ISSN 2392-1641

Economics and Business Review

Volume 1 (15) Number 3 2015

CONTENTS

Poznań University of Economics Press

Paper based publication

ISSN 2392-1641

POZNAŃ UNIVERSITY OF ECONOMICS PRESS
ul. Powstańców Wielkopolskich 16, 61-895 Poznań, Poland
phone +48 61 854 31 54, +48 61 854 31 55, fax +48 61 854 31 59
www.wydawnictwo-ue.pl, e-mail: wydawnictwo@ue.poznan.pl
postal address: al. Niepodległości 10, 61-875 Poznań, Poland

Printed and bound in Poland by:
Poznań University of Economics Print Shop

Circulation: 300 copies

Economics and Business Review, Vol. 1 (15), No. 3, 2015: 90–111
DOI: 10.18559/ebr.2015.3.7

Polish farmers' perception of spring frost and the use of crop insurance against this phenomenon in Poland[1]

***Monika Kaczała*[2], *Dorota Wiśniewska*[3]**

Abstract: According to Polish farmers spring frost is one of the most dangerous natural perils which a farm may face. The aim of the paper is to describe how farmers assess spring frost in the context of other sources of risk and to investigate if there are any interdependencies between the perception of spring frost and the use of crop insurance to cover this peril. The factors affecting the perception of spring frost were identified. The identified determinants of spring frost assessment were then used to construct an ordered response logit model that enables a classification of the farmer according to his assessment of spring frost.

Keywords: agriculture, spring frost, risk perception, crop insurance, ordered response logit model.

JEL codes: Q120, G220, D81.

Introduction

"Risk perception is the subjective assessment of the probability of a specified type of accident happening and how concerned we are with the consequences" [Sjöberg, Moen, and Rundmo 2004: 8]. Farmers' perception of sources of risk has been researched in different countries [Harwood et al. 1999; Coble et al. 1999; Chiotti et al. 1997; Meuwissen, Huirne, and Hardaker 1999; Tucker, Eakin, and Castellanos 2010; Assefa, Meuwissen, and Oude Lansink 2014], mainly in the USA. Some studies have shown that personal risk perception influences the type of risk management strategy undertaken by a farmer [Beal 1996; Tucker, Eakin, and Castellanos 2010]. It also affects demand for insurance [Ogurtsov, van Asseldonk, and Huirne 2009; Sherrick et al. 2004]. Risk perception could vary depending on the country in which farmers operate [Boholm 2003; Dessai

[1] Article received 6 March 2015, accepted 3 August 2015.
[2] Poznań University of Economics, Department of Insurance, al. Niepodległości 10, 61-875 Poznań, Poland; corresponding author, e-mail: m.kaczala@ue.poznan.pl.
[3] Poznań University of Economics, Department of Econometrics, al. Niepodległości 10, 61-875 Poznań, Poland.

et al. 2004; Eakin 2006; Fraser-Mackenzie, Sung, and Johnson 2014]. However almost no research has been conducted so far to determine farmer's risk perception in Eastern and Central Europe, especially in the post-communist countries.

Poland as an example of a Central European post-communist country has been selected for this study because it is one of the largest areas and has the most people in the EU employed in agriculture (it accounts for over 10% of EU arable land and over 25% of the EU agricultural population) [Statistical Yearbook of Agriculture 2013: 394]. According to Polish farmers spring frost is the most dangerous natural peril which a farm may face, followed by winterkill and drought [Kaczała and Wiśniewska 2015: 100].

Spring frost is usually defined as a drop in the air temperature to 0°C and below at the times when the mean temperature for 24 hours remains above 0°C [Chromow 1977: 138–139]. The definition of spring frost used in subsidised crop insurance refers to „damage caused by a drop in temperature below 0°C between 15th Apr and 30th June which have caused full or partial plant damage or full or partial crop loss".[4] Spring frost is inherent to Poland, although its severity and geographical distribution is varied [cf. e.g. Koźmiński and Michalska 2001: 75; IMGW 2013: 60–63]. There are areas in Poland where the spring frost-free period has shrunk (the north-east) [Kalbarczyk 2010; Grabowski 2010] and where it has lengthened (the region of Bydgoszcz) [Dudek, Żarski, and Kuśmierek-Tomaszewska 2012]. However according to estimates the pessimistic scenario assumes an increase in the frequency and severity of spring frost in Poland [Klimkowski 2002; Kundzewicz 2012: 21].

