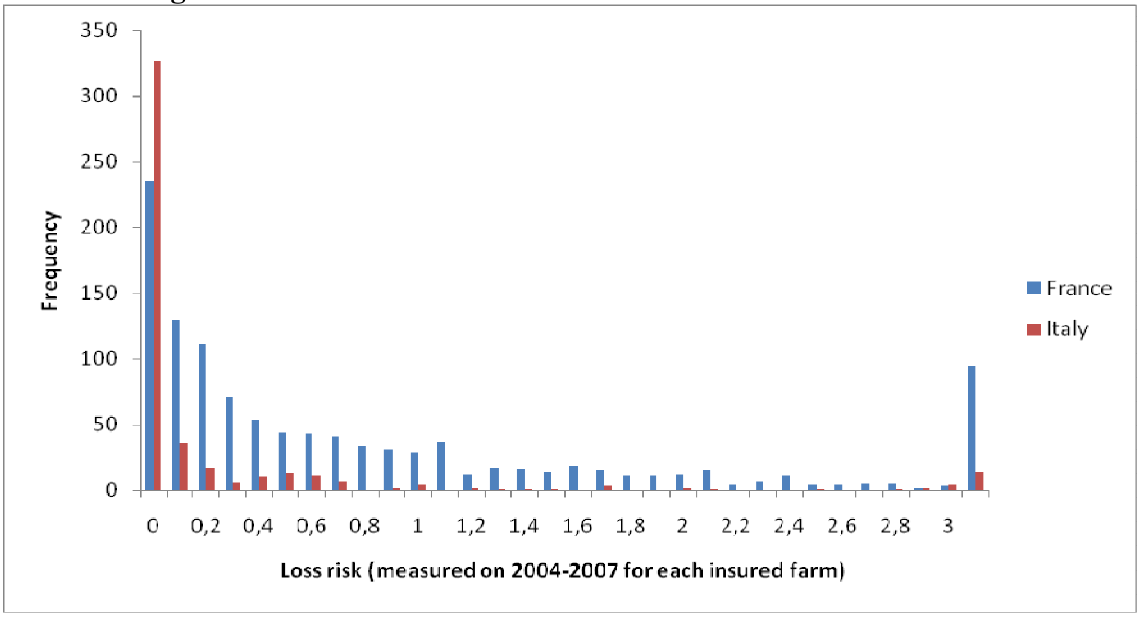
Contrary to France, no trend can be identified for the loss ratio in Italy (Table 5). The farmers globally pay more premiums than they receive indemnities. Year 2004 seems to have been in favour of the insured but this case is isolate. A strange result comes from the mean of the premium charge which is negative. This situation comes from the Italian regulation on crop insurance subscription: some farms pay (high) premia while they face negative crop revenue. However, a look at the median of the premium rate, i,e, its distribution, asserts that the distribution of premium rates is similar in France and in Italy.

Table 5. Comparison of the loss ratios and premium charges in Italy

Loss ratio (Indemnities/Premia)			Premium Charge (Premia/Crop revenue)		
Year	Mean	Median	Year	Mean	Median
2003	82.91%	0.00%	**2003**	-46.42%	1.91%
2004	128.31%	0.00%	**2004**	-112.76%	3.54%
2005	51.86%	0.00%	**2005**	-21.67%	1.62%
2006	26.73%	0.00%	**2006**	-325.60%	3.25%
All years	66.53%	0.00%	**All years**	-121.48%	2.54%

In relative terms, French and Italian farmers seem to face comparable costs for purchasing insurance (same distribution of premium charge) but in mean terms, it seems that French farmers benefit more from insurance (Figure 1).

Figure 1. Distribution of loss risk for French and Italian farms



4.2 Elasticities of demand for crop insurance in France and in Italy

We estimated a model of demand which takes the log-log form, so that the coefficients can be directly interpretated as elasticities. According to the Hausman's specification test (1978), we first estimated a panel-data model with random effects. Following Goodwin (1993), the dependent variable in equation (3) is the farm's liability as defined in Table 3.

Then we estimated a linear regression model with the same variables but only for year 2007 when private insurance was widely developed in France and Italy. In that case, all variables are computed taking into account 4 years before the decision to insure. All the estimated parameters are heteroskedasticity-robust and there are not correlated between each others.

