Anything left for animal disease insurance? A choice experiment approach

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Paper prepared for presentation at the EAAE 2016 Seminar 156
Prospects for agricultural insurance in Europe

3-4 October, 2016, Wageningen Campus, the Netherlands

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Abstract

Animal disease insurance plays only a minor role in public activities related to animal diseases in production animals in Europe, and the current situation is likely to persist as long as producers place strong faith on public compensation schemes. A survey for poultry and pig producers was undertaken in Finland employing a choice experiment to study the willingness to pay for animal disease insurance products. The study analyses challenges related to cost sharing in a situation where state financed schemes are already running, and producers are adapted to these schemes. The methods in the study are set to measure producers' WTP on top of the already existing public schemes. Each choice alternative consisted of five attributes: insurance provider, biosecurity requirement, damages compensated by the insurance, deductible, and the price. We found that producers' willingness to pay for animal disease insurance is relatively low, even if consequential losses are covered. However, there were statistically significant attributes of the insurance products that increase the likelihood of the producer wishing to purchase them. The most important attribute is a low deductible. The supplier of the insurance is of a minor importance, although there is a slight preference towards insurance companies over producers' mutual fund. Biosecurity requirement attached to the insurance was not significant in determining the choice likelihood. The price of the insurance was found to have a negative and statistically significant, but relatively small impact on demand for insurance. Using latent class analysis, four classes of producers were identified: those who were 1) not interested, 2) weakly interested or 3) strongly interested in insurance, and additionally 4) a group who emphasised biosecurity measures but was not willing to purchase insurance. Those primarily interested in insurance were typically young, well-educated producers from large farms and they already had a good level of biosecurity on their farms. Also producers who had faced an animal disease outbreak in the past were more interested in purchasing an insurance. The majority of the respondents preferred not to purchase insurance. The analysis suggests that commercial production animal disease insurance may need to be subsidised or otherwise made more attractive to producers, and even so many producers might consider it unnecessary.

Keywords: Insurance, animal disease, choice experiment, questionnaire, latent class

JEL Classification Codes: G220, Q12, Q160

1. Introduction

Animal disease outbreaks can be costly to the producers as well as the society in general. The European Union (EU) co-finances activities of the member states on selected zoonotic or otherwise societally important animal diseases. However, in recent years there have been increasing calls, both in the European Union as well as in individual member states, for cost sharing of publicly funded animal disease expenses. One potential alternative for cost sharing

is animal disease insurance. There appears to be considerable variation in compensation and finance schemes for animal disease losses around the world as the schemes are often tailored to meet specific needs (OECD, 2012). EU agricultural policy has moved a step from ex-post measures towards ex-ante support for agricultural risk management. This structural change from ex-post to ex-ante measures might be challenging for private insurance markets. Studies focusing on how public policies could promote risk management in agriculture (e.g. Cafiero et al. 2007) suggest that public support for insurance premiums is justified only if market-based demand for insurance exists and the markets are unable to provide producers with affordable insurance products. The main motivation for this paper is understanding whether there are sufficient incentives for producers to purchase commercial insurance against animal diseases by analysing the perceptions and producers' *a priori* willingness to pay (hereafter WTP) for an animal disease insurance. We do not consider the insurance companies' ability to provide affordable insurance products, but instead concentrate on revealing if market-based demand for insurance exits.

The above topics were studied through a choice experiment, where Finnish pig and poultry producers indicated their willingness to buy different kinds of insurance products. The specific questions we aim to answer are: 1) How much demand there is for animal disease insurance; 2) What are the preferred characteristics of insurance and what is the producers' WTP for them; 3) Are there specific characteristics of the farms or producers that can be used to explain their WTP for animal disease insurance.

The study analyses challenges related to cost sharing in a situation where state financed schemes are already running, and producers are adapted to these schemes. The methods in the study are set to measure producers' WTP on top of the already existing public schemes. Hence, our focus is on WTP for commercial animal disease insurance which is complementary to the existing schemes, and our estimates take into account also that producers evaluated implicitly also reliability and adequacy of the current schemes when choosing among options presented to them in the questionnaire. Our study examines commercial animal disease insurance products which are not available in the Finnish markets but which could be introduced to the markets in the future if sufficient demand for them exists.

2. Material and methods

To assess demand for animal disease insurance as well as to identify what kind of insurance characteristics the producers would prefer, we undertook a survey among the Finnish pig and poultry producers. The pig and poultry farms were selected because these production lines operate in an intensive manner and the risk of contagious animal diseases is important and constantly present in pigs and poultry. Pig and poultry producers are likely to be more aware of the role of insurance than cattle producers. In both pigs and poultry there have been cases where an animal disease has caused losses, and compensations have been argued to be insufficient. These production lines were hit by a large feed-related salmonella outbreak in 2009. Most pig and poultry farms in Finland are covered by salmonella group insurance. In pig production there have been attempts to introduce also other disease insurance products.

A questionnaire was sent to all commercial pig and poultry producers in Finland, enquiring for instance their disease history (information on previous disease outbreaks at the farm), current insurance cover (all types of insurance) and the biosecurity measures used on their farm. More specifically, the questionnaire included a list of 24 different biosecurity measures, such as whether the production facilities are compartmentalised, whether the farm employs all-in–all-out-principle, whether there is protective clothing available for visitors, whether the producers participate in disease-related training, and so on. The respondents chose the measures that they use on their farm. The final section in the questionnaire was the choice experiment, where different hypothetical insurance products were offered to the producers.

