The demand for public-private crop insurance and government disaster relief

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Abstract

Insurance premium subsidies and disaster relief payments are government actions that can help to smooth farmers' incomes between years. In the EU crop insurance based on public-private partnership is promoted. We present an analysis based on farmers' stated preferences with split data approach of crop insurance and disaster relief provided by the government. Results reveal that farmers' willingness to pay for crop insurance is conditional on the prospect for government disaster relief.

Keywords: **disaster relief, public-private partnership, crop insurance, choice experiment, willingness to pay**

1 Introduction

Since the end of the 1990s, the European Community has been interested in the role of agricultural insurance programmes (European Commission, 2001; European Commission, 2006; European Commission, 2011). EU opened support for agricultural insurance with Article 68 of EC 73/2009 (European Commission, 2009). In 2013 Common Agricultural Policy (CAP) of the EU reform introduced insurance premium subsidies as part of rural development (European Commission, 2013). This policy is implemented in the framework of public-private partnership. From 2015 onwards member states can use up to 65% premium subsidies (national, EU or combined) for agricultural insurances provided by private crop insurance companies or farmers mutual funds.

Crop insurance markets are exposed to unpredictable weather conditions. Yield risks are systemic in nature, and public intervention is often a necessity for the development of private crop insurance markets (Miranda and Glauber, 1997). Insurance premium subsidies, reinsurance and disaster relief payments are government actions that may help farmers to smooth the income waivers between years.

Adverse selection (see e.g. Goodwin, 1993; Smith and Baquet, 1996; Sherrick, Barry, Ellinger and Schnitkey, 2004; Velandia, Rejesus, Knoght and Sherrick, 2009) and moral hazard (see e.g. Smith and Goodwin, 1996; Mishra, Nimon and El-Osta, 2005) has seen to be the main problems to be tackled in the development of crop insurance markets.

Once the worst-case scenario is realised and large-scale yield losses occur through catastrophic events, there is political, social and media pressure to help people in distress. These ad hoc measures may lead to the failure of crop insurance markets. Thus, we believe that government actions related to disaster relief are as important for the successful development of insurance markets based on public-private partnership, as questions related to moral hazard and adverse selection traditionally linked to crop insurance markets.

Crop insurance operates in the market niche between the deductible level and governmental disaster relief. Small yield variation is covered by the deductible, and these risks are thus carried by farmers, while governments typically prepare to cover catastrophic risks. The gap for yield insurance in the market might thus be too limited. Furthermore, the limitations are regional and dependent on the climate and agricultural and trade policy conditions. The WTO rules for green box subsidies state that if government support is given for crop insurance, the deductible has to be at least 30% (WTO, 1994). EU legislation follows this limit. Both ends of the niche for commercial yield insurance are also under debate. Under the CAP legislation for 2015–2020, the EU will allow the Member States to introduce yield insurance such as that applicable in US and Canadian agricultural policy. In this program, the deductible will be limited to 30% to meet with the green box requirements in WTO rules (European Commission, 2013).

Finland is at the northern end of Europe, where the harsh climate and high yield variability increases the yield risks of farming. However, agricultural policy in Finland does not include any public support for yield insurances. At the same time as the new private insurance scheme is being developing, rules for ad hoc disaster relief *if any* from the government for farmers need to be defined.

The policy renewal in Finland inspired this research, but we believe that our approach will reveal some general conclusions also applicable in other countries. The current situation where new upcoming possibilities for private crop insurance introduced in the CAP offer a fruitful opportunity to examine the influence of farmers' expectations regarding government involvement in crop damage on their willingness to pay for new yield insurance products.

Both of these possibilities, disaster relief payments and premium subsidies and crop insurance based on public-private partnership, are valid not only in Finland but also in other countries renewing crop insurance schemes. However, government actions pull crop insurance in different directions. On the one hand, premium subsidies are paid to increase the interest of farmers in insurance, while on the other hand, ad hoc disaster relief reduces this interest. The question is highly practical, and it also raises a question. *Does ad hoc disaster relief seriously damage the market potential of yield insurance?* This question is especially important in Europe, where commercial crop insurance is not well developed and farmers place strong faith in government disaster relief in the case of crop failure.

