

A choice experiment method to assess vegetables producers' preferences for crop insurance

Lluc Mercadé¹; José M. Gil¹; Zein Kallas¹; Jordi Serra²

¹ CREDA-UPC-IRTA - Centre for Research in Agro-food and Development Economics, Castelldefels, Spain, e-mail: lluc.mercade.romeu@upc.edu, Chema.Gil@upc.edu, zein.kallas@upc.edu

² Departament d'Agricultura, Alimentació i Acció Rural-Generalitat de Catalunya, Barcelona, Spain, e-mail: jordi.serra@gencat.cat



Paper prepared for presentation at the 113th EAAE Seminar “A resilient European food industry and food chain in a challenging world”, Chania, Crete, Greece, date as in: September 3 - 6, 2009

Copyright 2009 by [Lluc Mercadé¹; José M. Gil¹; Zein Kallas¹; Jordi Serra²]. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.

A choice experiment method to assess vegetables producers' preferences for crop insurance

Lluc Mercadé¹; José M. Gil¹; Zein Kallas¹; Jordi Serra²

¹ CREDA-UPC-IRTA - Centre for Research in Agro-food and Development Economics, Castelldefels, Spain, e-mail: lluc.mercade.romeu@upc.edu, Chema.Gil@upc.edu, zein.kallas@upc.edu

² Departament d'Agricultura, Alimentació i Acció Rural-Generalitat de Catalunya, Barcelona, Spain, e-mail: jordi.serra@gencat.cat

Abstract. *Agricultural producers face many risks in their economic activity due to weather conditions, plant or animal diseases, price volatility, policy changes and so on. One of the management tools to deal with some of these risks is the crop insurance system. In Catalonia (North-East of Spain) farmers' participation in crop insurance for vegetables is low. Only 5 percent of the vegetables area is insured, when in Spain, as a whole, this percentage is around 20 percent. Different reasons have been suggested to explain this low participation ratio such as low risk perception, risk diversification, insurance cost or crop damage assessment rules, among others. However, no systematic research has been undertaken to assess farmers' preferences for crop insurance in Catalonia. Through a survey of 93 vegetables farmers in the main productive areas in Catalonia, we conducted choice experiments to assess main farmers' preferences for crop insurance. Each insurance policy was defined by 4 attributes: insurance cost; risks covered; minimum production damage level; and crop damage assessment rule.*

Results identify that insurance cost and crop damage assessment rules are among the most important factors to explain farmers' behaviour toward crop insurance. These results allow us to suggest some recommendations specifically addressed to re-orientate the existing crop insurance policy in the vegetables sector in Catalonia.

Keywords: crop insurance, vegetables, choice experiments, Catalonia.

1. Introduction

Agricultural producers face many risks in their economic activity due to weather conditions, plant or animal diseases, price volatility, and policy changes among others. Some factors affecting the agricultural sector like climate change, more market orientated CAP (Common Agriculture Policy), agricultural trade liberalization, restrictions on the use of crop protection products or production specialization indicate that risk faced by farmers may increase in the future^[1,2]. Therefore, we should expect that risk management tools will gain importance in the coming years. There are many different instruments to deal with risks in the agricultural sector like production diversification, cultivate products with short production cycles, use of marketing or production contracts, vertical integration, future markets or insurances among others^[1]. In this paper, we focus on farmers' participation in crop insurance. In particular, we study farmers' preferences for crop insurance.

Previous literature on demand for crop insurance has mainly analyzed farmers' or farm characteristics as factors that may affect participation in agricultural insurance. However, less attention has been given to farmer's preferences for crop insurance attributes^[3]. Therefore, in this paper, we try to analyze farmers' preferences for crop insurance. We have taken the vegetable crop insurance in Catalonia (North-East of Spain) as a case study. The motivation to study this issue comes from the fact that Catalan farmers' participation in crop insurance for vegetables is low. The figures show that only 5.3 %¹ of the vegetables area is insured, while at Spanish level this percentage is 20.6 %. Catalonia is one of the last Spanish Autonomous Communities in terms of percentage of vegetables area covered by crop insurance (see Figure 1).