Choice experiment is an application of the characteristics theory of value (Lancaster, 1966), combined with random utility theory. Based on random utility theory, we assumed that the surveyed producers would be able to choose the best alternative from different insurance product choices in the choice set. The overall utility from a good can be divided into attributes:

$$U_{in} = V_{in}(\mathbf{Z}_i) + \varepsilon_{in}\,, \tag{1}$$

where U_{in} is the utility of alternative i for individual n, V_{in} is the explained part of the utility, $\mathbf{Z}_i$ denotes product-specific attributes and ε_{in} is a random error, which is independent of other terms and independently and identically distributed (IID) with an identical type I extreme value distribution, representing the unobserved part of utility. The explained part of utility therefore specifies the attributes of a product that can be directly measured as well as the functional form V_{in}, through which it explains the overall utility.

Discrete choice models describe individual choices among alternatives. The probability p_{in} of individual n choosing alternative i is equal to the probability that the utility of alternative i is greater than, or equal to, the utility associated with alternative j for every alternative in the choice set (j=1, … , J). Formally:

$$p_{in} = prob\left[(V_{in} + \varepsilon_{in}) \geq prob\left(V_{jn} + \varepsilon_{jn}\right) \quad \forall j\,; i \neq j\right]. \tag{2}$$

The multinomial logit model was derived under the assumption that the error term is independent and identically distributed for all i. The logit probability is (McFadden, 1974):

$$p_{in} = \frac{e^{\beta V_{in}}}{\sum_{j=1}^{J} e^{\beta V_{jn}}}. \tag{3}$$

where $V_{in} = \beta' Z_i$. In the multinomial logit model (equation 3), the choice probabilities of the different insurance options are modelled. Several attributes (see Table 1) were used as explanatory variables and their functional forms were specified by V_{in}. It was assumed that this function is separable, additive and linear.

Discrete choice models measure the utility of respondents. Thus, the estimated model coefficients are not interpretable in economic terms. Therefore, to reveal the overall

willingness to pay (WTP) for an insurance product, implicit price (IP) estimates of insurance attributes were calculated as:

$$IP_k = -\left(\frac{\beta_k}{\beta_p}\right), \quad (4)$$

where β_k is the coefficient of kth attribute, and β_p is the price coefficient. Note that parameters β_k and β_p constitute vector β in equation 3. To calculate the WTP for the product, the estimated IPs for individual characteristics (summarised in Table 1) were summed up and compared to the WTP of the baseline case (status quo):

$$WTP_i = -\left[\left(\frac{\sum_{k=1}^{K}\beta_k}{\beta_p}\right) - \left(\frac{\sum_{k=1}^{K}\beta_{base,k}}{\beta_p}\right)\right], \quad (5)$$

where $\beta_{base,k}$ denotes the coefficients associated with the baseline case (status quo).

Typically decision makers feel that the greater are their assets, the less they should pay for insurance to cover a given risk (Pratt, 1964). Thus producers' WTP for insurance against animal diseases might vary largely. As we were also interested in potential respondent segments, a latent class model was employed. It assumes that the respondents belong to heterogeneous latent classes based on their differing attitudes and perceptions of product attributes and other phenomena (Swait, 1994). These differences are reflected in their segment-specific choice behaviour. The latent class model reveals both the segments and the relative preferences prevailing in each segment (Hu et al., 2004; Vermunt and Magidson, 2005). The best model having the optimal number of classes was selected using Bayesian and Akiake information criteria (BIC and AIC).

Insurance premiums are typically differentiated according to the location of a farm and other farm- or producer-related characteristics. These socioeconomic factors were also accounted for in the choice experiment. In the latent class model they were included as covariates to explain class characteristics. However, they were set to be inactive, meaning that only the product characteristics and choice behaviour determined class membership, but socio-demographic and farm-specific characteristics were used to explain class membership. They therefore provide an opportunity to seek for recognisable groups among the potential buyers of insurance. Alternative specific constants were excluded from the model because of multicollinearity with some of the product characteristics, primarily with the compensation level. Because of this, the compensation level coefficients are negative, as they indicate deviation from the status quo and dislike towards buying the insurance. The data were analysed using Latent GOLD statistical software (Statistical Innovations, Inc.).

A pilot questionnaire was sent to 180 farms in July 2011. Accounting for the responses to this questionnaire, the final form of the questionnaire was mailed to all Finnish poultry and pig producers, altogether approximately 2,500 farms, in August 2011. The addresses of the producers were obtained from the Ministry of Agriculture and Forestry Information Centre.

The choice experiment consisted of 32 choice sets, each choice set included two insurance products, and each respondent was presented four of these sets. Within each choice set, the respondent had three options: choose insurance product A, choose insurance product B or choose "I would not buy either product". The sets were formed using the Ngene software (ChoiceMetrics Pty Ltd). In the final construction, the D-error was 0.014 and the A-error 0.169. The lower these measures are, the more efficient the choice set design is (see, e.g. Rose and Bliemer, 2012). In the design, priors for the alternatives were based on the results of the pilot questionnaire.