We conducted a split sample choice experiment where the role of government disaster relief was included in the choice experiment as a constant variable. We argue that the main problems for the development of new crop insurance products in the EU based on public–private partnership are not moral hazard and adverse selection. Rather, we need to address the question of whether crop insurance is a viable product in the EU under the pressure of deductible rules and ad hoc disaster relief.

We present a stated preference survey using choice modelling with an error component logit (ECL) estimation method to investigate the factors affecting crop insurance purchases. Furthermore, we compute the willingness to pay (WTP) estimates for different attributes of crop insurance products for two different hypothetical situations regarding government intervention following catastrophic crop losses.

2 Data and the estimation method

Experimental design

The choice experiment design was included in a mail survey conducted in late 2012. The survey was sent to total of 5,000 farmers, which is some 8% of all farms in Finland. The discrete choice method is used to describe the choices of decision makers among alternatives. The experimental design, i.e. the combination of alternatives and different levels of attributes, was created for our questionnaire in accordance with efficient design. Efficiency was sought for the multinomial logit model (MNL). Efficient design aims to result in a dataset that generates parameter estimates with standard errors that are as small as possible. The complete experimental design consisted of 126 choice cards that were grouped into 21 blocks. In order to create an efficient design, some prior information about the parameter values was needed. In this study, the questionnaire was pretested with a pilot survey. The number of responses from the pilot study was not sufficient to be modelled. However, we obtained valuable information on the expected signs of the parameters that enabled us to improve the final design.

In the choice experiment design, respondents were shown six insurance product cards. On every choice card there were two crop insurance products with differing crop insurance attributes. Farmers were asked to choose the more suitable crop insurance product from the two alternatives.

Respondents could also choose not to purchase crop insurance at all (Figure 1). Because Finnish farmers have no prior hands-on experience of private market crop insurance (private markets opened later on 2015), the respondents were given information about insurance attributes before they were asked to make the insurance choices. All four attributes were described in detail.

INSURANCE CARD 1	Insurance 1	Insurance 2	I would not purchase insurance
Insurance premium €/hectare	12	16	
Deductible	20 %	20 %	
Insurance type	Yield index insurance, farm inspection is not needed.	Farm yield insurance, inspection of loss at the farm is needed.	
Expected indemnity €/hectare	300	600	
MY CHOICE	□	□	□

Figures 1. Example of choice card.

The attributes chosen for insurance products were the price, deductible, insurance type and expected indemnity. The price of insurance was determined per cultivated hectare and ranged from 4 to 32 Euros/hectare. The deductible, i.e. insurance coverage, determines the share of the loss that is covered by the farmer and in this experiment was set at 10%, 20% or 30%. The insurance type was either index or farm-specific insurance (Table 1). In farm-specific insurance, loss inspection is needed if the farm experiences a crop loss. In index insurance, the compensation is based on regional indices, e.g. the regional yield. If the value of the index falls below the deductible level, an insured farmer is eligible for compensation, even if he has not experienced crop damage. The expected indemnity was also determined per cultivated hectare. It had three different levels, which were 100 Euros/hectare, 300 Euros/hectare and 600 Euros/hectare. The probability of an expected indemnity impact also to farmer's choices, but it is left as an endogenous variable. In fact it is one of the major reasons for farmers heterogeneous choices.

Table 1. Crop insurance product attributes in the choice experiment design.

Attribute	Levels
Price	4, 8, 12, 16, 24, 32 Euros/hectare
Deductible	10, 20, 30%
Expected indemnity	100, 300, 600 Euros/hectare
Insurance type	Index insurance, Farm-specific insurance

We applied a split sample approach to study the market-distorting effect caused by a government policy complementary to crop insurance products. Farmers in the two samples were given different status quo options, but the attributes in the choice experiment design did not vary across the two samples. The split sample approach in the CE context has been used, for example, in evaluating how the WTP for one nature restoration and preservation project depends on the overall scale of nature preservation activities (Jacobsen, Lundhede, Martinsen, Hasler, and Thorsen, 2011). Mørkhback, Christensen, and Gyrd-Hansen (2010) and Kragt (2013) investigated how the WTP changes when the maximum level of the cost attribute varies across samples. Pozo, Tonsor, and Schoeder (2012) utilized the split sample approach to examine how the WTP of consumers varies when different mixtures of attributes are used in a CE.