The aim of the paper is to investigate the factors affecting the Polish farmers' perception of spring frost. Firstly, we describe how farmers assess spring frost in the context of crop insurance and the appraisal of other sources of risk. Secondly, we investigate the factors affecting the perception of spring frost amongst arable farmers in Poland. First, the objective features of the farmers and their farms will be considered. Next, the significance of past experience concerning different adverse events (weather phenomena, agricultural policy, changes in market prices, changes in crop technology, health problems, etc.). The following hypotheses will be tested:

H1: Farmers who perceived spring frost as dangerous are more likely to use crop insurance covering spring frost than farmers who are not afraid or who have a neutral attitude towards this peril.

H2: There are factors differentiating farmers between those who assess spring frost as either a dangerous, neutral or not dangerous peril and as a consequence it is possible to construct a practically applicable tool to identify individuals with one of the above perceptions of spring frost.

---

[4] This is the final definition that was originally formulated in Art. 3 Section 2 point 11 of the Act of July 7th 2005 and then it was altered twice – by art. 1 point. 4c of the Act of 2nd March 2007 and by art. 1 point. 1a of the Act 25th July 2008.

The paper is divided into three sections. The first section is devoted to data and methodology, the second contains empirical results and the last presents interpretations of the results and conclusions.

1. Scope and methods of the study

1.1. Data

Primary data was gathered on the basis of a survey conducted in March 2012 by means of the CATI method, with the use of a structured questionnaire, on a focus group of 750 farmers across Poland who grow crops. A representative sample was selected on the basis of the farm location and size. Answer variants and respondents' profiles were expressed by means of different qualitative variables: binary variables, polynomial variables – both nominal and ordinal ones. The data about the farmers and the characteristics of their farms was collected. Farm managers assessed 13 perils in the scale from 1 to 7, where 1 denoted a negligible peril, whilst 7 represented a definitely dangerous phenomenon. The list included moveable perils, such as hail, flood, winterkill, spring frost, drought, hurricane, plant pests and diseases, the farmer's health problems, increase in agricultural input prices, price volatility on the crop markets, political changes, property damage and sudden changes in agricultural technology. The data on acceptable losses in crops and losses in crops leading to a farm's bankruptcy were obtained according to declarations made by farmers, as well as data about loss experience and insured perils.

1.2. Methods applied in the subsequent stages of study

In order to describe the structure of responses to the question about the perception of spring frost risk and evaluate these responses with regard to the assessment of other risks, some frequency tables were created and the distribution of responses analysed. Due to the fact that an ordinal scale was used for the evaluation of particular risks (scored from 1 to 7), a non-parametric Kruskal-Wallis test could be applied to determine significant differences in the evaluation of each risk, with particular focus on whether spring frost risk is considered as the most dangerous risk of all.

Apart from the non-parametric analysis of variance a Spearman's rank correlation analysis was conducted in order to determine the correlation between the perception of spring frost risk and the evaluation of other risks. The findings of this analysis encouraged the extension of the study using cluster analysis, which would help to establish homogeneous groups of respondents depending on their risk perception. First of all, in order to determine the number of clusters, an agglomerative method was used. This was followed by the application of the k-means method in order to classify the respondents into specified clusters.

In order to verify the hypothesis concerning the correlation between the spring frost risk perception and various qualitative features, a number of contingency tables (cross-tabulation) was produced and the Pearson's test of independence was conducted. As some of the features considered had quite a few variants, a problem appeared with regard to the appropriate sample size in each cell of the contingency table. Therefore, spring frost risk perception was categorised into three classes:

– Low level of risk, if it was evaluated 1 or 2,
– Medium level of risk, if evaluated 3 to 5,
– High level of risk, if evaluated 6 to 7.

Reduction of the number of variants of the given variable made it easier to interpret the way in which different variants of the considered qualitative features affect the perception of spring frost risk. Cramer's coefficient, based on chi-squared statistics was used as a measure of strength of this correlation.