Each choice alternative consisted of five attributes: insurance provider, biosecurity requirement, damages compensated by the insurance, deductible, and the price. The levels of these attributes are presented in Table 1. We briefly discuss these attributes below, based on Heikkilä and Niemi (2008), Civic Consulting (2006), van Asseldonk et al. (2005) and Shaik et al. (2006). The attribute combinations (and therefore the products offered) are hypothetical. However, the attributes and their levels were all set at realistic ranges, drawing on the above literature reviews in European insurance systems as well as the authors' own experience on the insurance market in Finland. The attributes can be found in products existing in different real-life contexts, and the specific attribute levels were tested in the pilot questionnaire.

A private insurance company and producers' mutual fund were presented as possible insurance providers. We did not have any *a priori* information on whether the producers have preferences towards the provider of insurance, and therefore this was included as an attribute.

Biosecurity requirement helps the insurance system to encourage the producer to manage the disease risks. Requirements for a specific level of biosecurity to be maintained at the farm will also help to manage asymmetric information and moral hazard. Biosecurity management is, however, costly to the producer, as disease prevention measures incur costs (protective clothing, animal disposal, disinfection, and so forth). Some producers may wish to have a lower insurance premium in return for adopting enhanced biosecurity measures compared to the national standard.

The insurance scheme should provide producers with incentives to purchase insurance and to take disease prevention measures thereafter. Increasing the level of compensation may raise the insurance premiums, but it may also provide a better safety net for the producers. However, when indemnities are based on losses, the risk of moral hazard needs to be taken into consideration. Previous studies have suggested that producers are not very willing to purchase insurance that covers an extended amount of losses, for instance indirect losses (van Asseldonk et al., 2005). We tested this by including three levels of compensation in the choice sets as a scale attribute. The basic level covers only material damages and animals, and additional levels increase the cover to income loss, as well as protection against potential price fluctuations associated with the disease outbreak.

The deductible is a necessarily part of a functioning insurance scheme, as it decreases moral hazard and creates incentives for producers to maintain sufficient disease prevention.

However, if the deductible is set too high, it may undermine the incentives to detect disease at an early stage. We tested a range of deductibles, varying from 0% to 30%.

The price of the insurance defines the annual amount that the producer pays to the insurance provider for carrying the disease risk and compensating the damages in case of a disease outbreak. When the insurance is fairly priced, risk averse producers should, according to theory, insure, because they would not be worse off by purchasing than not purchasing the insurance (see e.g. Mas-Colell et al., 1995).

Table 1. An example of a choice set offered to a pig farm (Alternative 1, Alternative 2, and the No buy-option) and the set of all attribute levels used in the choice experiment (right hand side column). Levels for alternatives 1 and 2 shown to each respondent were selected from the sets of all attribute levels, resulting in 32 different choice sets.

	Alternative 1	Alternative 2	All attribute levels (not shown to the respondent)
Provider of insurance	Private insurance company	Producers' mutual fund	Producers' mutual fund Private insurance company
Biosecurity requirement	Additional requirements	National basic requirements	National basic requirements Additional requirements
Compensated damages	Material damages and animals, as well as income losses due to an infection	Material damages and animals, income losses due to an infection and losses due to price fluctuations associated with the disease	Material damages and animals ('low coverage') Material damages and animals, and income losses due to an infection ('medium coverage') Material damages and animals, income protection and losses due to price fluctuations associated with the disease ('high coverage')
Deductible	20 %	0 %	0 % 5 % 10 % 20 % 30 %
Price (euro / 100 animal places / year)	Finishing farm: 4,00 euro Farrowing or farrowing-to-finishing farm: 13,20 euro	Finishing farm: 48,00 euro Farrowing or farrowing-to-finishing farm: 158,00 euro	2 euro 4 euro 8 euro 20 euro 32 euro 40 euro 48 euro 60 euro 80 euro 120 euro
I would buy this product			
I would not buy either product			

An example of a choice set is provided in Table 1. The respondents were also provided additional information regarding the biosecurity requirements, as well as an explanation to what the different levels of compensated damages would cover.

The questionnaire was sent to producers of different pig production types (finishing, farrowing, and farrowing-to-finishing pig farms) as well as to two types of poultry producers (broiler and laying hen farms). Where "other pig farm" is used, it refers to farrowing and farrowing-to-finishing farms collectively. Each producer was quoted a price that was adjusted for their type of production. The prices were formed such that they represent a given percentage of market revenue generated by the animals. Using this type of relative prices, we gave each production line a comparative set of prices. The prices that were included in the choice sets were 0.01%-0.30% of the market revenue. For instance, for the finishing pig producers the annual insurance price varied from 4 euro to 120 euro per 100 animal places (Table 1, where the prices denoted are for pig producers in finishing farms). In the regressions, each production line was analysed separately in relation to the price coefficient.

3. Results

3.1 Purchase intentions

A total of 559 questionnaire responses were received, the response rate being 21.9%. The main data characteristics are described in Table 2. Of all the insurance choice sets altogether 56% of the insurance products were not purchased – in other words the "I would not buy either product" -option was chosen. Thus, in 44% of the choice situations one of the offered hypothetical insurance products was purchased. Some prejudice votes may also be included, as 22% of the respondents (125 respondents) answered "I would not buy either product" to all four choice sets they were presented.

Table 2. Descriptive statistics of the data and basic information on the respondents.