The role of government disaster relief was included in the choice experiment setting as a constant variable. Before farmers were asked to complete the insurance choices, it was stated **in half of the questionnaire forms that the government will not under any circumstances grant disaster relief in the case of a catastrophic event (NO)**. In the **other half of the questionnaire forms it was stated that government disaster relief is possible, but the condition for compensation is that farmers have purchased private crop insurance (YES).** The aim of this structure was to determine whether market-distorting effects are present when government disaster relief is available. In addition, the split sample approach reveals how the willingness to pay for crop insurance products varies across products when the government intervenes in crop insurance markets.

The structure of the split sample is somewhat restricting, because the alternative where crop insurance is not a requirement for government disaster relief is not included as one option or data splitting factor. However, the situation where disaster relief can be granted without crop insurance is not feasible option for the Finnish government. If the government declares that it will cover catastrophic risks even if farmer don't have crop insurance before crop insurance markets have evolved, it will prevent the development of viable crop insurance markets.

Choice experiment data

A total of 1,170 from the 5,000 mailed survey forms were returned. After missing responses were removed from the dataset, there were 6,105 completed insurance choices. There were 494 farmers in the sample where government will no longer participate in crop damage compensation **(NO)** and 560 farmers in the sample where disaster relief is possible with insurance **(YES)**.

Table 2 describes the explanatory variables included in the discrete choice models. The variable means and standard deviations are of the two samples and pooled data are presented. The crop insurance attributes in the choice experiment design are described in Table 1. There were no major differences in attribute means between the split samples.

Two of the explanatory variables were categorical. The opinions of farmers concerning the government's role in compensating crop damage in the future were enquired with five response categories. The other categorical variable concerned whether the farmer considered that his/her farm yield variability was higher than the average yield variability in the county where the farm was located. A dummy variable was included concerning whether the farm had received a government based Crop Damage Compensation payment at least once in the preceding 18 years.

Table 2. Mean values (standard deviation in parentheses) of explanatory variables.

Variable		Whole sample (POOLED)	Sample with disaster relief not possible (NO)	Sample with disaster relief possible (YES)
Rented agricultural area	Continuous variable: farm's rented cultivated area in hectares	21.65 (23.26)	22.36 (23.19)	21.04 (23.32)
Government should compensate crop damage in the future (GCOMP)	Categorical variable (1=Totally agree. 5=Totally disagree)	2.28 (1.05)	2.34 (1.06)	2.23 (1.04)
Yield variability is higher on my farm than on other farms in my province (YVAR)	Categorical variable (1=Totally agree. 5=Totally disagree)	3.50 (0.90)	3.48 (0.89)	3.50 (0.91)
Age	Continuous variable: farmer's age in years	53.11 (11.45)	52.83 (11.25)	53.42 (11.53)
Cultivated area	Continuous variable: farm's cultivated area in hectares	40.14 (38.47)	40.97 (40.21)	39.41 (36.90)
Farm has received crop damage compensation (CDC)	Dummy variable. 1 = farm has received crop damage compensation at least once in the past 18 years	0.18 (0.39)	0.18 (0.39)	0.18 (0.38)
Northern and Eastern Finland (NE)	Dummy variable. 1 = farm is located in the northern or eastern part of Finland	0.26 (0.44)	0.31 (0.46)	0.23 (0.42)
Production line is plant production (PLANT)	Dummy variable. 1 = farm's production line is crop or other plant production	0.80 (0.40)	0.79 (0.41)	0.80 (0.40)

3 Estimation method

The choice experiment is an application of the characteristics theory of value (Lancaster, 1966), combined with random utility theory. Based on random utility theory, we assume that farmers can choose the best alternative from different insurance product choices in the choice set. The Multinomial Logit (MNL) model is derived under the assumption that the error term is independent and identically distributed for all farmers and thus expressing homogenous tastes between farmers.