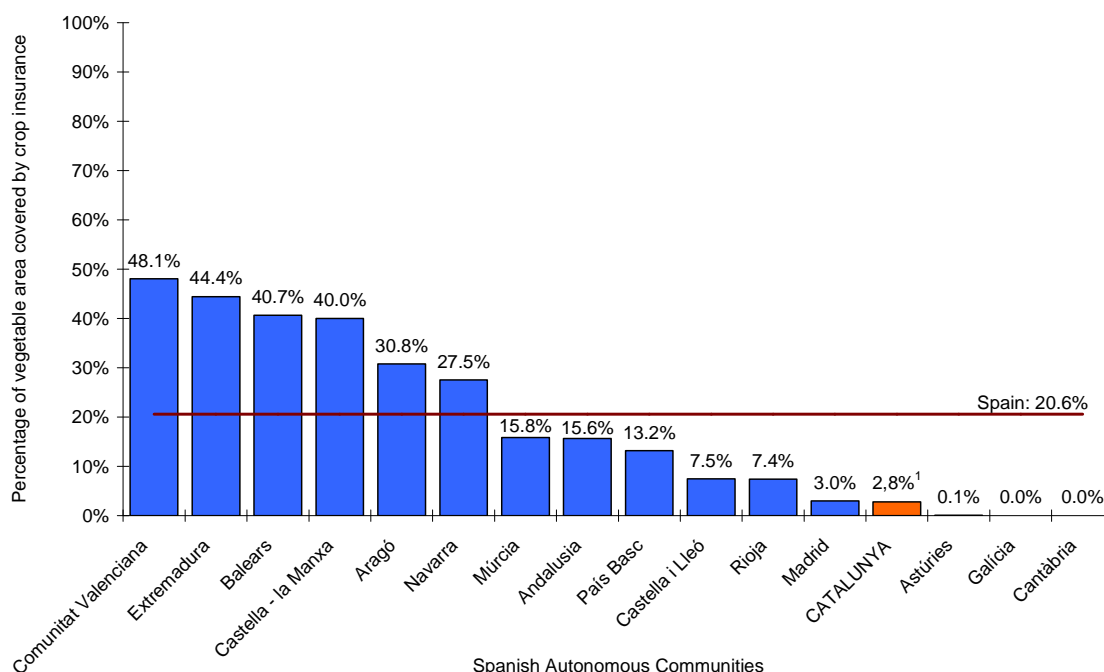


Figure 1. Percentage of vegetable area covered by crop insurance in Spain and its Autonomous Communities in 2006. Source: Own elaboration based on Agroseguro data and *Anuario de estadística agroalimentaria y pesquera 2007* (Ministry of the Environment and Rural and Marine Affairs of Spain)

The Spanish agricultural insurance system can be briefly described as a combination of public and private agents, where the public administration through the State agrarian insurance body (ENESA) establishes, each year, the framework (annual plans) for the agricultural insurance system, promotes the system and monitors the implementation of the insurance plans and, a coinsurance pool of private insurance companies (AGROSEGURO) fixes the specific conditions and the premium rates for the insurance products, hires independent loss adjusters and, pays the indemnities. The private insurance companies commercialize the policies through their networks. The farmer's participation in the system is voluntary,

¹According to our calculations, the percentage of vegetable area covered by crop insurance in Catalonia is 5.3% (2007). However, to elaborate the figure for Spain and its Autonomous Communities (Figure 1) we have used other data sources. This, and also that rates are referred to different years explain the difference between the two participation rates for Catalonia.

and the Spanish government and the Autonomous Communities governments, in order to encourage farmers to purchase insurance policies, subsidize almost 50% of the insurance premium^[1,4,5].

With regard to vegetable crop insurance, the Spanish agricultural insurance system provides coverage for all vegetables against damages caused by a wide range of risks: hail, frost, persistent rain, flooding, high wind, fire, virosis in tomato plant and, since 2009, wildlife damage.

In 2002, a new insurance line, the vegetable multicrop policy designed to respond to the needs of the producers that grow different vegetable crops was introduced. However, although many Catalan farmers grow different vegetable crops, the multicrop policy has not improved the insurance participation rate as it was expected. In 2007, less than one hectare of the 16,851 ha of the vegetable area in Catalonia² was covered by this insurance line. The total vegetable area covered by a crop insurance, for that year, was 891.5 ha² (5.3% of the vegetable area).

Different reasons have been suggested to explain this low participation ratio such as low risk perception, risk diversification, insurance cost or crop damage assessment rules, among others. However, no systematic research has been undertaken to assess farmers' preferences for crop insurance in Catalonia.