	All farms	Pig farms	Poultry farms
Questionnaires sent	2557	1885*	647*
Responses (response rate)	559 (21.9%)	402 (21.3%)	157 (24.3%)
Answer all sets / some sets / no sets	81% / 7% / 12% of respondents		
Chose at least one of the products offered	77% of respondents / 44% of choice situations		
Respondents' education:			
- primary education	14%	14%	17%
- agricultural education	38%	42%	29%
- higher education	4%	2%	10%
Respondents' age:			
- <30 years, 'young'	4%	4%	4%
- >60 years, 'senior'	10%	10%	12%
Share of female respondents	19%	18%	19%
Mean number of years in business	20.1	20.0	20.4
Had a disease outbreak in the past 10 years	18%	22%	10%
Has animal production insurance (mean annual cost)	97% (1152€)	95% (1076€)	99% (1330€)
Has animal disease insurance (mean annual cost)	82% (634€)	82% (489€)	82% (959€)
Mean number of biosecurity measures in use (% of 24 listed measures)	13.9 (58%)	13.8 (57%)	14.4 (60%)

*) 25 mixed farms, producing commercially both pigs and poultry, are excluded.

3.2 Logistic regression models

To study how the insurance purchase likelihood varies with the different attributes, logistic regression models were applied. The dependent variable in each regression model indicates whether the insurance product was chosen. A positive coefficient associated with a particular attribute (explanatory variable) implies a higher probability that the product is chosen and therefore a higher level of utility associated with the attribute when the value of the explanatory variable increases. Likewise, a negative coefficient infers decreasing probability that the product is chosen. In addition to the generic case, a regression was run for both disease types separately.

Overall the basic model explains the choices relatively well (Table3). Although the R^2 statistic is modest (0.026) the $R^2(0)$ statistic is better (0.141). The difference between these statistics is in how they include the constants in the comparison, and the large difference is due to strong preference for the "no buy" option. Most of the explanatory variables are statistically significant and the signs of the coefficients are logical. Moreover, in logistic models R^2 statistic is often low even if the model classifies the observations correctly, in other words correctly predicts individuals or observations that would entail the purchase of insurance.

The most significant variables are the compensated damages (low, medium, high). However, these capture also the constant associated with the "no buy" option. The compensated damages are naturally zero if no product is chosen, and as this is the level to which the level of compensated damages is compared, also the "no buy" constant is reflected here. The negative and highly significant coefficients of compensated damages suggest that regardless of the attribute levels, many respondents preferred to choose the "no buy" option, i.e. not to purchase insurance. The coefficients indicated that the respondents on average preferred more compensation to less compensation (compensated damages 'high' had a less negative coefficient than compensated damages 'medium', which in turn was less negative than compensated damages 'low'). However, the difference in magnitude between the medium and high levels of compensated damages is fairly small, indicating that increasing the coverage of compensated damages increased purchase intentions only very little, if at all.

Table 3. Results of the multinomial logit model. The dependent variable is the stated purchase intention.

	Estimate	s.e.	p value
Price (finishing pig)	-0.513	0.174	0.003
Price (other pig)	-0.157	0.046	<0.001
Price (poultry)	-5.594	2.207	0.011
Insurance company	0.104	0.076	0.170
Biosecurity requirement	-0.096	0.084	0.250
Compensated damages, low	-4.060	0.417	<0.001

	Estimate	s.e.	p value
Compensated damages, medium	-3.508	0.368	<0.001
Compensated damages, high	-3.384	0.357	<0.001
Deductible	-0.033	0.004	<0.001
R^2	0.026		
$R(0)^2$	0.141		

Also the price and the deductible were statistically significant attributes, the deductible being the second most important variable. The price had the expected negative sign: as the price increases, demand for insurance decreases. The price coefficients for different production lines are all negative and highly significant, but of different magnitudes, reflecting different values of the animal place as well as potentially different choice behaviour of the respondents in each line of production. The biosecurity requirement and the provider of the insurance were not statistically significant at 95% confidence level. These attributes have little impact on respondents' choice of insurance.

After having an overview of the demand for insurance, the next question was whether there are respondent or farm-related characteristics that affect the demand for insurance. We therefore analysed the latent classes with the regression model. Based on the BIC and AIC values, a four-class model was chosen (Table 4). The overall statistics were significantly improved from the one-class base model, R^2 statistic being 0.48 and $R^2(0)$ statistic 0.54. The parameters in Table 4 describe how different characteristics are related to the four classes. The Wald p-values indicate that the attributes were jointly significant, while the Wald() p-values show that only the price, biosecurity requirement and some levels of compensated damages were class dependent.

Table 4. Results of the latent class model. The dependent variable is the stated purchase intention. The independent variables are mostly categorical, with the exceptions of price and the deductible. The covariates are inactive and describe the farm having the characteristic in question.