In the cases when the considered determinants of spring frost risk perception were quantitative (e.g. how many times in the previous ten years a given risk had occurred), the non-parametric Kruskal-Wallis test was applied in order to find out if the three classes of risk differed in terms of the qualitative feature value.

The potential determinants of risk perception researched can be put into three groups:

a) objective features of the respondents and their farms:
   – sex, age, educational background,
   – farm size, production purpose, dominant soil quality class, the use and character of additional, non-farming sources of income, dominant production,
   – types of crops,
   – province where the farm is located;

b) subjective opinions of the respondents, i.e.:
   – the degree of crop loss which does not jeopardise the farm operation,
   – the degree of crop loss leading to bankruptcy;

c) experience related to different perils:
   – the frequency of various adverse occurrences in the previous 10 years,
   – the scope of adverse occurrence affliction, i.e. the evaluation of the influence the adverse phenomenon had on the farm's income from crops (in the scale of 1 to 4, where 1 denotes lack of influence on the income, and 4 denotes a very big influence).

In the last stage of the research two ordered categories logit models were constructed in order to produce a tool to permit the respondents' classification into one of the three determined risk classes. In the first model the potential exogenous variables were assumed to be only the objective features of the respondents and their farms, which were identified by means of the correlation analysis of their qualitative features. In the other model, the potential exogenous variables also included those which reflected the respondents' subjective features and their experience regarding adverse occurrences. The qualitative (nominal) features were introduced into the model through a number of binary variables; hence, if a given variable had *i*-variants, one of them was assumed to be the base and *i*-1 of the variables were introduced into the model. Selection of the variables for both models was carried out by means of stepwise regression. It was assumed that the variables which remained in the model would be significant at the confidence level of 95 percent.

Unfortunately none of the available respondents' features could be directly used to measure their risk aversion. In order to make the best possible use of the survey findings, additionally composite (synthetic) variables were established which could reflect risk aversion. The first one being the mean of diagnostic variables was constructed on the basis of opinions about a brand new insurance product, i.e. index insurance. The opinions were expressed as the answers to two questions as to whether the respondents liked the product (on a scale from 1 to 6); in the first question variant the price of the product was not revealed. This was supposed to illustrate the respondents' propensity for accepting novelties. The second composite variable was to reflect the degree of the respondents' trust toward insurance companies. It was identified on the basis of 6 questions regarding the degree of agreement with a particular opinion about the operations of insurance companies. The responses were given in the ordinal scale of 1 to 5, where 1 represented lack of agreement, and 5 reflected a high degree of agreement. Both the measures were introduced into the aforementioned logit models in order to attempt to improve the classification quality.

GRETL and Statistica10PL software was used for all the calculations.

2. Empirical results

2.1. The structure of spring frost risk assessment and the use of crop insurance

As has already been mentioned the respondents assessed the degree of spring frost risk on a scale of 1 to 7, where 7 denotes the highest degree of risk. As a result of 750 observations it became clear how some of the respondents rated this risk. Their ratings are presented in Figure 1. I Importantly the graph additionally presents a separate distribution of sub-groups of those who declared that they had insured their crops against spring frost and those who claimed to have no insurance of this kind. The analysis of this graph shows clearly that respondents most often gave high grades to spring frost: 5 in 29 percent of the cases and 6 in 24 percent. It is also quite obvious that the highest grades were given by the people who had insured their crops (6 and 7) and the lowest grades (1, 2, 3 and 4) were given by those who had not insured their crops.