In order to elicit farmers' preferences for crop insurance, a choice experiment was designed. Previously, we conducted a focus group and a meeting with agricultural insurance experts, vegetable producers, and Government employees, to discuss and establish the insurance attributes to be included in the choice experiment. Finally, each insurance policy was defined by 4 attributes: insurance cost; risks covered; minimum production damage level; and crop damage assessment rule.

2. Methodology: The Choice Experiments

The Choice Experiments (CE) characterize the object of study through a definite number of attributes whose combination allow creating hypothetical scenarios that will be evaluated by subjects. The conceptual foundations of CE rely on two main theories a) Lancaster's Theory of Value^[6], which proposes that utilities for goods can be decomposed into separable utilities for their characteristics or attributes, and b) Random Utility Theory^[7], which explains the dominance judgments made between pairs of offerings. Based on this theoretical framework, subjects choose among alternatives according to a utility function with two components: a systematic (i.e. observable) component plus a random term (non-observable by the researcher). Mathematically:

$$U_{in} = V_{in}(Z_i, S_n) + \varepsilon_{in} \quad (1)$$

where U_{in} is the utility provided by alternative i to subject n , V_{in} is the systematic component of the utility, Z_i is the vector of attributes of alternative i , S_n is the vector of socio-economic characteristics of the respondent n , and ε_{in} is the random term.

Among the probabilistic choice models, the conditional logit (CL) model^[8,9] is the most employed model for dealing with CE-sampled data^[10]. Under this specification, the condition of independent and identically distributed (IID) error must be met according to a Gumbel (or Weibull) distribution. Such a distribution in the error term allows for the verification of the independence of irrelevant alternatives (IIA) property, known as Luce's axiom^[11], which implies that the ratio of the probabilities of choosing any pair of alternatives i and j [$\Pr(i/C_n)/\Pr(j/C_n)$] is not dependent on the systematic utility of any other alternative within the set of alternatives C_n . To validate the IIA property, the most common test employed is that of Hausman and McFadden^[12].

According to the CL model, the probability that an individual n will choose alternative i (P_{in}) among other alternatives ($i = 1$ to I) of a set C_n is formulated as follows^[8]:

² Own elaboration based on data of Ministry of Agriculture, Food and Rural Action of the Government of Catalonia.

$$P_{in} = \frac{e^{\mu V_{in}}}{\sum_{i=1}^{i=I} e^{\mu V_{in}}} \quad \forall i \in C_n \quad (2)$$

where V_{in} is the systematic component of the utility provided by alternative i , and μ is a scale parameter which is inversely proportional to the standard deviation of the error terms and is usually assumed to be equal to one^[9].

Equation 2 enables the probability of choice of an alternative to be linked to its utility. To determine the relative importance of the attributes within the alternatives, the functional form of V_{in} must be defined. The most common assumption of this function is that it is separable, additive and linear following this expression:

$$V_{in} = ASC + \sum_k \beta_k X_{ki} \quad (3)$$

Where;

ASC = Alternative Specific Constant, representing the utility of the fixed comparator
 $i = 1 \dots I$, representing the selected alternative i within the set of alternatives (C_n);
 $k = 1 \dots K$, representing the attributes which characterize alternative j ;
 β_k = model parameter of attribute k ;
 X_{ki} = value of attribute k in alternative i ;

From (3) the basic CL model is given by:

$$P_{in} = \frac{e^{ASC + \sum_k \beta_k X_{ki}}}{\sum_{i=1}^{i=I} e^{ASC + \sum_k \beta_k X_{ki}}} \quad (4)$$

By estimating the basic CL model (4), implicit prices (IP) can be obtained for each attributes and levels (5). These average values for the individuals in the sample can be set in ranking structure determining the preferences of attributes and levels.

$$IP_{\text{Product_attribute}} = - \left(\frac{\beta_{\text{Product_attribute}}}{\beta_{\text{monetary_attribute}}} \right) \quad (5)$$

3. Empirical application

In the empirical application, the first step is the determination of attributes and levels for farmers' insurance preference. We need to clearly define the attributes that farmers take into consideration for contracting crop insurance. The strategy employed was to identify and specify the most relevant attributes. The identified attributes were subsequently discussed in a focus group and a meeting comprising agricultural insurance experts, vegetable producers, and Government employees. All participants agreed the need to include or eliminate some of the commented attributes. The final set of attributes was: Risks covered, minimum percentage of production damage that allow farmers to be compensated, crop damage assessment rule and, insurance cost.