Limitations of the assumption about the independent and identically distributed error term in the MNL model can be obviated by using a more flexible mixed logit model (MMNL). This is achieved by allowing for random taste variation, an unrestricted substitution pattern and correlation in unobserved factors over time. Mixed logit probabilities are the integrals of standard logit probabilities over a density of parameters. The mixed logit probability is (Train, 2003):

$$p_{n,i} = \int \left(\frac{e^{\beta' V_{n,i}}}{\sum_{j=1}^{J} e^{\beta' V_{n,j}}} \right) f(\beta) d\beta$$

where $f(\beta)$ is the density function. The mixing distribution $f(\beta)$ gives weights to the mixed logit probability. Therefore, it is a weighted average of the logit formula evaluated at different values of β. In the mixed logit model, coefficients can vary between respondents. This allows us to estimate the mean coefficients and standard deviations of the random parameters, representing unobserved heterogeneity in preferences, in order to accommodate heteroscedasticity. The parameters of all models are estimated with maximum simulated likelihood using 1,000 Halton quasi-random draws.

With discrete choice models, the utility of respondents is measured. Thus, the estimated model coefficients are not interpretable in economic terms. Therefore, in order to reveal the overall WTP for a crop insurance product, implicit price (IP) estimates of crop insurance attributes are calculated as:

$$IP_k = -\left(\frac{\beta_k}{\beta_p}\right)$$

where βk is the parameter of kth attribute, and βp is the price coefficient.

The estimated utility of crop insurance for a farmer was assumed to depend on the insurance price, deductible level, expected indemnity and the type of insurance. A normally distributed zero mean random parameter was added to the model in order to allow for different variance in the two insurance options and the no insurance choice. Thus, the discrete choice method applied is an extension of the mixed logit model known as error components logit (ECL). It was expected that respondents would treat the no insurance choice in a different manner to the two hypothetical insurance products. A shared error component term was included in the utility function for the two crop insurance products, but not for the no insurance alternative. This shared random effect captures unobserved heterogeneity that is alternative specific (Greene and Hensher, 2007). The error components are normally distributed random variables with zero mean and a standard deviation of σ_i. In this study, the estimated standard deviation was related to the correlation of the different alternatives. We assumed that the two insurance choices were close substitutes for each other, but not for the no insurance choice. Therefore, a nested system for three alternatives was specified.

Various combinations of explanatory variables and insurance product attributes were tested, but only significant variables were included in the final model. Coefficients were estimated for the combined insurance alternatives, because the explanatory variables did not cause the utility level to differ between the alternatives 1 and 2 presented in the choice cards. Categorical and socioeconomic variables were included in the utility specification of insurance purchase. We assumed that the coefficient of socioeconomic variables captures the utility difference between insurance and no insurance. Normal and other forms of distribution, such as lognormal, were tested for all the insurance attributes. In order to maintain the overall significance of the model, a normal distribution was only specified for the price attribute.

4 Results

An insurance product was chosen in 46.5% of the cases in the entire dataset. The availability of disaster relief did not have a major effect on the number of insurance cards chosen. The possible availability of disaster relief when farmers had compulsory crop insurance may have increased the number of respondents choosing an insurance product. In other words, some farmers may have chosen the insurance product in order to obtain the extra cover provided by the government. However the main conclusion is that disaster relief did not have a major effect on the number of insurance purchase decisions.

The first column of Table 3 provides the estimated coefficients of the MNL model for the entire dataset. The coefficients of insurance attributes were significant with the expected signs. The pseudo R-square for the MNL model was 0.2034. The independence assumption of the MNL model was tested with Hausman's specification test (Hausman and McFadden, 1984), which revealed that the independence of irrelevant alternatives (IIA) assumption did not hold with our dataset. Therefore, the logit model could be rejected in favour of the ECM model, and in the remainder of this article we only discuss the results for the ECL models.