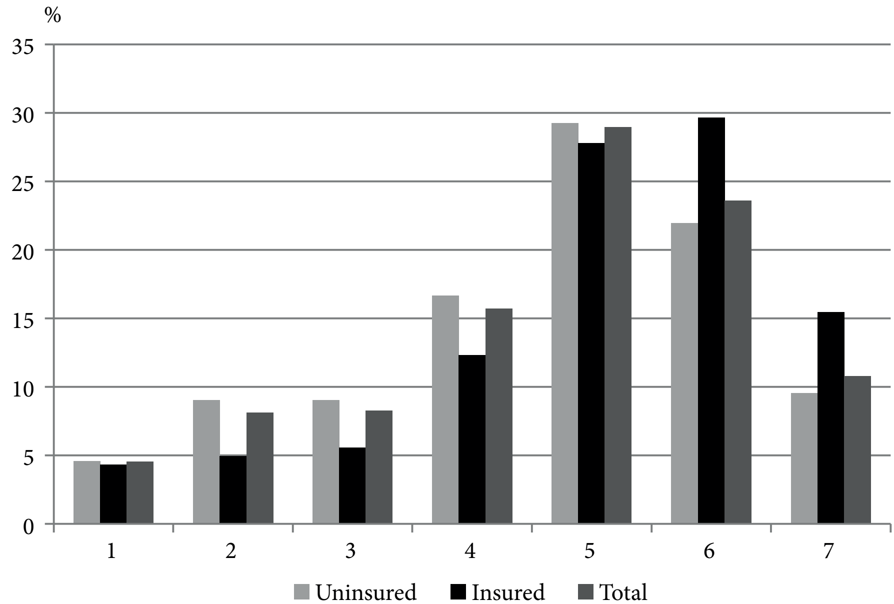

Figure 1. Distribution of spring frost risk rating in the whole focus group and in sub-groups of those who had insured their crops and those who had not

Table 1. Percentage of respondents who declared a low, medium or high spring frost risk rating vs. insurance or lack of it against spring frost

Scope	Spring frost risk assessment (%)			Independence test results	
	Low	Medium	High		
Total	13	53	34	Chi sq.	12.103
Insured	9	46	45	p-value	0.002
Uninsured	14	55	31	Cramer coeff.	0.127

In order to confirm the statistical significance of the response distribution an independence test of qualitative features was conducted assuming three classes of risk assessment. The findings presented in Table 1 show that there is a correlation between the risk assessment and a decision to buy a crop insurance policy at a confidence level of 99.8 percent. This correlation is not very strong.

Table 2 shows the structure of various risk assessments and a mean rating for each peril. The findings of the Kruskal-Wallis test prove significant differences between the perceptions of those risks. Rather importantly spring frost constitutes the most highly rated risk amongst the occurrences connected with adverse weather phenomena and plant diseases. This risk perception is not significantly lower than the similarly assessed drought and winterkill. Amongst all other risks the most highly rated ones were the risks connected with increases

Table 2. Findings of the examination of spring frost risk vs. other risks assessment

Risk assessed		Drought	Flood	Hail	Spring frost	Winterkill	Hurricane	Plant diseases	Health problems	Rising prices of agricultural input	Agricultural market volatility	Political changes	Property damage	Technological changes
Grade given	1	5%	31%	16%	5%	6%	31%	9%	25%	4%	7%	16%	29%	31%
	2	9%	20%	20%	8%	10%	21%	12%	15%	4%	6%	9%	12%	17%
	3	12%	10%	14%	8%	9%	12%	12%	6%	5%	5%	6%	6%	6%
	4	17%	11%	17%	16%	19%	14%	20%	15%	14%	14%	15%	12%	15%
	5	23%	12%	16%	29%	26%	9%	25%	15%	25%	24%	24%	20%	15%
	6	15%	7%	11%	24%	18%	8%	13%	13%	21%	21%	17%	13%	11%
	7	18%	8%	6%	11%	12%	5%	9%	10%	28%	23%	13%	9%	4%
Average grade		4.624	3.081	3.511	4.704	4.517	2.96	4.169	3.607	5.245	4.959	4.208	3.564	3.181
Std.dev.		1.742	2.001	1.812	1.59	1.695	1.883	1.716	2.081	1.616	1.775	1.977	2.109	1.954
Kruskal-Wallis test		H(12; N = 9750) = 1269.807, p-value = 0.000 p-value obtained from pair comparisons (grades given to spring frost risk and other risks)												
		0.99	0.00	0.00	Nd	0.99	0.00	0.00	0.00	0.00	0.64	0.00	0.00	0.00

in prices of agricultural input and risk concerning agricultural market volatility. In the first case the assessment is even significantly higher than the rating given to the spring frost risk.