The second step after the identification of attributes is to determine which levels should be associated with. These were discussed as follow:

- The “risks covered” in the current situation are hail, frost, persistent rain, flooding, high wind and fire. We have identified other 3 groups of risks covered: one with fewer risks covered, and the other two with more risks covered (see Table 1).
- The attribute “minimum production damage level” is defined as the minimum percentage of the production value loss required to take a claim into consideration. In the current insurances this percentage depends on the insurance line and the type of risk. Discussions in the focus group and in the meeting resulted in the identification of 4 minimum production damage levels: 10%, 15%, 20%, and 25%.
- The crop damage assessment rule is the way used to assess the crop damage. In order to identify their levels, it is worth considering that currently this assessment is carried out through a loss adjuster hired by AGROSEGURO. However, farmers complain that loss adjustment does not value the production damage adequately, as in some cases damaged production cannot be sold in the food chain or, if sold, perceived prices are lower. Thus, we have identified principally two levels: the first is based on loss adjustments rules and the other is based on commercial or market rules.
- Finally the last attribute “insurance cost” was defined as the amount paid for each 100 € of the insured capital. In this context, it is not possible to define the insurance premium currently paid by farmers in general, because it depends on many factors such as the insurance line, insurance option, farm location, discounts, bonus and subsidies among others. Thus, to identify the appropriate levels for this attribute, we have considered, as a starting point, the total vegetable crop insurance premium paid and the total capital insured in the area of study (provinces of Barcelona and Tarragona). In 2007, these were 0.12 million € and 1.75 million €, respectively. Thus, in average in 2007 the vegetable insured farmers paid 6.9 € for each 100 € of the insured capital. From this figure and after some discussion within the focus group and the meeting, we have identified the following 4 insurance cost: 2 €, 5 €, 8 € and 11 € for each 100 € of the insured capital.

Once attributes and levels were identified, a pilot questionnaire was designed and implemented to check for the adequacy of the experiment. No significant problems were reported. Table 1 shows the attributes and levels considered in this study.

Attributes		Levels description	Levels symbol
<i>Risks covered</i>	(A ₁)	▪ Hail, Persistent rain, Flooding, High wind, Fire.	<i>Cov</i> ₀ *
		▪ Hail, Persistent rain, Flooding, High wind, Fire, Frost	<i>Cov</i> ₁
		▪ Hail, Persistent rain, Flooding, High wind, Fire, Frost, Crop pests and/or diseases, Water shortage.	<i>Cov</i> ₂
		▪ Hail, Persistent rain, Flooding, High wind, Fire, Frost, Crop pests and/or diseases, Water shortage, Decrease in prices received for production, Increase in production costs.	<i>Cov</i> ₃
<i>Minimum percentage of production damage that allow farmers to be compensated</i>	(A ₂)	▪ 10%	<i>Dam</i> ₀ *
		▪ 15%	<i>Dam</i> ₁
		▪ 20%	<i>Dam</i> ₂
		▪ 25%	<i>Dam</i> ₃
<i>Crop damage assessment</i>	(A ₃)	▪ Based on loss adjustment rules	<i>Ass</i> ₀ *
		▪ Based on commercial rules	<i>Ass</i> ₁
<i>Insurance cost</i>	(A ₄)	▪ 2 € for each 100 € of the insured capital	<i>Cost</i>
		▪ 5 € for each 100 € of the insured capital	
		▪ 8 € for each 100 € of the insured capital	
		▪ 11 € for each 100 € of the insured capital	

*: base level

Table 1. Attributes and levels of farmers’ insurance preference

Once attributes and levels are defined, an experimental design should be applied. We need to decide how many alternatives and which combination of attributes and levels is included in the choice sets, and the final number of choice sets presented to each interviewee. Two insurance alternatives was included in each choice set beside a null-alternative to assure the realism of the hypothetical simulated market in the

experiment. The combination of the all attributes and levels is known as “full factorial design Following this complete design, and tacking into account the 3 attributes with 4 levels and 1 attributes with 2 levels (Table 1), we obtain an universe of $(2^1 \times 4^3) \times (2^1 \times 4^3) = 16,384$ possible combinations for the insurance alternatives. This initial number of choice sets is extremely high which should be reduced using a fraction of it. Thus, we follow an “orthogonal fractional factorial design” to estimate all main effects, obtaining 16 choice sets.^[13] Even so, this number still too high to be presented to the subjects^[14]. Therefore, we separate them into blocks following a factorial blocking method. The 16 sets were divided into two blocks of eight sets each. Figure 2 shows one of these choice sets.