Table 3. Results of the pooled multinomial logit model and error components logit model (SE in parentheses).

Parameter means	Multinomial logit Model (POOLED)	Error components logit model (POOLED)
Choice experiment attributes		
Price[1]	-0.03853*** (0.00332)	-0.11832*** (0.01357)
Deductible	-2.98088*** (0.27113)	-4.13768*** (0.39203)
Expected indemnity	0.00335*** (0.00014)	0.00463*** (0.00023)
Farm insurance	-2.91735*** (0.28914)	-1.84059*** (0.6141)
Index insurance	-2.69479*** (0.2869)	-1.56555** (0.61231)
Random parameter estimates		
Price[1]	N/A	0.09375*** (0.01708)
Interaction variables		
Rented agricultural area*Expected indemnity	0.00011224*** (0.00004343)	0.0002639*** (0.0000837)
Rented agricultural area*Price	-0.00034*** (0.00011)	-0.00040* (0.00021)
Categorical variables		
GCOMP	0.12814*** (0.02596)	0.34919*** (0.07845)
YVAR	-0.07695** (0.03011)	-0.21287** (0.08734)
Socioeconomic variables		
Age	-0.01850*** (0.00256)	-0.05080*** (0.00857)
Cultivated area	0.00499*** (0.00103)	0.01084*** (0.00299)
CDC	0.28269*** (0.07074)	0.81950*** (0.217)
NE	-0.23610*** (0.06511)	-0.64471*** (0.19222)
PLANT	0.18032** (0.07242)	0.55338*** (0.20864)
Standard deviant error component	N/A	4.12126*** (0.43721)
Log-likelihood	-5343	-5257
N	6105	6105
McFadden Pseudo- R-square	0.2034	0.2162
AIC	10713	10546

***, **, * Significant at 1, 5 and 10% level
[1] Normal distribution.

In the pooled (POOLED) and the two subsample (NO and YES) ECL models, a normal distribution was specified for the price attribute, as this yielded the best model fit. The two split sample model parameter values and corresponding model specifications are presented in Table 4.

Table 4. Results of the two subsample error components logit model (SE in parentheses).

Parameter means	Sample disaster relief not possible (NO)	Sample disaster relief possible with insurance (YES)
Choice experiment attributes		
Price[1]	-0.11469*** (0.02003)	-0.12116*** (0.01873)
Deductible	-3.63248*** (0.54158)	-4.7144*** (0.58152)
Scale	0.00427*** (0.00035)	0.00492*** (0.00032)
Farm insurance	-2.24020** (0.9941)	-3.36345*** (0.81348)
Index insurance	-2.03605** (0.99377)	-3.01716*** (0.80562)
Random parameter estimates		
Price[1]	0.07962*** (0.02633)	0.10852*** (0.02303)
Interaction variables		
Rented agricultural area*Scale	0.0002129* (0.000115)	0.00036678*** (0.0001291)
Rented agricultural area*Price	-0.00016 (0.00027)	-0.00076** (0.00034)
Categorical variables		
GCOMP	0.52166*** (0.13418)	0.17891* (0.10236)
YVAR	-0.26825* (0.13688)	-0.16754 (0.11534)
Socioeconomic variables		
Age	-0.05871*** (0.0142)	-0.04696*** (0.01091)
Cultivated area	0.01828*** (0.00492)	0.00361 (0.00384)
CDC	0.51449** (0.2476)	0.56615*** (0.1942)
NE	-0.51830* (0.2832)	-0.84594*** (0.2736)
PLANT	0.17015 (0.32022)	0.91343*** (0.28801)
Standard deviant error component	4.41796*** (0.71422)	3.916*** (0.55593)
Log-likelihood	-2470	-2771
N	2860	3245
McFadden Pseudo- R-square	0.2139	0.2228
AIC	4972	5574

***, **, * Significant at 1, 5 and 10% level
[1] Normal distribution.

All the coefficients of insurance attributes had the expected signs in ECL model. The price and deductible had a negative effect on the utility of the farmer. The expected indemnity of the insurance had a positive effect on the utility of the farmer. The coefficients for insurance types were negative and significant, indicating that the farmers preferred index insurance over farm-specific insurance. In the pooled model, random coefficients for price were positive and highly significant ($p < 0.01$). This implies significant unobserved heterogeneity in preferences towards the price choice attribute. The additional standard deviant error term was significant and large in all three ECL models, which implies larger variance of the two insurance alternatives than of the no insurance alternative.