Another issue that was subject to research was the correlation between the growth in the negative perception of spring frost risk and the potential growth or drop in assessment of other risks. Rank correlation coefficients which are presented in the second column of Table 3 enable evaluation of the direction and strength of these correlations. Subsequent risks are listed in a specific order: the first to be listed are the ones whose assessment is most tightly correlated to the evaluation of spring frost risk. The strongest positive correlation can be seen between spring frost and winterkill, hurricane and hail, whilst the weakest one are in respect of flood and health problems.

Table 3. Measures of the strength of the correlation between spring frost perception and assessment of other risks

	Spearman's rank correlation coefficients	
Type of risk	**Calculation based on all observations**	**Calculation excluding the farmers who rated all risks very highly**
Winterkill	0.5608	0.5553
Hurricane	0.3296	0.2668
Hail	0.2922	0.2301
Plant diseases and pest	0.2805	0.2650
Political changes relating to agriculture	0.2705	0.2455
Drought	0.2386	0.1993
Rising prices of agricultural input	0.2300	0.2137
Crop prices fluctuations	0.2217	0.2008
Dramatic changes in cultivation technology	0.2007	0.1664
Property damage	0.1907	0.1457
Health problems	0.1613	0.1374
Flood	0.0868	–0.0198[a]

[a] Statistically insignificant correlation at the significance level of 0.05.

Although all the coefficients of this correlation do not achieve very high values it may be surprising that they are all positive. This may mean that there is quite a large group of people who ranked one of the risks high (low) and at the same time was prone to evaluate all the other risks in the same way. Therefore, in order to identify more precisely the way in which respondents evaluated the

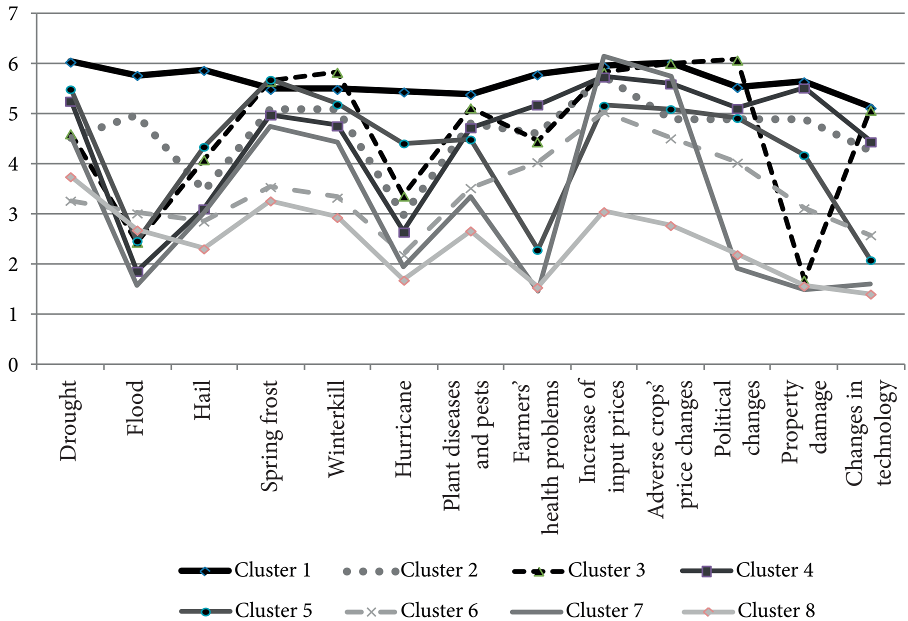

Figure 2. Average ratings given to particular risks in the identified clusters
Source: Own calculations with the use of Statistica 10PL

risks, it was decided that they should be divided into groups which similarly assessed particular types of risks. As a result of cluster analysis the respondents were divided into eight clusters. Average ratings of particular perils by the people grouped in a given cluster are presented in Figure 2.