Table 6. French elasticities of demand for crop insurance

$R^2 = 0.3020$	Coefficient	Std. Err.	z	P > |z|
Premium per ha^{-1}	0.201	0.017	11.65	0.000
Cultivated area	0.753	0.052	14.49	0.000
Total area	-1.006	0.236	-4.26	0.000
Total assets^{-1}	0.156	0.050	3.10	0.002
Financial leverage^{-1}	0.018	0.014	1.35	0.178
ROCE^{-1}	0.126	0.014	8.66	0.000
Temperature^{-1}	-0.071	0.021	-3.36	0.001
Precipitations^{-1}	-0.055	0.019	-2.87	0.004
Intercept	4.044	0.587	6.89	0.000

Table 7. Italian elasticities of demand for crop insurance

R^2 = 0.3670	Coefficient	Std. Err.	z	P > |z|
Premium per ha^{-1}	0.038	0.013	2.83	0.005
Cultivated area	0.314	0.040	7.74	0.000
Total area	0.001	0.111	0.01	0.994
Total $assets^{-1}$	0.332	0.025	13.31	0.000
Financial $leverage^{-1}$	0.206	0.063	3.27	0.001
$ROCE^{-1}$	0.210	0.007	30.87	0.000
$Temperature^{-1}$	0.665	0.200	3.33	0.001
$Precipitations^{-1}$	0.052	0.195	0.27	0.791
Intercept	5.460	0.511	10.68	0.000

The results for France and Italy are given in Tables 6 and 7. Except for climatic variables, the results of the estimations are quite similar between the two countries. It is in particular the case for the influence of the elasticity of the premium per *hectare* to the liability, i.e. insurance coverage. Goodwin (1993) noticed for a US study that the effect should be negative because an increase in the premium level should lead to less insurance. However, in European countries, the increase of the premiums has been linked to an increase in the range of the covered risks. In both countries, the coefficient indicates a relative inelasticity which might characterize an adverse selection effect.

Conversely, insurance is positively linked to the size of the farm, whether agricultural (cultivated area) or financial (total assets), which is in line with literature. Performance, measured by the return on capital employed, and distress, measured by leverage, also tends to have a positive effect on insurance decision.

One of the main conclusions made by Goodwin was that *"that counties with low loss-risks have considerably more elastic demands for crop insurance than those counties where producers typically collect high indemnities relative to their premium payments"*. Considering our results, this suggests that increasing premium rates for all producers would increase aggregate loss-risk levels among the pool of participants as cancellations would occur among low loss-risk producers at a significantly higher rate than high loss-risk producers. As a result, it clearly emphasizes the question of an inadequacy in setting crop insurance premiums in France and Italy.

4.3 The determinants of crop insurance purchase for French and Italian farms

To complement the former approach, we estimated a model of demand considering whether the farmer is insured or not. This allows to determine the factors that lead farmers to insure in France and Italy. The results are given in Tables 8 and 9. They show more dispersion between the two European countries.

Table 8. French determinants of demand for crop insurance

11992 obs. $R^2 = 0.5209$	Parameters estimates					Marginal effects			
	Coef.	Odds Ratio	Std. Err.	z	P>|z|	Coef.	Std. Err.	z	P>|z|
Claim per ha^{-1}	0.000	1.000	0.000	0.40	0.690	0.000	0.000	0.40	0.690
Insured^{-1}	4.123	61.762	3.720	68.45	0.000	0.774	0.006	128.42	0.000
Age	-0.003	0.997	0.004	-0.83	0.409	-0.001	0.001	-0.83	0.409
Sex	-0.038	0.962	0.119	-0.31	0.755	-0.010	0.031	-0.31	0.755
Status	-0.146	0.864	0.059	-2.13	0.033	-0.037	0.017	-2.14	0.033
Turnover^{-1}	0.000	1.000	0.000	1.02	0.308	0.000	0.000	1.02	0.308
Total assets^{-1}	-0.000	1.000	0.000	-1.63	0.104	-0.000	0.000	-1.63	0.104
Financial leverage^{-1}	0.002	1.002	0.006	0.35	0.724	0.001	0.002	0.35	0.724
ROCE^{-1}	-0.014	0.986	0.017	-0.83	0.409	-0.004	0.004	-0.83	0.409
Yield^{-1}	-0.000	1.000	0.000	-1.37	0.171	-0.000	0.000	-1.37	0.171
Cultivated area	0.002	1.002	0.001	3.93	0.000	0.001	0.000	3.93	0.000
Irrigated area	0.005	1.005	0.002	3.36	0.001	0.001	0.000	3.36	0.001
Cultivated crops	0.064	1.066	0.014	4.98	0.000	0.016	0.003	4.98	0.000
Organic farming	-0.016	0.984	0.085	-0.19	0.852	-0.004	0.022	-0.19	0.852
Temperature^{-1}	0.263	1.301	0.207	1.66	0.097	0.066	0.040	1.66	0.097
Precipitations^{-1}	0.015	1.015	0.008	1.93	0.053	0.004	0.002	1.93	0.053
Education 1	0.174	1.190	0.182	1.14	0.255	0.043	0.038	1.14	0.254
Education 2	0.170	1.185	0.175	1.15	0.251	0.042	0.037	1.15	0.250
Education 3	-0.103	0.902	0.150	-0.62	0.536	-0.026	0.042	-0.62	0.536
Education 4	0.093	1.098	0.286	0.36	0.720	0.023	0.065	0.36	0.720
Specialization	0.463	1.589	0.107	6.89	0.000	0.115	0.017	6.95	0.000
Altitude 1	0.031	1.031	0.095	0.33	0.739	0.008	0.023	0.33	0.739
Altitude 2	-0.181	0.835	0.110	-1.37	0.171	-0.045	0.033	-1.37	0.169
Intercept	-3.018	-	0.329	-9.19	0.000	0.000	0.000	0.40	0.690