The coefficients of the interaction variables (Rented agricultural area*Scale and Rented agricultural area*Price) reveal that the expected indemnity attribute was valued more by those farmers who had a greater rented agricultural area. In contrast, those farmers with a large rented agricultural area worried less about the price of insurance. This result is in line with the assumption that farmers operating with a high proportion of rented area are more exposed to yield and price variability in their business due to lowered risk management at the field level. Attitudes towards crop insurance affect the utility derived from crop insurance products. Farmers who stated that the government should not have any role in compensating yield losses in the future were also more likely to buy crop insurance products. Farmers who stated that yield variability is smaller on their farm than on average in their area were less likely to buy crop insurance products. Insurance companies can use this knowledge in the future when marketing crop insurance products to farmers. Possible adverse selection problems can also be detected.

The aim of this study was to reveal how the prospect of government disaster relief affects the willingness to pay for crop insurance products. This was studied with the split data approach. The difference in the parameter values for the two different samples compared to the pooled data was tested with the log likelihood method. The test statistic, $\chi2 = -2*(LLPOOLED-(LLNO+LLYES))$, was derived, where LLPOOLED is the log likelihood of the model from entire dataset. The test statistic ($\chi2 = 33$) indicates that we can reject the null hypothesis of equal parameter values at the 1% level. Implicit prices and their confidence intervals for two separate samples were derived by a method proposed by Krinsky and Robb (1986) with 5,000 replications. The difference in IP estimates between the two subsamples was tested with the t-test. The null hypothesis of equal values could be rejected for all IPs based on high t-values. Thus, we can conclude that the WTP differed between the two subsamples.

Table 5. Median implicit price estimates (confidence intervals in parentheses) of choice experiment attributes and t-test results.

	Sample disaster relief not possible (NO)		Sample disaster relief possible with insurance (YES)		Average % change in IP ((YES-NO)/|NO|)	t-value
10% deductible	-3.17	(-4.49 to -2.28)	-3.89	(-5.13 to -3.02)	-23.0%	64.91
Expected indemnity 100 Euros/hectare	3.75	(2.77 to 5.2)	4.07	(3.13 to 5.70)	8.4%	21.50
Farm insurance	-19.76	(-44.20 to -2.31)	-27.66	(-46.29 to -14.31)	-39.9%	41.13
Index insurance	-17.31	(-41.89 to -0.50)	-25.00	(-43.81 to -11.30)	-44.5%	39.73

Confidence intervals based on the 2.5th and 97.5th percentiles of the simulated IP distribution.

The deductible level is a major factor affecting the demand for crop insurance in Finland. Our results reveal that government involvement in crop insurance markets would reduce the WTP of the deductible. The difference was statistically significant and the deductible attribute was 23% smaller in the YES sample compared to the NO sample. In contrast to the deductible attribute, farmers were willing to pay more for the expected indemnity of crop insurance when disaster relief was possible with voluntary crop insurance. The WTP for the expected indemnity attribute was 8.4% higher in the YES sample compared to the NO sample. The implicit prices for both insurance types were higher in the NO subsample. Thus, the level of WTP for farm or index crop insurance products was lower when it was stated that the government would intervene in the crop insurance markets. Although there was statistically significant difference in attribute IPs between the two subsamples, the difference in the overall WTP for the hypothetical crop insurance products was conditional on the characteristics of the supplied insurance product. According to overall picture derived from table 5, government disaster relief had the biggest influence on insurance designed to cover losses to crops that have a low level of expected indemnity. In crop production, low per hectare profit crops such as wheat and barley fall into this category. If farmers expect government disaster relief payments, they will not be concerned about crop losses for the most common crops. Wheat, oats and barley are the main arable crops in the study area, and the government's stated actions regarding forthcoming disaster relief will therefore have a major effect on the design of crop insurance contracts. The demand for crop insurance can be encouraged by introducing insurance premium subsidies. If the government is willing to pay disaster relief payments, the crop insurance premium subsidy level for cereal crops, i.e. wheat, oats and barley, needs to be increased. This will lead to extensive use of taxpayers' money as these crops cover almost half of agricultural area in Finland. Thus, the government should either grant disaster relief payments and refrain from insurance premium subsidies or introduce an insurance premium subsidy, but refrain from disaster relief payments.