Cluster analysis made it possible to establish the possible cause of positive correlation between the ratings given to particular risks: there is quite a large group of respondents (approximately 100 people) who rated all risks highly, regardless of their provenance; these people constituted cluster 1. This manner of risk perception can be rather puzzling – it might result from the fact that either all these people are highly risk-averse, which is quite difficult to verify, or they have abundant negative experience (which is very unlikely, as occurrences such as adverse price changes or agricultural policy shifts do not affect such limited groups), or it may be the effect of carelessness or impatience in offering responses.

Considering the latter potential cause of establishing cluster 1 it was decided that examination of the correlation between spring frost risk perception and other features of the respondents would additionally involve checking if these regularities also occurred in the case of all 750 observations and in the subgroup out of which cluster 1 respondents had been excluded. Consequently Table 3 also presents the rank correlation coefficients obtained in the case of the reduced group. It turned out that a large majority of the correlations was confirmed, albeit they were a little lower (as had been expected). What is important is that the negative sign of the correlation between spring frost risk and flood risk evaluation obtained was more factually correct.

2.2. Factors affecting the perception of spring frost

2.2.1. Respondents' objective features

The results of the chi-square independence test clearly point to the fact that risk perception is not affected by features such as sex, educational background, farm size, production purpose or sources of income. Age and its influence on risk perception was placed on the verge of significance and the confidence level regarding the occurrence of particular regularities depends on the scope of the group. Distribution of spring frost perception depending on the respondents' age is shown in Table 4. It is worth mentioning that persons aged over 60 rated spring frost highly much more often than younger people (40.18 percent of the oldest group, while 34 and less percent was reported in the younger groups). At the same time, the rating distribution in the other age groups is similar enough to make it impossible to reject the zero hypothesis concerning lack of correlation between the respondent's age and their evaluation of risk.

Table 4. Percentage of respondents evaluating the spring frost risk as high, medium or low depending on their age

	Response distribution for all observations				**Independence test findings**		
Risk evaluation	**<40 (%)**	**41–50 (%)**	**51–60 (%)**	**>60 (%)**		**All observations**	**Excluding cluster 1**
High	33.94	33.99	31.84	40.18	Chi sq.	8.353	10.462
Medium	51.52	50.74	58.80	46.43	p-value	0.213	0.106
Low	14.55	15.27	9.36	13.39	C. coeff.	0.075	0.090

The factor which significantly affects spring frost perception is the dominant production. As Table 5 indicates, the highest ratings were given relatively more often if the dominant production involved pigs (more than 42 percent of these respondents gave it the highest rating) and crops (39.3 percent respectively). However the correlations are not strong, despite being statistically significant.

It might seem likely that the type of cultivated crop has a substantial influence on spring frost perception. It turns out, however, that the above assumption is valid only for winter barley and rape. Although their cultivation, as expected, slightly increases the likelihood of giving the risk a very high rating, Table 6 shows that this influence is not that strong and out of the remaining

Table 5. Spring frost rating distribution according to the dominant production

Risk evaluation	Crops (%)	Milk (%)	No dominant production (%)	Pigs (%)	Independence test findings	
High	39.30	25.00	26.37	42.55	Chi sq.	15.044
Medium	49.73	60.00	60.44	46.81	p-value	0.0199
Low	10.96	15.00	13.19	10.64	C. coeff.	0.102

Table 6. Comparison of plants whose cultivation has the largest influence on spring frost risk perception, in the light of the Chi-square test of independence

Type of plant	Chi-sq. stat. (p-value)	Relationship
Winter barley	11.7172 (0.003)	45.3 percent of farmers cultivating winter barley gave the highest rating to spring frost risk whilst 8.18 percent of these farmers gave it the lowest rating. In the cases of farmers who do not cultivate this crop the percentages are 31.5 percent and 13.9 percent respectively
Rape	9.94 (0.007)	47.44 percent of farmers cultivating rape gave the highest rating to spring frost risk while 3.85 percent of these farmers gave it the lowest rating. In the cases of farmers who do not cultivate this crop the percentages are 32.9 percent 13.7 percent respectively
Winter triticale	4.33 (0.115[a])	36.9 percent of farmers cultivating winter triticale gave the highest rating to spring frost risk while 11.21 percent of these farmers gave it the lowest rating. In the cases of farmers who do not cultivate this crop the percentages are 30.5 percent 14.9 percent respectively

[a] Statistically insignificant correlation at the significance level of 0.05.

winter crops only triticale cultivation affects the spring frost perception at the verge of significance.

