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ASSESSMENT OF FACTORS INFLUENCING FARM INSURANCE IN BULGARIA THROUGH PROBABILITY STATISTICAL METHODS

ABSTRACT

The aim of the report is to explain the impact of key factors on farm insurance level in the context of risk management. The presented results were obtained from a survey on 300 farmers within the project “Risk Management in Agriculture” in 2011–2012, carried out by a research team from IAE. The methods used are probabilistic modelling, probit and logistical statistical modelling in particular. Currently, farmers’ interest in insurances as a modality to cope with natural hazards is at a low level. The greatest chance for insurance has been found in the young farmers; those who receive a high enough amount of EU subsidies and manage utilized agricultural land areas larger than 10 ha. It is necessary to build a new insurance system in agriculture, where the risk is shared between farmers, insurance companies and the state.

Key words: insurance probability, farmers, probit models, CAP subsidies.

JEL Classification: C2, Q1, G22.

1. INTRODUCTION

The risk management measures have acquired increasing importance in the context of climate changes, on one side, and of the reform of CAP tools for market support, on the other hand. Risk management in agriculture is important out of several reasons. The absence of risk management has a direct impact on farmers’ incomes, on market stability in the sector and on the potential food security. This is particularly significant for the EU New Member States, as in such situations the temporary insufficiency leads to a drastic price increase. Farmers are confronted with the insecurity of average yields, which is expected to increase in the next years. Climate changes will increase the number of extreme weather events, which will have a negative impact upon average yields. The presented results are obtained after the project elaboration “Risk management in agriculture” in 2011-2012, led by Prof. D. Nikolov.

2. STATE OF KNOWLEDGE

The analysis of factors that impact the purchasing of agricultural insurances is a main element for the assessment of the stability and profitability of insurance programs and related public support (Goodwin, B. K. and V. H. Smith (1995). There are researches on the determining factors in insurances conducted in USA (Goodwin, B. K. (1993); Smith, V. H. and A. E. Baquet (1996a); and (1996b); Smith, V. H. and B. K. Goodwin (1996); Mishra, A. K. and B. K. Goodwin (2003a); Serra, T., Goodwin, B.G. and Featherstone, A.M. (2003); Velandia, M., R. M. Rejesus, T. O. Knight and B. J. Sherrick (2009), (Zulauf, C. and D. Orden (2012)). Among the analyses on the receptivity regarding the insurance schemes the following could be mentioned: Garrido, A. and D. Zilberman (2008); Enjolras, G. and P. Sentis (2011), Enjolras, G., F. Capitanio and F. Adinolfi (2012) etc. In the New Member States one could mention the research works by Spörri, M., L. Baráth and I. Fertö (2012), with FADN data.

In Bulgaria, under the project "Risk management in agriculture" in 2011, an assessment of the impact of main factors on the insurance strategies was made.

3. MATERIAL AND METHOD

The presented results were obtained from a survey on 310 farmers on the level and factors of their insurance activity. The survey was conducted in 2011 under the project "Risk management in agriculture" by the IAE team, led by Prof. D. Nikolov. The respondents were farmers from all the regions of Bulgaria.

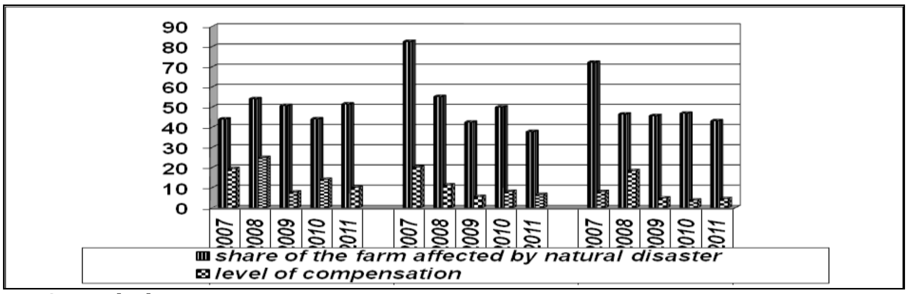
The probit- and log- statistical modelling methods were used. The independent variable values (X) in the constructed models were identified by the following factors: agricultural production structure, presented by the production variety indicator; amount of incomes received under CAP; farmer's age and UAA size on the farm. At the preliminary selection of the methodological tools, it turned out that for the first two factors (variety indicator and indicator for CAP incomes) the most appropriate is the probit- model, while for the other two cases (age and UAA) the logistic model is more convenient.