5 Conclusions

There are several ways to publicly intervene in crop insurance markets. Disaster relief and premium subsidies for crop insurance are among of the most popular means. Our results highlight that these interventions should not be used simultaneously, as this would waste taxpayers' money. We realise that in the case of a catastrophic event, there is political, social and media pressure to help people in distress, but this point is also a test for risk carrying. Who will carry the risks?

If government decides to carry the low frequency high loss risks, i.e. catastrophic risks, our results reveal that the WTP of farmers for crop insurance products was not equal compared to the situation where disaster relief would no longer be granted under any circumstances. In general, the WTP was higher when disaster relief would no longer be granted. However, the effect varied between the insurance attributes. The difference in the median overall WTP for hypothetical insurance products was greatest when the deductible was set at a high level and the expected indemnity was low.

The results have major implications for crop insurance product development and policy design. In the EU, the limit for the deductible level in subsidized crop insurance products is set to 30%. If insurance products are developed to give a small amount of cover against crop losses, the possibility for government disaster relief will have a large negative impact on the overall WTP of farmers. This will lead governments to use high premium subsidies for crop insurance to obtain a large share of farmers under commercial crop insurance schemes.

A further question is at what stage the government can grant ex post ad hoc disaster relief, if any. When extensive crop damage is realised, there is pressure to help farmers in distress. This makes the situation complicated, especially for the politicians in charge. Due to the systemic nature of yield losses, reinsurance or disaster relief provided by the government can help the development of crop insurance markets. However, if rules for disaster relief are vague, decision makers will also have the urge to help farmers in situations that could be dealt with using market instruments. This may lead to state where the market niche for crop insurance between deductible and disaster relief is too small. This can be avoided by defining ex ante catastrophic risks and situations where government intervention is permitted following catastrophic events affecting agriculture.

6 References

Bielza Diaz-Caneja, M., Conte, C. G., Gallego Pinilla, F. J., Stroblmair, J., Catenaro, R. and Dittmann, C. (2009). *Risk management and agricultural insurance schemes in Europe.* JRC Reference Reports. http://ec.europa.eu/dgs/jrc/downloads/jrc_reference_report_2009_09_agri_ins.pdf. Accessed 17, September 2013

Enjolras, G. and Sentis, P. (2011). Crop insurance policies and purchases in France. *Agricultural Economics,* 42 (4), 457–486.

European Commission. (2013). Regulation (EU) No 1305/2013 of the European Parliament and of the Council of 17 December 2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) No 1698/2005.

European Commission. (2011). *The future of CAP market measures.* Agricultural Policy Perspectives Briefs. Brief no 3. DG Agriculture.

European Commission. (2009). *Council regulation establishing common rules for direct support schemes for farmers under the common agricultural policy and establishing certain support schemes for farmers,* EC No 73/2009, Brussels.

European Commission. (2006). *Agricultural insurance schemes.* Joint Research Centre, ISPRA.

European Commission. (2001). *Risk management tools for EU agriculture, with special focus on insurance.* Working Document, DC Agriculture.

Garrido, A. and Zilberman, D. (2008). Revisiting the demand for agricultural insurance: The case of Spain. *Agriculture Finance Review,* 68 (1): 43–66.