	Class 1 ('Non-buyers')		Class 2 ('Strong buyers')		Class 3 ('Weak buyers')		Class 4 ('Concerned non-buyers')		Overall	
	Estimate	s.e	Estimate	s.e	Estimate	s.e	Estimate	s.e	Wald p-value	Wald () p-value
Price (finishing pig)	0.135	0.493	-1.766	0.703	-2.080	0.695	-6.180	2.937	<0.001	0,012
Price (other pig)	0.047	0.127	-0.296	0.169	-1.312	0.384	-0.863	0.282	<0.001	<0,001
Price (poultry)	-0.256	0.484	-22.856	8.226	-62.015	23.998	-7.114	4.703	0.001	0,004
Insurance company as a provider	0.180	0.247	-0.241	0.171	0.442	0.412	-0.297	0.390	0.360	0,240
Biosecurity requirement	-0.240	0.280	0.189	0.278	-2.941	0.707	2.476	0.585	<0.001	<0,001

	Class 1 ('Non-buyers')		Class 2 ('Strong buyers')		Class 3 ('Weak buyers')		Class 4 ('Concerned non-buyers')		Overall	
	Estimate	s.e	Estimate	s.e	Estimate	s.e	Estimate	s.e	Wald p-value	Wald () p-value
Compensated damages, low	-7.196	1.306	-3.620	1.433	-3.339	1.971	-3.637	1.702	<0.001	0,180
Compensated damages, medium	-6.887	1.204	-2.646	1.238	-2.597	1.761	-2.754	1.505	<0.001	0,046
Compensated damages, high	-5.813	1.139	-1.868	1.156	-3.318	1.694	-4.792	1.586	<0.001	0,079
Deductible	-0.047	0.014	-0.063	0.015	-0.058	0.020	-0.027	0.017	<0.001	0.430
Class size	47%		19%		17%		16%			
R^2	0.040		0.126		0.442		0.348		0.477	
$R(0)^2$	0.584		0.265		0.446		0.392		0.540	
Covariates (inactive)										
Poultry producers	29.2%		25.4%		27.6%		25.2%		27.5%	
Farm had a disease[1]	13.7%		20.0%		17.7%		27.6%		17.8%	
Young respondents[2]	2.4%		5.9%		4.6%		6.0%		4.1%	
Senior respondents[3]	47.7%		47.9%		42.2%		46.3%		46.6%	
Large farm[4]	27.3%		33.7%		26.3%		34.7%		29.6%	
Small farm[5]	23.6%		20.0%		21.4%		22.2%		22.3%	
High biosecurity[4]	44.7%		49.9%		43.9%		49.8%		46.4%	
Low biosecurity[5]	5.3%		3.7%		1.1%		5.2%		4.3%	
University education	20.2%		21.9%		23.0%		25.6%		21.9%	
Agricultural education	61.1%		59.7%		63.1%		58.3%		60.7%	
Primary education	15.4%		11.4%		10.8%		9.8%		13.0%	
Female respondent	17.4%		13.4%		18.7%		15.7%		16.6%	
3 or 4 responses in "would not buy either product"	83.0%		0.1%		13.6%		33.8%		47.1%	
Average current annual animal disease insurance payment	583€		643€		520€		764€			

Notes: 1) The farm indicated they have suffered from a disease in the past 10 years. 2) Less than 30 years old. 3) More than 60 years old. 4) Belonging to the largest quartile. 5) Belonging to the smallest quartile.

Class 1 includes 47% of the respondents. They are not interested in purchasing insurance ('Non-buyers'). Compared to the whole sample, the class is characterised by a somewhat lower share of young and somewhat higher share of older producers, and the respondents are more likely to have only primary education. The farms have a lower likelihood of having encountered a disease in the past 10 years, and they are somewhat more likely to be poultry

farms than pig farms. Their farms are typically smaller and they have adopted fewer biosecurity measures than the other farms on average. In this class, coefficients for insurance price, provider and biosecurity requirement were statistically insignificant. All three compensation levels and the deductible had a large negative impact on demand for insurance in this class. Hence, having insurance could reduce their utility and they had no willingness to pay for any kind of insurance.

Class 2 includes 19% of the respondents. It is characterised by strongly interested buyers, who chose one of the insurance products in most choice situations ('Strong buyers'). They are typically young and operate larger-than-average farms, on which they have a higher than average biosecurity. They have a positive willingness to pay for insurance. Demand for insurance in this class responds more sluggishly to changes in price, but more heavily on changes in the deductible.

Class 3 includes 17% of the respondents. It is characterised by weakly interested buyers of insurance ('Weak buyers'). Additional biosecurity requirement has a negative impact on their demand for insurance, and also the impact of the deductible is fairly strong. The class includes a smaller share of the low-biosecurity farms as well of the high-biosecurity farms than the sample on average. The group is characterised by a somewhat higher share of those with agricultural education. Also female respondents are more presented in this group. All the attributes are vital for the demand for insurance in this group. Hence, their demand for insurance responds strongly to changes in the type of insurance provider, price, biosecurity requirement, losses covered and the deductible.

Finally, Class 4 includes 16% of the respondents. It is characterised by producers who prefer additional biosecurity measures to be included in the insurance, but who are not willing to purchase insurance themselves ('Concerned non-buyers'). A much larger share of them has encountered an animal disease in the past than the sample on average. They are more likely than the average farm to have high level of biosecurity, but there were also several respondents with lower than average biosecurity in this class. The respondents are more often young, from large farms, and with university education. As they are not willing to purchase insurance, their responses may indicate preference that insurance should include requirements for stronger biosecurity measures for other farms, such that the overall risk of disease is reduced.