The dependent variable (Y) is the same in all the four cases. This is the probability for the farm to get insured against the main natural disasters: hails, storms, heavy rains, fires etc.

On the basis of probit-models, the value of the factor variable could be indicated in order to assert with some degree of probability that the resultant phenomenon will come true, in our case the probability for farmers to insure their production.

4. RESULTS AND DISCUSSIONS

The results of the analysis reveal the absence of sufficiently high insurance activity of farmers. Out of total surveyed farms, about 20 % purchased some kind of insurance against natural risk in 2011. More exactly: against hail – 23.1%; against heavy rains – 20.5%; against storm risks – 18.8%, frost – 17.0%, freezing – 18.8%, root fire – 19.6%. The low farm insurance level is mainly due to the insufficient efficiency of the insurance activity, which could not guarantee the complete damage recovery. The ratio of the damaged part of the farm to the share of received indemnities gives reason for such an affirmation (Fig. 1).



Source: Own calculations

Figure 1. Size of the affected part and level of compensation for hails, storms and heavy rains per farm, average value in 2007–2011.

It is obvious that for the three kinds of natural disasters the level of received compensations is several times lower than the volume of suffered damages.

From the following two figures (Fig. 2 and 3), one could notice the presence of almost linear correlation between the insurance and the production diversity, on one side, and the received CAP incomes, on the other side.

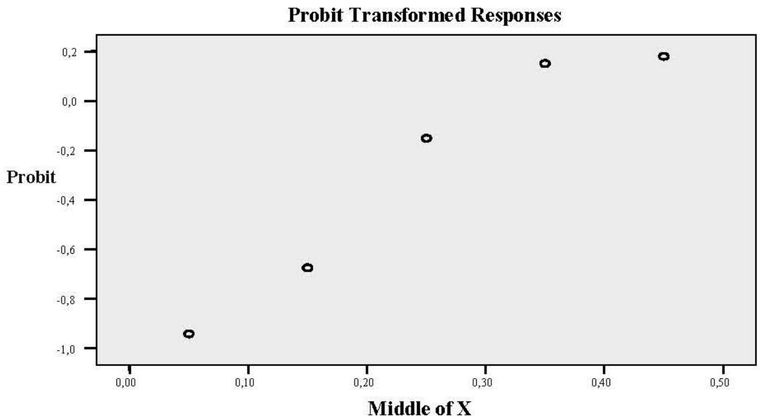


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Figure 2. Correlation between the insurance probability and the diversification level.

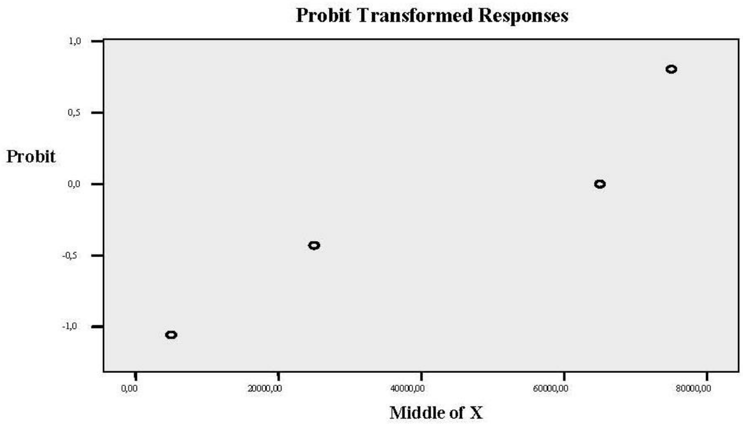

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Figure 3. Correlation between the insurance probability and CAP incomes.

The correlation between insurance and production diversification, firstly, and between insurance and amount of received CAP subsidies, secondly, could be seen in Table 1.

Table 1

Values of correlation coefficients between the dependent variable “insurance” and the factors “diversification indicator” and “received CAP subsidies”

	Diversification index	
	Pierson	**Spearman**
Insurance	0.326	0.304
	Received CAP subsidies	
	Pierson	**Spearman**
Insurance	0.440	0.330

Source: Own calculations

The strength of requested correlations is moderate, according to Pierson and Spearman coefficients. The impact of subsidies on the farm insurance probabilility is stronger, compared to the level of production diversity of the economic unit

The assessments of the following two Probit-models were obtained after the execution of the necessary iterative procedures:

➢ The first model is called Probit model – A. It expresses the relation between the insurance probability and production diversification.