ELECTION # 1	Alternative “A”	Alternative “B”	Alternative “No election”
<i>Risks covered</i>	Hail, Persistent rain, Flooding, High wind, Fire, Frost, Crop pests and/or diseases, Water shortage.	Hail, Persistent rain, Flooding, High wind, Fire, Frost, Crop pests and/or diseases, Water shortage, Decrease in prices received for production, Increase in production costs.	Neither
<i>Minimum percentage of production damage that allow farmers to be compensated</i>	15%	20%	
<i>Crop damage assessment</i>	Based on loss adjustment rules	Based on commercial rules	
<i>Insurance cost</i>	8 € for each 100 € insured capital	11 € for each 100 € insured capital	
Supposing these options are the only ones available, which would you buy?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure 2. Example of a choice set

The analysis was conducted through a face-to-face survey of 93 vegetables farmers in the main productive areas in Catalonia. 80 farmers have answered correctly the choice experiments and were introduced into the analysis assuring the equality of answers from each block of the design.

Assuming a separable, additive and linear utility function we follow equation 3 for the econometric modeling. We consider only the attributes and levels as the only regressors of this function. This model assumes homogenous preferences across the sample, thus by estimating it every individual is assumed to have “average” preferences and thus the willingness to pay for the different analyzed attributes is similar. In this case, one implicit price or estimate exists for each attribute/level combination and for the whole package of insurance. This utility function in the basic Conditional Logit model, take the following form:

$$V_{in} = ASC + \beta_{Cov1} \cdot Cov_{1i} + \beta_{Cov2} \cdot Cov_{2i} + \beta_{Cov3} \cdot Cov_{3i} + \beta_{Dam1} \cdot Dam_{1i} + \beta_{Dam2} \cdot Dam_{2i} + \beta_{Dam3} \cdot Dam_{3i} + \beta_{Ass1} \cdot Ass_{1i} + \beta_{Cost} \cdot Cost_i$$

where variables are previously explained in Table 1.

4. Results

Table 2 shows the results of the basic CL model. As can be seen, at the 99% confidence level, we can reject the null hypothesis that all coefficients are jointly or simultaneously equal to zero. We thus do not reject the overall significance of the model. The goodness of fit of model can be assessed through the McFadden's *pseudo-R*² (0.073). In spite of the low results obtained, the values are similar to those obtained in other empirical studies^[15, 16, 17, 18] and could be regarded as valid and acceptable in this type of application. Moreover, the result of the Hausmann-MacFadden test for both models demonstrates the non-violation of the IIA property (acceptance of the null hypothesis). The statistical value of the test is 6.13 lower than the corresponding χ^2 with a 99% confidence level (21.66).

	<i>Variables</i>	<i>Coeff.</i>	<i>Std. error</i>	<i>p-value</i>
Risk covered: Hail, Persistent rain, Flooding, High wind, Fire, Frost	<i>Cov</i> ₁ **	-0.299	0.118	0.011
Risk covered: Hail, Persistent rain, Flooding, High wind, Fire, Frost, Crop pests and/or diseases, Water shortage	<i>Cov</i> ₂	0.008	0.114	0.941
Risk covered: Hail, Persistent rain, Flooding, High wind, Fire, Frost, Crop pests and/or diseases, Water shortage, Decrease in prices received for production, Increase in production costs.	<i>Cov</i> ₃ ***	0.581	0.107	0.000
Minimum percentage of production damage that allow farmers to be compensated is 15%	<i>Dam</i> ₁	0.179	0.115	0.122
Minimum percentage of production damage that allow farmers to be compensated is 20%	<i>Dam</i> ₂	-0.145	0.116	0.212
Minimum percentage of production damage that allow farmers to be compensated is 25%	<i>Dam</i> ₃ **	-0.301	0.120	0.012
Crop damage assessment is based on commercial rules	<i>Ass</i> ₁ ***	0.308	0.062	0.000
Insurance cost (€ for each 100 € of the insured capital)	<i>Cost</i> ***	-0.099	0.020	0.000
Alternative Specific Constant, representing the utility of the null alternative or fixed comparator	<i>Asc</i>	0.207	0.146	0.157
<i>Summary statistics</i>				
No. of observations	640			
Log-Likelihood (0)	-660.63			
Log- Likelihood (θ)	-612.66			
Log- Likelihood ratio	95.93 (0.000)			
ρ ² (pseudo R ²)	0.073			

Significance levels: *** p<0.01; **p<0.05; * p< 0.10.