The results suggest that young (less than 30 years) and highly educated (university education) respondents are more positive towards purchasing animal disease insurance than middle-aged or low-educated respondents. Gender did not play a substantial role in the purchase behaviour, although female respondents were somewhat reluctant towards buying insurance. As for the farm level characteristics, there is no significant difference between pig and poultry producers in their willingness to buy insurance. However, there are signs that producers who have experienced an animal disease outbreak in the past 10 years are more positive towards buying insurance (Class 2) as well as perhaps demanding others to take better precautions (Class 4) than producers without previous experience on disease outbreaks. Finally, large farms (belonging to the largest 25% of the farms as measured by the number of animals) are more willing to purchase insurance. Farms that have adopted only

few biosecurity measures (belonging to the lowest 25% of the farms with respect to the adoption of biosecurity) are less keen on insurance (Class 1 and Class 4).

3.3 Willingness to pay for insurance

The willingness to buy (WTP) estimates were calculated comparing the utility associated with given insurance products to the utility without the product. The WTP estimates are expressed in euro, and can be interpreted as the annual price the producers are willing to pay per animal place.

For Class 1 it was not possible to calculate WTPs due to statistically insignificant price coefficient, but this class presents those who would not buy the insurance in any case and to whom even a zero-price did not make a difference (Table 5). Positive WTPs are found for Classes 2 and 3.

The level of the deductible affects the WTP significantly. In Class 2 each percentage point increase in the deductible decreases WTP by 0.04 euro (finishing pig producers), 0.21 euro (other pig producers) and 0.003 euro (poultry producers) per animal place. In Class 3 the corresponding figures are 0.03 euro, 0.04 euro and 0.001 euro.

The WTP for the wider coverage of compensated damages increases moderately as the compensation level rises. Thus implicit price for the highest level of compensated damages is higher than for the second highest level, which in turn is higher than for the lowest level. Although the relationships are statistically significant, the actual WTP is very low and in many cases negative. However, in Classes 3 and 4 (Table 5) the WTP is highest at the medium level of damages (although in Class 4 it is still negative). The immediate reason for this is the lower negative coefficient for medium compensation than for high compensation. The result indicates that there does not seem to be much demand for the highest compensation level of the insurance.

The WTPs were translated to farm-level figures using the average number of animal places as the multiplier (Table 6). For Class 2 the WTPs are the largest, varying from 142 euro to 5,291 euro for the low compensation level, 385 euro to 7,381 euro for the medium compensation level and 579 euro to 9,048 euro for the high compensation level. For Class 3 the annual total WTPs are approximately 86 euro to 2,254 euro for the low compensation level, 143 euro to 2,841 euro for the medium compensation level and 88 euro to 2,271 euro for the high compensation level. The WTPs are highest for the broiler farms, followed by the finishing pig farms. The laying hen farms and other pig farms have a lower overall WTP.

Table 5. Pig and poultry producers' willingness to pay (WTP) for selected insurance products (euro/animal place).

WTP for insurance	Class 2			Class 3			Class 4		
	Finishing pig	Other pig	Poultry	Finishing pig	Other pig	Poultry	Finishing pig	Other pig	Poultry
Compensated damages, low									
Deductible 0%	1.40	8.33	0.11	1.37	2.17	0.05	-0.15	-1.11	-0.13
Deductible 10%	1.04	6.19	0.08	1.10	1.74	0.04	-0.20	-1.42	-0.17

Deductible 30%	0.32	1.92	0.02	0.54	0.86	0.02	-0.28	-2.04	-0.25
Compensated damages, medium									
Deductible 0%	1.95	11.62	0.15	1.73	2.74	0.06	-0.01	-0.09	-0.01
Deductible 10%	1.59	9.48	0.12	1.45	2.30	0.05	-0.06	-0.40	-0.05
Deductible 30%	0.87	5.21	0.07	0.90	1.43	0.03	-0.14	-1.02	-0.12
Compensated damages, high									
Deductible 0%	2.39	14.24	0.18	1.39	2.19	0.05	-0.34	-2.45	-0.30
Deductible 10%	2.03	12.10	0.16	1.11	1.75	0.04	-0.39	-2.76	-0.33
Deductible 30%	1.31	7.83	0.10	0.55	0.88	0.02	-0.47	-3.38	-0.37

Note. Class 1 is not shown as their price coefficients were insignificant and they had no WTP.

Table 6. Pig and poultry producers' willingness to pay (euro per year) for selected insurance products in Classes 2 and 3, adjusted for average size farms.

	Class 2				Class 3			
Insurance	Finishing pig farm	Other pig farm	Broiler farm	Laying hen farm	Finishing pig farm	Other pig farm	Broiler farm	Laying hen farm
Compensated damages, low								
Deductible 0%	615	833	5,291	1,015	603	217	2,254	432
Deductible 10%	457	619	3,934	755	482	174	1,800	345
Deductible 30%	142	192	1,220	234	239	86	891	171
Compensated damages, medium								
Deductible 0%	858	1,162	7,381	1,416	760	274	2,841	545
Deductible 10%	700	948	6,024	1,156	639	230	2,386	458
Deductible 30%	385	521	3,310	635	396	143	1,478	283
Compensated damages, high								
Deductible 0%	1,052	1,424	9,048	1,736	608	219	2,271	436
Deductible 10%	894	1,210	7,691	1,475	486	175	1,816	348
Deductible 30%	579	783	4,977	955	243	88	908	174

The farm-level WTPs can be compared to the average annual insurance payments by the farms. This information was obtained in the questionnaire, by asking how much the farms currently pay annually for animal disease insurance. The average figures are 490 euro for pig farms and 960 euro for the poultry farms. Based on farm accountancy data, the animal disease insurance payments were 619 euro for the pig farms and 668 euro for the poultry farms in 2009. These figures are in the same ballpark as the estimated WTPs indicating that on top of the existing schemes, not much additional WTP exists.