Legend: see Table 3.

Table 9. Italian determinants of demand for crop insurance

25232 obs. $R^2 = 0.5084$	Parameters estimates					Marginal effects			
	Coef.	Odds Ratio	Std. Err.	z	P > |z|	Coef.	Std. Err.	z	P>|z|
Claim per ha[-1]	0.000	1.000	0.000	0.75	0.455	0.000	0.000	0.75	0.455
Insured[-1]	4.473	87.623	5.138	76.29	0.000	0.701	0.009	78.64	0.000
Age	-0.007	0.993	0.002	-3.07	0.002	-0.000	0.000	-3.08	0.002
Sex	0.193	1.213	0.150	1.56	0.119	0.009	0.005	1.68	0.092
Status	0.115	1.122	0.065	1.99	0.046	0.006	0.003	1.99	0.047
Turnover[-1]	0.000	1.000	0.000	6.81	0.000	0.000	0.000	6.72	0.000
Total assets[-1]	0.000	1.000	0.000	0.58	0.560	0.000	0.000	0.58	0.560
Financial leverage[-1]	0.013	1.013	0.007	1.91	0.057	0.000	0.000	1.91	0.057
ROCE[-1]	0.001	1.001	0.204	0.01	0.995	0.000	0.010	0.01	0.995
Yield[-1]	0.000	1.000	0.000	0.10	0.924	0.000	0.000	0.10	0.924
Cultivated area	0.003	1.003	0.000	7.94	0.000	0.000	0.000	7.94	0.000
Irrigated area	0.001	1.001	0.003	0.50	0.619	0.000	0.000	0.50	0.618
Cultivated crops	-0.085	0.919	0.016	-4.83	0.000	-0.004	0.001	-4.83	0.000
Organic farming	-0.169	0.844	0.094	-1.52	0.129	-0.008	0.005	-1.52	0.129
Temperature[-1]	-1.044	0.352	0.055	-6.67	0.000	-0.051	0.008	-6.65	0.000
Precipitations[-1]	0.025	1.025	0.008	3.21	0.001	0.001	0.000	3.21	0.001
Education 1	0.113	1.120	0.162	0.79	0.432	0.006	0.007	0.77	0.442
Education 2	0.115	1.122	0.157	0.82	0.410	0.006	0.007	0.82	0.409
Education 3	0.247	1.280	0.203	1.56	0.119	0.013	0.009	1.43	0.152
Education 4	-0.526	0.591	0.171	-1.82	0.069	-0.002	0.009	-2.31	0.021
Specialization	-0.018	0.982	0.060	-0.29	0.770	-0.001	0.003	-0.29	0.770
Altitude 1	0.349	1.418	0.112	4.44	0.000	0.020	0.005	3.97	0.000
Altitude 2	0.402	1.495	0.175	3.44	0.001	0.023	0.008	2.96	0.003
Intercept	-2.919	-	0.271	-10.76	0.000	0.000	0.000	0.75	0.455

Legend: see table 3.

We notice that the parameters estimates and the marginal effects converge for each variable: they exhibit the same significance and the same sign.

In both countries, the fact to have been insured the year before appears to be very important for the current subscription. This means either a fidelity or inertia effect towards crop insurance. The cultivated area is also a common criterion that increases the coverage.