Goodwin, B. K. (1993). An empirical analysis of the demand for multiple peril crop insurance. *American Journal of Agricultural Economics,* 75 (2): 425–434.

Greene, W. H. and Hensher, D. A. (2007). Heteroscedastic control for random coefficients and error components in mixed logit. *Transportation Research Part E: Logistics and Transportation Review,* 43(5): 610–623.

Hausman, J. and McFadden, D. (1984). Specification tests for the multinomial logit model. *Econometrica,* 52 (5): 1219–1240.

Jacobsen, J. B., Lundhede, T. H., Martinsen, L., Hasler, B. and Thorsen, B. J. (2011). Embedding effects in choice experiment valuations of environmental preservation projects. *Ecological Economics,* 70 (6): 1170–1177.

Kragt, M. E. (2013). The effects of changing cost vectors on choices and scale heterogeneity. *Environmental and Resource Economics,* 54: 201–221.

Krinsky, I. and Robb, A. L. (1986). On approximating the statistical properties of elasticities. *The Review of Economics and Statistics,* 68 (4): 715–719.

Lancaster, K. J. (1966). A new approach to consumer theory. *The Journal of Political Economy,* 74 (2): 132–157.

McFadden, D. (1974). Conditional logit analysis of qualitative choice behaviour. In: Zabrenka. P. (Ed.). *Frontiers in econometrics.* Academic Press. New York.

Meuwissen, M. P. M., Assefa, T. T. and van Asseldonk, M. A. P. M. (2013). Supporting insurance in European agriculture: Experience of mutual in the Netherlands. *EuroChoices,* 12 (3): 10–16.

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): 206-215.

Mishra, A. K. and Goodwin, B. K. (2003). Adoption of crop insurance versus revenue insurance: A farm level analysis. *Agricultural Finance Review,* 63 (22): 144–155.

Mishra, A. K., Nimon, W. and El-Osta, H. S. (2005). Is moral hazard good for the environment? Revenue insurance and chemical input use. *Journal of Environmental Management,* 74 (1): 11–20.

Mørkbak, M. R., Christensen, T. and Gyrd-Hansen, D. G. (2010). Choke price bias in choice experiments. *Environmental and Resource Economics,* 45: 537–551.

Myyrä, S. and Pietola, K. (2011). *Testing for moral hazard and ranking farms by their inclination to collect crop damage compensations.* In: European Association of Agricultural Economists, 2011 International Congress, Zurich.

Orgurtsov, V. A., van Asseldonk, M. A. P. M. and Huirne, R. B. M. (2009). Purchase of catastrophe insurance by Dutch dairy and arable farmers. *Review of Agricultural Economics,* 31 (1): 143–162.

Pozo, V. F., Tonsor, G. T. and Schoeder, T. C. (2012). How choice experiment design affects estimated valuation of use of gestation crates. *Journal of Agricultural Economics,* 63 (3): 639–655.

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 (1): 103–114.

Smith, V. H. and Baquet, A. E. (1996). The demand for multiple peril crop insurance: Evidence from Montana wheat farms. *American Journal of Agricultural Economics,* 78 (1): 189–201.

Smith, V. H. and Goodwin, B. K. (1996). Crop insurance, moral hazard and agricultural chemical use. *American Journal of Agricultural Economics,* 78 (2): 428–438.

Train, K. (2003). *Discrete choice methods with simulation.* Cambridge University Press.

van Asseldonk, M. A. P. M., Meuwissen, M. P. M. and Huirne, R. B. M. (2003). Belief in disaster relief and the demand for public-private insurance program. *Review of Agricultural Economics,* 24 (1): 196–207.

Velandia, M., Rejesus, R. M., Knight, T. O. and Scherrick, B. J. (2009). Factors affecting farmers' utilization of agricultural risk management tools: The case of crop insurance, forward contracting, and spreading sales. *Journal of Agricultural and Applied Economics,* 41 (1):107–123.

WTO. (1994). *Agreement on agriculture, GATT, Marrakesh Agreement 1994*, World Trade Organization, Geneva.