1) $Y = \{probit (\pi)\} = \Phi \{-1.10958 + 3.45202 X\}$

The Chi Square values and the comparison between the probability of empiric characteristics and the level of significance ($\alpha = 0.05$) show that the assessed model is adequate. The observed values and those estimated by the Probit model can be seen in Table 2.

Table 2

Comparative results of real and received values
from Probit model – A values of dependent variable Y

Mean value of intervals of the variable X – diversification index	**Observed number of insured persons**	**Expected number of insured persons**	**Absolute difference between the observed and expected number of insured persons**
0.05	26	26.158	-0.158
0.15	5	5.54	-0.54
0.25	11	10.065	0.935
0.35	14	13.482	0.518
0.45	4	4.7	-0.7

Source: Own calculations

As it can be seen, the absolute difference between the observed values and the extrapolated values of the number of insured persons is sufficiently low. Unlike the common regression analysis, the probit modelling could not give a meaningful interpretation of obtained regression coefficients, due to the complex character of the function Φ. In the statistical theory methods have been elaborated allowing the further use of the constructed model for a response to the following question: What should be the value of the independent variable (in this case – the diversification index level) to claim that at a certain level of probability the resultant phenomenon will come true, in our case that the farm will be insured? More frequently, the so-called average efficient level is assessed, for which the dependent variable fulfillment probability is 0.5, i.e. the level of factor variable (X) for which the occurrence of the dependent variable (Y) will have the probability of 50%. The analysis of results for the farm diversification index shows that only 1.3 % of them meet this condition. Except for the average effective level (50%), the necessary diversification index levels have been evaluated on the basis of other values of the insurance probability. For instance, for the farms with diversification index value higher than 0.32 (whose relative share is 3.5%), the probability to be insured is higher than 50%. It is obvious that from the point of view of the farm production diversification factor, the insurance probability is under 50% on most farms.

- The second probit model – B describes the dependence of the insurance probability on the volume of CAP subsidies. Its specific parameters define the following model type:

2) $Y = \{\text{probit}\ (\pi)\} = \Phi\ \{-1.10484 + 0.00003\ X\}$

In this case, too, the model adequacy could be verified by comparing the values of the theoretical and empirical characteristics of χ^2 test, as well as the probability of the empirical characteristics P ($0.208>0.05 = \alpha$). This comparison proves that the obtained model can be considered as adequate. Analogically, as in the first probit model, in this case also the absolute difference between the empirical values and those evaluated in the model of the dependent variable Y is under 1 (Table 3).

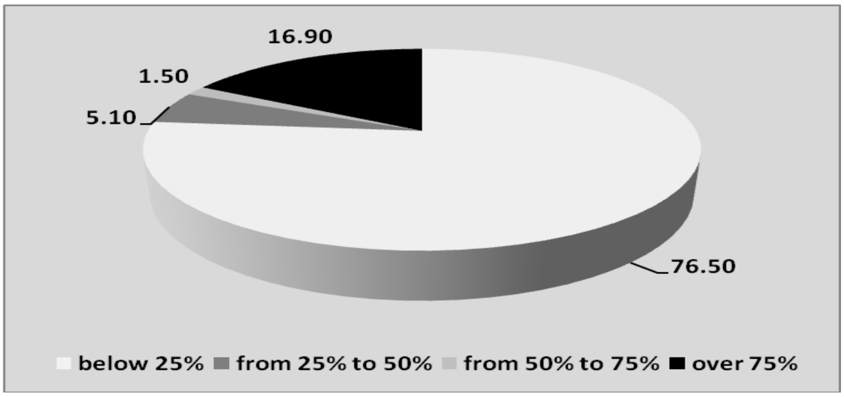
Table 3

Comparative results of real values and of those obtained from Probit model – B values of dependent variable Y