4. Discussion

In this paper, we have analysed demand for animal disease insurance in pigs and poultry in Finland. Our results suggest that overall, there is currently limited demand for a new animal disease insurance as a commercial product. This concerns a product which could be brought to the market to complement currently existing insurance and public compensation policies. Although WTP for such insurance products is low, in some cases even negative, it also varies by market segment, and there are important product attributes that increase the likelihood of

the producer wishing to purchase insurance policy. The attributes include, perhaps most importantly, a low deductible. This result combined with 30% deductible required for a public insurance intervention (in connection to the Common Agricultural Policy (CAP)) to be introduced to the markets reveals the possibilities for parallel existence of private and public insurance. Public intervention does not crowd out all (shallow loss type) private market insurances for animal diseases. Even though a low deductible was seen as an attractive characteristic of insurance, even a 0% deductible did not attract all the respondents to purchase insurance.

Compensated damages were offered at three levels (low, medium and high), and it was assumed that the larger levels were more desirable. However, this was hardly reflected in the choices made by the respondents. A higher coverage of damages compensated may increase purchase intentions, but the increase is relatively small. Pearson x^2-tests of independence between the variables showed that the difference between compensation levels regarding the purchase intensity was not significant at the 95% level of confidence. A similar result has been found by van Asseldonk et al. (2005) and Ngange et al. (2004). In flood insurance, Botzen and van der Bergh (2012) found that lowering the coverage from 100% to 75% reduced the WTP by only about 10%. It is perhaps not worth supplying insurance products that cover all kinds of risks, for instance income risks, because different risk management tools can be used to cover different types of risks.

The price of the insurance was found to have a negative and statistically significant although a fairly small impact on stated insurance purchases. The price was not as important a factor as anticipated. This result provokes reflection on whether the respondents were overwhelmed by all the attributes, whether they had too many and too complicated options to address, or whether the impact of the price was overshadowed by the other attributes. In addition, the producers may have perceived difficulties in attaching a price to animal disease insurance as it is not widely available in the markets. Where found positive, WTPs were relatively similar compared to the insurance fees that the farms currently pay (on average about €630 per farm per year).

Latent class analysis suggests that the type of supplier of the insurance does not play any significant role in determining the demand for animal disease insurance, although there are minor signs that a private insurance company may be somewhat preferred over producers' mutual fund. The lessons learned from EU member states show that a mutual fund covering animal disease expenses is the most commonly used form for cost sharing of direct costs in the Netherlands (Van Asseldonk et al., 2005; Meuwissen et al., 2003; OECD, 2012), Germany (OECD, 2012; British Embassy Berlin, 2002) and France (Cassagne, 2002). Under CAP mutual funds could be reported only if dealing with risks beyond farmers 30% deductible. Hence, there seems to be room for market orientated coordination on animal disease insurance. Private companies handle shallow losses which is the area where CAP-supported mutual funds are not allowed to operate. Furthermore private insurance company has the advantage of having experience from other fields of insurance and a functioning infrastructure for operating the insurance scheme. The producers' mutual fund pursues to promote the

interests of the industry, but it may lack the necessary infrastructure which may reduce its' attractiveness.

Whether the producer buys animal disease insurance is part of the wider risk management plan of the farm. In Finland, most livestock farms are covered by property insurance, which covers for instance losses due to fire, and by salmonella group insurance. According to Pukara (2014, data based on our questionnaire), 89% of the surveyed pig and poultry farms had a business interruption insurance and 63% had other production animal insurance. Farm insurance products in Finland are often sold as packages such that one product is purchased on top of another. Some of these packages may cover animal disease losses as well. For instance, a farm can purchase an insurance to cover business interruption losses or generic production animal insurance, and in some cases (such as upon high mortality) these may cover animal disease losses.

Insurance products frequently include conditions to prevent the damage from occurring. Many of the conditions in the salmonella group insurance are included in the production contracts that producers sign with slaughterhouses or egg packers. Similar conditions may occur in other existing insurance products as well. Hence, group insurance and production contracts constitute a set of rules and guidelines which encourage producers to apply proper management methods and to take care of biosecurity and other preventive measures. They are thus also setting a biosecurity standard in the field. In our analysis, the biosecurity requirements attached to the insurance did not affect the overall choices. However, the latent class analysis identified a group of respondents who preferred additional biosecurity measures related to the insurance product, but who were not willing to purchase any additional insurance themselves, to some extent because they were already better insured against animal diseases than the other respondents.

Our results provide some support for the notion that biosecurity and insurance are seen as complements by the producers. This follows from the fact that in classes where WTP was positive, the biosecurity levels were higher (and more importantly, were not lower) than average. A similar finding has been made by Ranganathan et al (2014) who found that those who use alternative risk management measures also have a positive WTP for price insurance and by Botzen and van der Bergh (2012) who found that probability for flood insurance was higher for those who already have other insurance products. This also suggests that adverse selection may not be an overwhelmingly large issue (see also Botzen and van der Bergh, 2012). A challenge for the insurance providers is to find incentives for those smaller farms that have a lower level of biosecurity to insure themselves against disease risks. If producers see biosecurity and insurance as substitutes to each other, any insurance scheme will face challenges.