Table2. Results of the basic CL models

Results show that almost all levels' parameters are statistically significant except the intermediate coverage insurance package "Cov₂" level of "Cov" attribute, and the lowest minimum percentage to be compensated Dam₁ (15%) and Dam₂ (20%) levels of "Dam" attribute. The non significance of these levels shows an insufficient contribution into farmers' utility function and reveals that these levels do not affect farmers' preferences to insure their activities. In this same context, the non significance of the null alternative reveals that farmers prefer to have insurance policy, confirming them as non risk lover economic agent.

The positive sign of coefficient implies higher levels of utility associated with its corresponding attributes' levels. Thus, as expected when the insurance package include more service "Cov₃", farmers' utility is greater. Moreover, crop damage assessment based on commercial rules "Ass₁" increase their utility. The negative sign implies that an increase in the levels decrease utility. In this line, the basic insurance package "Cov₁" decrease farmers' utility showing a preference for a more complete service

contract. The negative sign of the highest damage percentage “Dam₃” coefficient represents higher utility as the level of this attribute decreases (the lower is the percentage) showing, as expected, farmers’ preference for lower percentage of damage to be compensated.

We should bear in mind that levels are codified using the effect coding. In this type of codification the reference point is defined as the negative sum of the estimated coefficients of the remaining levels. Thus, the utility of the reference level equals to: $\beta_1 \times (-1) + \beta_2 \times (-1) + \dots + \beta_{L-1} \times (-1)$. Following this calculation, we can obtain the coefficient of the reference level. Thus, for instance, for the “Dam” attribute, the reference level “10%” have a coefficient equals to $0.1786 \times (-1) + (-0.1447) \times (-1) + (-0.3006) \times (-1) = 0.2666$.

As mentioned before, the economic interpretation can be obtained from the implicit price (IP) of each level of the attributes. Since these estimates are stochastic, it is usual to calculate their confidence intervals. In this study we employed the method of Krinsky and Robb^[19] through 1000 random repetitions. Results are shown in Table 3.

	Attributes	IP (€)	95% C.I.
<i>Risks covered (A₁)</i>	IP _{Cov0}	-2.942	(-6.56 ; 0.28)
	IP _{Cov1} **	-3.039	(-5.70 ; -0.89)
	IP _{Cov2}	0.086	(-1.98 ; 1.93)
	IP _{Cov3} ***	5.895	(3.60 ; 9.49)
<i>Minimum percentage of production damage that allow farmers to be compensated (A₂)</i>	IP _{Dam0}	2.705	(-0.77 ; 6.80)
	IP _{Dam1} *	1.813	(0.05 ; 4.25)
	IP _{Dam2}	-1.468	(-3.78 ; 0.40)
	IP _{Dam3} **	-3.050	(-5.80 ; -1.01)
<i>Crop damage assessment (A₃)</i>	IP _{Ass0} ***	-3.126	(-5.28 ; -1.91)
	IP _{Ass1} ***	3.126	(1.80 ; 5.04)

Significance levels: *** p<0.01; **p<0.05; * p< 0.10.

Table 3. Implicit prices and confidence intervals for attribute’ levels

As shown in Table 3 the willingness to pay for the insurance cover attributes, increase when a higher coverage of potential damages are included as expected. Thus, farmers request a discount of (3.039 €) per 100 € insured capital in order to accept the secondgroup of risks offered (Hail, Persistent rain, Flooding, High wind, Fire, Frost). However, they are willing to pay 5.895 € to assure a whole set of risks offered by the insurance contract. Moreover, farmers exhibit a preference for lowering thresholds (percentage of damage) for which they have the right to be compensated. Results show also that farmers could accept an insurance contract with a 25% of damage to allow them to be compensated only if the package has a discount of 3.050 € for each 100€ of insured capital. Farmers also prefer to use the commercial rules for crop damage assessment. They are willing to pay 3.126 € for this attribute level.