The effect of the financial size, measured by the turnover, is significant in Italy with a similar positive effect but not in France. Most financial variables do not seem to influence insurance decision: leverage, returns, yields are not statistically significant in France and in Italy. The same result concerns the level of education of the farmer.

The climatic indicators have an ambiguous effect: they are not significant in France while they have opposite and ambiguous effects in Italy: excessive temperatures (too hot or too cold) decrease the probability to insure whereas the effect is positive for precipitations. This kind of variables may be more accurate for analyses year by year (Enjolras and Sentis, 2011).

Among the way farmers traditionally use to hedge, there exist diversification, measured by the number of cultivated crops per hectare, and irrigation. These techniques have a positive effect on insurance in France. In this context, they act as complements to insurance. In Italy, the negative sign associated to cultivated crops indicates that diversification is a substitute to insurance.

5. Implications for the creation of an insurance market at the European scale

Lacking a common framework, EU Members State (MS) have autonomously adopted national policies for assisting farmers in dealing with agricultural production risks, as well as natural catastrophes, within the broad limits defined by the national State regulations (Cafiero et al, 2007) The types and the extent to which national policies have been adopted, however, differ widely within EU MS, possibly reflecting the agro-climatic conditions and crop specialization. Policy intervention aiding farmers' risk management activities has been carried out mainly in the EU Southern countries, such as France, Greece, Italy and Spain, where subsidies to crop insurance and/or agricultural solidarity funds are in place. In other EU countries, such as United Kingdom, agricultural insurance is not publicly supported although ad hoc assistance is offered when necessary.

Despite the parallel between France and Italy, the practice of insurance is different in the two countries. For instance, French farmers are more diversified than Italian ones. Similarly, our study indicates that French insured farms are more willing to receive premiums than Italian farms. However, many factors that lead to insurance are quite similar between the two states.

Taken by themselves, these results of the comparison present a major interest for the future of the Common Agricultural Policy (De Castro et al, 2012a; De Castro et al, 2012b). In the perspective of the creation of a European insurance market, the countries characteristics are determinants: they must comply with more or less the same administrative rules. At the same time, the farmers should reveal different behaviors and expositions so that a mutualization of the risks applies (Schlesinger 2000).

It would be clear that when normal enterprise risks are considered, as entrepreneurs, farmers should develop own risk management abilities by making use of private markets of insurance, credit and financial instruments. In this case, public intervention should act in order to promote, at European level, a private market or to favor the development of private abilities to manage risk, providing the needed regulatory institutions and informational support in order to promote the expression of the private demand for market-based risk management tools, while guaranteeing competition on the supply side (Capitanio et al, 2011).

Moreover, promoting the constitution of precautionary savings account through direct and indirect incentives, such as fiscal benefits in order to increase the potential of self insuring against some of the less severe risks at the individual farm level and promoting the concentration of the demand for risk management instruments in order to have a more efficient access to all of these markets. In this case, supporting the operation of mutual funds is an effective way of fostering development of risk markets.

Conclusion

This study represents one of the first attempts to measure the determinants of crop insurance purchases in two European countries. France and Italy are among the major crop producers between the European countries and they have introduced insurance in agriculture since decades. Nearly at the same time in the mid 2000s, they reformed their system in order to encourage private companies to develop policies.

Thanks to a complete set of data available in the two countries, we have been able to perform a two-stage analysis that is usually split into literature: the measure of relevant elasticities of crop insurance demand and the econometric determination of the factors that lead farmers to cover their yield.

A key point is the extent in the range of covered risks provided by the reforms of public systems: at now, most of catastrophic risks (floods, storms) are included in the policies, which led to a significant increase in the premium levels in Italy while this effect was mitigated in France due to public subsidies. As a result, insurance tent to become more costly and less profitable. Yet, the potential benefits procured by insurance overcame the costs so that an insured farmer remained insured even if insurance was more expensive. This contrasts with usual observations for the United States, especially when measuring the elasticities of insurance demand (Goodwin 1993).

We also noticed that purely agricultural indicators such as the size of the farm, measured by the cultivated area, and diversification, measured by the number of cultivated crops, are key factors for insurance purchase decision in both countries. However, strategic financial variables such as leverage and returns had no influence in the two countries while these indicators are usually relevant in corporate finance. Other variables such as weather conditions seemed to have no impact on insurance decision. An analysis performed year by year might reveal more precise information.

The study of the similarities and the differences noticed between French and Italian farmers toward crop insurance decision allow understanding the dynamics of a recent and promising market. It also opens many perspectives in terms of risk management and of insurance development considering the forthcoming evolution of the Common Agricultural Policy.

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