The producer and farm characteristics suggest that those primarily interested in insurance include young, educated producers from large farms, who mostly already have a good level of biosecurity on their farms. This may be related to producers' risk perceptions due to education, and their debt obligations and the magnitude of risks involved in livestock farming at different stages of farm life cycle. The result is in line with the current situation in Finland: the study by Pukara (2014) on pig and poultry farms' current insurance coverage revealed

that producer's education, young age and large farm size were associated with increased probability to have their farm covered by different insurance policies. Also more generally, the adoption of risk management tools can be linked to factors such as producer's age, education or farm size (e.g. Velandia et al., 2009). Producers who have faced an animal disease outbreak in the past are more willing to purchase insurance, suggesting that perhaps their preferences may have changed or that there are possible misconceptions regarding the extent of state support. Having said that, the overall WTP for the insurance is mostly low, especially if the deductible is at the currently typical level of 20-30 %. The results also indicate that WTP for insurance varies according to the farm and producer characteristics. Given the structural change towards fewer and larger livestock farms, producers' attitudes towards insurance may become more positive on average.

Conclusions

Our analysis suggests that currently there are limited opportunities to increase animal disease insurance cover of pig and poultry farms. We identified two subgroups of respondents who would be willing to purchase an animal disease insurance and one group who mostly already have one. Those interested in insurance are typically young and operate larger-than-average farm. The subgroups of producers could be analysed in greater detail in further studies. Moreover, insurance characteristics such as price and the deductible matter, but their impact seems to be typically quite small. Incentives for private insurance should be taken into account when designing potential ways for the state to support animal disease risk management.

References

British Embassy Berlin. 2002. Livestock diseases compensation – systems available in Germany to limit economic damage to producers, Agri-Note of March 2002.

Botzen W.J.W. and van der Bergh J.C.J.M. 2012. Monetary valuation of insurance against flood risk under climate change. International Economic Review 53 (3): 1005-1025.

Cafiero C., Capitano F., Cioffi A. and Coppola A. 2007. Risk and crisis management in the reformed European agricultural policy. *Canadian Journal of Agricultural Economics* 55: 419–441.

Cassagne M-H. 2002. Managing compensation for economic losses in areas surrounding foot and mouth disease outbreaks: the response of France*, Office International des Épizootics (OIE) Scientific and Technical Review* 21, 823-829.

Hu W., Hunnemeyer A., Veeman M., Adamowicz W. and Srivastava L. 2004. Trading off health, environmental and genetic modification attributes in food, *European Review of Agricultural Economics* 31, 389–408.

Lancaster K. 1966. A new approach to consumer theory, *Journal of Political Economics* 74, 132–157.

Mas-Colell A., Whinston M. and Green, J. 1995. *Microeconomic theory*, New York, Oxford University Press.

McFadden D. 1974. Conditional logit analysis of qualitative choice behaviour, in: *Frontiers in econometrics*, Zabrenka P. (ed), New York, Academic Press, 105-141.

Meuwissen M, van Asseldonk M. and Huirne R. 2003. Alternative risk financing instruments for pig epidemics, *Agricultural Systems* 75, 305-322.

OECD. 2012. Livestock Diseases: Prevention, Control and Compensation Schemes. Paris, OECD.

Pratt W. 1964. Risk aversion in the small and in the large. *Econometrica* 32, 122-136.

Pukara, J. 2014. Kotieläintuotannon vakuutusturvan laajuus ja siihen vaikuttavat tekijät sika- ja siipikarjatiloilla (In Finnish). MSc thesis, University of Helsinki, Department of Economics and Management. http://hdl.handle.net/10138/155727

Ranganathan Thiagu, Gaurav Sarthak and Singh Ashish. 2014. Demand for price insurance among farmers in India: a choice experiment-based approach. IEG Working Paper No. 340.

Rose J. and Bliemer M. 2012. Stated preference experimental design strategies, in: *Transport Economics: Critical Concepts in Economics*, Hensher D. (ed). Oxford, Routledge, 304-332.

Shaik S., Barnett B., Coble K., Miller J. and Hanson T. 2006. Insurability conditions and livestock disease insurance, in: *The economics of livestock insurance: concepts, issues and international case studies,* Hoag D., Thilmany D. and Koontz S. (eds), Cambridge, CABI Publishing, 53-67.

Swait J. 1994. A structural equation model of latent segmentation and product choice for cross-sectional revealed preference choice data, *Journal of Retailing and Consumer Services*, 1, 77–89.

van Asseldonk M., Meuwissen M., Mourits M and Huirne R. 2005. Economics of controlling avian influenza epidemics, in: *Proceedings of the Frontis workshop on Avian Influenza: Prevention and Control,* Schrijver R, Koch G. (eds), Wageningen UR Frontis Series. Vol 8. Springer.

Velandia, M., Rejesus, R.M., Knight, T.O. and Sherrick, 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, 107-123

Vermunt J. and Magidson J. 2005. *Latent GOLD® Choice 4.0 User's Manual*, Statistical Innovations, Inc.