The previous results represent the Implicit Prices of each attributes individually. However, it is relevant to analyze if there are significant differences between these IP. In order to analyze these hypothesis tests, first we need to calculate marginal utility between each level. In a second step we calculate the IP of the change to go from one level to another. The marginal utility derived from the change from one level (L-1) to another one (L) can be obtained by calculating the differences between coefficients, that is: $\beta_L - \beta_{L-1}$. To obtain the IP of this change we divide the resulting marginal utility by the coefficient of

cost attribute as following: $-\frac{\beta_L - \beta_{L-1}}{\beta_{Price}}$. The results are shown in Table 4.

Levels' change	Marginal Utility differences	IP of change from levels (€)	95% C.I.
<i>Cov</i> ₀ → <i>Cov</i> ₃	0.871	8.837***	(4.97 ; 15.22)
<i>Cov</i> ₀ → <i>Cov</i> ₂	0.298	3.028	(-0.60 ; 7.68)
<i>Cov</i> ₀ → <i>Cov</i> ₁	-0.010	-0.098	(-4.19 ; 4.08)
<i>Cov</i> ₁ → <i>Cov</i> ₃	0.881	8.935***	(5.75 ; 14.85)
<i>Cov</i> ₁ → <i>Cov</i> ₂	0.308	3.125**	(0.60 ; 6.62)
<i>Cov</i> ₂ → <i>Cov</i> ₃	0.573	5.809***	(3.05 ; 10.06)
<i>Dam</i> ₀ → <i>Dam</i> ₃	-0.567	-5.755***	(-11.11 ; -1.83)
<i>Dam</i> ₀ → <i>Dam</i> ₂	-0.411	-4.173*	(-9.01 ; -0.34)
<i>Dam</i> ₀ → <i>Dam</i> ₁	-0.088	-0.893	(-5.09 ; 2.94)
<i>Dam</i> ₁ → <i>Dam</i> ₃	-0.479	-4.862***	(-9.25 ; -2.09)
<i>Dam</i> ₁ → <i>Dam</i> ₂	-0.323	-3.280*	(-7.24 ; -0.60)
<i>Dam</i> ₂ → <i>Dam</i> ₃	-0.156	-1.582	(-4.77 ; 1.08)
<i>Ass</i> ₀ → <i>Ass</i> ₁	0.357	6.253***	(4.29 ; 10.03)

Significance levels: *** p<0.01; **p<0.05; * p< 0.10.

Table 4. Implicit prices and confidence intervals for change in levels

As shown in Table 4, almost all changes between levels in each attribute are significant. These results confirm in all cases farmers' preference founded before toward insurance contract. Thus, for "risk coverage" attribute, going from the lowest level of insurance service toward the complete package, farmers' utility increase as expected. Moreover, farmers show a preference for the lowest minimum percentage to be compensated (10%). They claim a discount of 5.755 €/100 € of capital insured if the minimum threshold to be compensated is 25% compared with the 10% level. The results show also that utility change is irrelevant for threshold change from 10% (*Dam*₀) to 15% (*Dam*₁) and from 20% (*Dam*₂) to 25% (*Dam*₃). Finally, farmers preferences for assessment rules based on commercialization norms is highly significant with an IP of 6.253€/100% capital to change between levels.

5. Conclusion and discussion

Our paper focuses on assessing the vegetables producers' preferences for crop insurance. We carry out an empirical analysis using the choice experiment method, where each insurance policy was defined by 4 attributes: insurance cost; risks covered; minimum production damage level; and crop damage assessment rule. The choice experiments were administered to 93 Catalan crop producers of the main productive areas in Catalonia, through a face-to-face survey. 80 farmers answered correctly and were introduced into the analysis. The results enable to identify some of the farmers' preferences for vegetable crop insurance.

Insurance attributes are important when farmers make their insurance choices. Results demonstrate that farmers are likely to accept insurance policy under certain conditions. Concerning the "risks covered" attribute, the results show that insurance policies that cover the risk of the decrease in perceived prices and the increase in production cost contribute to higher farmers' utility. Regarding the "minimum percentage of production damage" farmers prefer low percentages. Finally, Catalan crop producers clearly prefer a crop damage assessment based on commercial rules than loss adjustment rules.