Mean value of intervals of the variable X – CAP subsidies (BGN)	**Observed number of insured persons**	**Expected number of insured persons**	**Absolute difference between the observed and expected number of insured persons**
5000	34	33.94	0.06
15000	1	1.957	-0.957
25000	2	1.219	0.781
35000	2	1.088	0.912
45000	0	0.676	-0.676
55000	2	1.579	0.421
65000	1	1.75	-0.75
75000	18	17.727	0.273

Source: Own calculations

The obtained results on the average efficient level of subsidies at 50 % farm insurance probability against natural disasters amount to 31830 BGN. In other words, there is a 50% probability for the farm to have this insurance, on the condition it has received CAP subsidies amounting to 31830 BGN. With the increase of probability percentage, the necessary amount of funds, which should be received under CAP, also increases. In order to guarantee farm insurance with 99% probability, 98850 BGN as CAP subsidies are necessary. This is the maximal value, adopted by the factor variable X. For most farms (76.5%), the insurance probability is determined to be under 25% (Fig. 4).



Source: Own calculations

Figure 4. Structure of farms according to the insurance probability estimates by Probit model – B probability of insurance (%).

It is not difficult to see on the figure above that the relative share of farms with insurance probability higher or equal to 50% is less than 20% (18.4%). Therefore, out of 10 farms that received direct subsidies, approximately two farms are expected to be insured with a probability degree of 50 % or more.

In the analysis of the impact of factors "age" and "UAA size" on the insurance probability, the classical logistic modeling methods were applied because of the opportunity for quantitative assessment of these two factors. The following model has been developed as a result of describing the relation of the variable dependent on age:

➢ 3) $Y = \ln(\pi/ \pi -1) = \exp(-0{,}026)* X/ (1+ \exp(-0{,}026)* X))$,

where $\pi = P_r \{ Y= 1 \}$, i.e. π presents the farm probability to be insured against natural disasters being equal to 1.

As the evaluated probability of the empiric characteristic Sig. (equal to zero) is lower than the significance level $\alpha = 0.05$, the model is adequate from the statistical point of view. The determination coefficient ($R^2 = 0.298$) shows that about 30% of the insurance probability depends on the farmer's age. According to the interpretation of the dependent X values from the model, it could be concluded that with the increase of farmer's age by 1 year, the farm insurance probability decreases by 2.6% on the average. This result is a proof that the younger age groups are more interested in farm insurance, better understand its importance as a significant tool to fight against the natural disasters effects. Traditionally, in Bulgaria there is a passive attitude to the insurance activity in general, mainly in the case of farm production insurance, which is more specific to the elderly population in the countryside. Obviously, the old farmers have a more conservative attitude as regards the use of the insurance system opportunities in the management of different natural risks, which can result from their insufficient information on the conditions of different insurance companies and the concrete actions that should be undertaken in order to get insured. The lack of sufficient confidence in the insurance effectiveness due to the delayed or partial compensation for the damages on the insured production is another reason for the unwillingness to get insured.

There is an important diffusion of insured farms, according to the area size (Variance = 3196.97), which can be seen in Fig. 5.

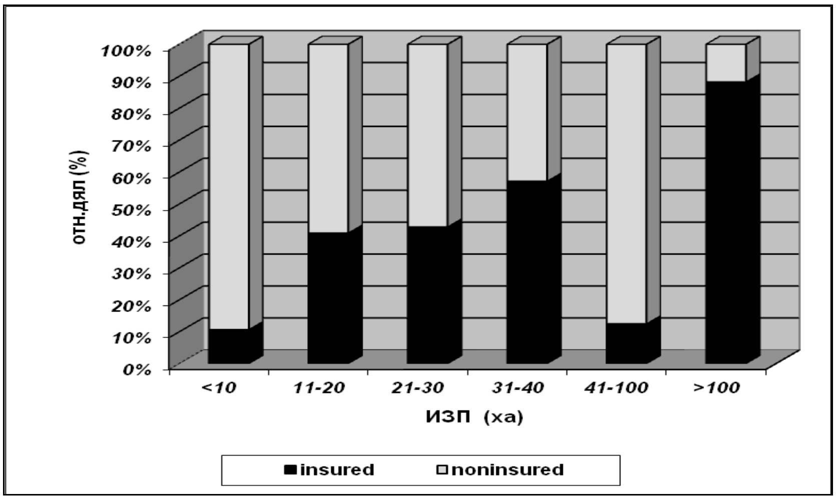
In the analysis of the relation between insurance and UAA, the farms were divided into two groups:

– with agricultural land into ownership up to 40 ha and
– with agricultural land over 100 ha.