If we estimate the willingness to pay for vegetable crop insurance with the attributes levels similar to the current insurances policies³, the resulting willingness to pay is negative, which confirms the low rate of insurance participation in Catalonia. Catalan farmers do not appreciate current crop insurance; however,

³ Risks covered: hail, frost, persistent rain, flooding, high wind and fire (*Cov*₁); Minimum percentage of production damage (in the current insurances this percentage depends on the insurance line and the type of risk): 10% (*Dam*₀); and Crop damage assessment: Based on loss adjustment rules (*Ass*₀)

other insurance packages can be more attractive to them. Results show that farmers' willingness to pay may reach 11.7 € for each 100 € of the insured capital in the most valued crop insurance⁴.

The current vegetable crop insurances in Spain, at least for Catalan crop producers should be modified in order to increase farmers' participation in crop insurance. However, we still need to verify to what extent the real premiums of the proposed insurance packages are affordable by both farmers and insurance companies.

Acknowledgment

We acknowledge the financial support of the Ministry of Agriculture, Food and Rural Action of the Government of Catalonia which has funded this research, which is part of a larger study about the low Catalan farmers' participation in crop insurance for vegetables.

⁴ Risks covered: hail, frost, persistent rain, flooding, high wind, fire, crop pests and/or diseases, water shortage, decrease in prices received for production, increase in production costs. (Cov₃); Minimum percentage of production damage (in the current insurances this percentage depends on the insurance line and the type of risk): 10% (Dam₀); and Crop damage assessment: Based on commercial rules (Ass₁)

References

1. European Commission. Agriculture Directorate-General. Directorate A. Economic analyses, forward studies, evaluation (2001). Risk Management Tools for EU Agriculture with a special focus on insurance. Working Document
2. Commission of the European Communities. (2005). Communication from the Commission to the Council on risk and crisis management in agriculture. Brussels, COM (2005) 74
3. Sherrick, B. J., Barry, P. J., Schnitkey, G. D., Ellinger, P. N. & Wansink, B. (2003). Farmers' Preferences for Crop Insurance Attributes. *Review of Agricultural Economics* 25(2), 415-429.
4. OECD (2000). Income Risk Management in Agriculture.
5. European Commission. JRC Ispra. Institute for the Protection and Security of Citizens. Agrifish Unit (2006, modified in 2008). Agricultural Insurance Schemes. Final Report.
6. Lancaster, K. (1966), A new approach to consumer theory. *Journal of Political Economy*, 74, 132-57.
7. Thurstone, L. (1927), A law of comparative judgement, *Psychological Review*. 34, 273-286.
8. McFadden, D. (1974), *Conditional logit analysis of qualitative choice behavior*. In: Zarembka, P. (Ed.). *Frontiers in econometrics*. Academic Press. New York.
9. Ben-Akiva, M., Lerman, S.R. (1985), *Discrete choice analysis: Theory and applications to travel demand*. MIT Press. Cambridge.
10. Adamowicz, W., Louviere, J., & Swait, J. (1998), *Introduction to attribute-based stated choice methods*. Adavanis: Edmonton.
11. Luce, R., (1959), *Individual choice behaviour: a theoretical analysis*. John Wiley and Sons, New York.
12. Hausman, J., McFadden, D., (1984), Specification tests for the multinomial logit model, *Econometrica* 52, 1219-1240.
13. Louviere, J. (1988), *Analyzing Individual Decision-Making: Metric Conjoint Analysis*. Sage University Paper Series on Quantitative Applications in the Social Sciences, N° 07-067, Sage Publications. Beverly Hills.
14. Swait, J., Adamowicz, W., (2001), Choice environment, market complexity and consumer behaviour: a theoretical and empirical approach for incorporating decision complexity into models of consumer choice, *Organizational Behaviour and Human Decision Processes* 86(2), 141-167.
15. Boxall, P., Adamowicz, W., (2002), Understanding heterogeneous preferences in random utility models: a latent class approach, *Environmental and Resource Economics* 23(4), 421-446.
16. Mazzanti, M., (2003), Discrete choice models and valuation experiments, *Journal of Economic Studies* 30(5-6), 584-604.
17. Mogas, J., Riera, P., Bennett, J., (2005), Accounting for afforestation externalities: a comparison of contingent valuation and choice modelling, *European Environment* 15(1), 44-58.
18. Kallas, Z., Gómez-Limón, J.A., & Barreiro J., (2007), Decomposing the value of agricultural multifunctionality: combining contingent valuation and the analytical hierarchy process. *Journal of Agricultural Economics*, 58(2), 218 – 241.
19. Krinsky, I., Robb, L., (1986), On approximating the statistical properties of elasticities, *The Review of Economics and Statistics* 68(4), 715-719.