The exclusion of farms with land areas from 40 to 100 ha in the probability models is determined by the small number from this group in the sample (barely 3.6%).

The resulting logistic model for the first group of farms is the following:

➢ 4) $Y = \ln(\pi/ \pi -1) = \exp(-2.2631 + 0.0844 * X)/ (1+ \exp(-2.2631 + 0.0844 * X))$



Source: Own calculations

Figure 5. Share of insured farms according to UAA size (%).

In this model the lower limit of the independent X variable values is 0 and the upper limit is 40 ha. The model check verification by comparing the Sig. and α values proves its statistical adequacy. The significance of the coefficient related to variable N means that for the land area increase by 1 ha up to the maximal value of 40 ha, an average increase of the insurance probability by 8.8% will follow. Obviously, the highest value of the insurance level in this group is 40 ha of agricultural land and the share is 57.1%. The linear relation and the proportional increase of the insurance level with the increase of area in this group can be seen in Figure 4. Nevertheless, the average insurance level of farmers with agricultural land under 40 ha is unsatisfactory – it barely reaches 17 %. A generalization could be made, namely that definitely the farms from this group increasingly consider that the insurance is important as a form to avoid the damages caused by natural disasters

➢ In the group of other farms, with over 100 ha, the insurance dependence on the UAA size is described by the following logistic model:

5) $Y = \ln(\pi/ \pi -1) = \exp(0.001)* X/ (1+ \exp(0.001* X))$

The model adequacy is present (Sig. = 0.025 < α = 0.05) and consequently the obtained results are sufficiently effective from the statistical point of view and could be analyzed by a higher degree of probability. At a first glance, the coefficient obtained in this model proves something interesting. With the increase of the land area by 1 ha, the probability for the farmer to get his production insured against natural disasters causing great damages has augmented only by 1%. Practically, the insurance level is almost not at all influenced by the further increase of the agricultural area. The reason is that the insurance level among large farmers is high enough and reaches nearly 90 % (88.2%), i.e. almost all farmers from this group (90 out of 100) have insured their agricultural production against possible natural disasters. The acknowledgement of the role and significance of insurance as an important instrument of natural risks management by the large farmers is completely explicable, considering the large scale production and the expected large production volume respectively.

From the analysis of the insurance activity level and of the relation between insurance and some main factors, the following generalizations could be made:

The impact of each examined factor (production diversity level, amount of CAP subsidies, farmers' age and UAA size) on the insurance probability against natural disasters is moderate or weak.

There is a non-significant difference in the intensity of relation between insurance and diversification level, on one side, and the received subsidies and insurance, on the other side.

The diversification index threshold necessary to guarantee at least 50 % of the insurance level is relatively high, having in view the low farm production diversity level. For almost one fifth of farms, which have used CAP subsidies, we could state that they got their agricultural production insured, with a probability of 50 % or more than 50%.

The age indicator has a moderate impact on the formation of positive attitude as regards farm insurance. Young farmers, by comparison with the older age groups, are more interested and have more intense activity with regard to the insurance opportunities, as one of the most popular tools to fight against the negative effects of natural disasters.

The dependence of the insurance level on the agricultural land area size for the farms with less than 40 ha is quite significant. With its increase up to 40 ha, the insurance probability gradually increases and exceeds 50 %.

The highest insurance level has been noticed for the farms with land areas larger than 100 ha. As the largest part of these farms have their production insured, practically the opportunities for the supplementary insurance of the new farms from this group are minimal.

5. CONCLUSIONS

The interest of farmers in insurance as a tool for coping with natural risks is still low. The obtained results and the conclusions drawn could be in favour of the insurance agencies for attracting new clients and in general, for increasing the insurance activity dedicated to agricultural producers. The greatest chance to positively respond to insurance agents can be found in the relatively young farmers (aged less than 40 years); those who receive a high enough amount of EU subsidies and operate agricultural land over 10 ha. Furthermore, the efforts should be directed to create a new insurance system in agriculture, where the risk is shared between farmers, insurance companies and the state. Thus, the funds received by farmers will cover the losses caused by natural disasters to a great extent and will increase their insurance activity.

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