Another feature of the farm that seems to have a significant influence on risk perception is the farm's location. In the cases of the lower number of responses from Opole, Pomerania, Warmia-Masuria and Silesia provinces, they had to be removed from some of the cells of the contingency tables. However amongst other provinces it was possible to identify the ones where the highest ratings were relatively more often given to spring frost risk (Table 7). It refers to the provinces of Lublin, Wielkopolska, Kujawy-Pomerania, Świętokrzyskie and Łódź. Unfortunately location despite its statistical significance is also not a very strong determinant in risk perception.

Table 7. Farm location vs. the structure of spring frost risk evaluation (%)

Risk assessment	Lower Silesia	Lublin	Małopolska	Mazovia	Subcarpathisn	Podlasie	Świętokrzyskie	Lubuskie	West Pomerania	Kujawy-Pomerania	Wielkopolska	Łódź
High	24	<u>43</u>	21	31	11	34	<u>41</u>	23	33	<u>42</u>	<u>43</u>	<u>41</u>
Medium	62	43	52	56	74	50	49	62	52	54	49	47
Low	14	14	26	13	16	16	11	15	15	5	8	13
Test of independence results: Chi sq. = 35.59, p-value = 0.033; Cramer coeff.= 0.15												

2.2.2. Respondents' subjective features and farming loss experience

The results of the independence test indicate that the risk assessment distribution is not contingent on acceptable or non-acceptable loss of crops. On the other hand a strong correlation was noticed between various risk assessments and different variables denoting the farmer's experience with them. As the respondents were divided into three groups depending on their risk perception, whilst the occurrence frequency was indicated on a ratio scale, a classical analysis of variance and non-parametric Kruskal-Wallis test was conducted in order to identify the significant differences in the frequency of occurrence of particular risk connected with natural phenomena which the three groups had experienced. Table 8 presents the results which indicate that the higher the given phenomenon's frequency of occurrence, the larger the propensity to rate spring frost risk as highly dangerous. A reverse correlation can only be seen in the case of flood frequency (in the areas often struck by floods the propensity for spring frost assessment as highly dangerous is smaller). This may be due to the fact that the shores of lakes, large ponds and river banks are conducive to the cultivation of crops which are vulnerable to spring frost. Adverse phenomena connected with low temperatures (winterkill) have the largest influence on spring frost risk perception.

Apart from the influence of adverse occurrences the effect these phenomena had on the farmers' income from crops was also examined. The survey identified this effect within an ordinal scale (with four feature variants) regarding not only the natural phenomena but also entirely different occurrences. The results of the examination of the relationship between the degree to which the occurrence struck the respondent and their risk perception category are presented in Table 9.

In order to interpret this table properly one has to keep it in mind that within the whole focus group 34 percent of respondents rated spring frost risk the highest. If a visibly large percentage of respondents who were struck by a given

Table 8. Frequency of the phenomena vs. spring frost risk perception – results of the classical analysis of variance and the non-parametric Kruskal-Wallis test

Phenomenon	Statistics F and H	p-values	Type of relationship
Drought	5.384	0.005	The more frequently drought occurred, the higher the risk was rated
	11.36	0.003	
Flood	4.242	0.015	The more frequently flood occurred, the lower the risk was rated
	9.016	0.011	
Hail	9.327	0.000	The more frequently hail occurred, the higher the risk was rated
	20.55	0.000	
Spring frost	29.391	0.000	The more frequently spring frost occurred, the higher the risk was rated
	72.14	0.000	
Winterkill	33.372	0.000	The more frequently winterkill occurred, the higher the risk was rated
	75.897	0.000	
Hurricane	4.687	0.009	The more frequently hurricanes occurred, the higher the risk was rated
	5.44	0.066	
Fire, Animal attacks, Plant diseases			Lack of significant relationship

Table 9. Assessment of the degree to which a given occurrence affected the farm's income vs. the frequency of giving the spring frost risk a low, medium or high rating – the Chi-square test of independence results

Occurrence	Chi-sq. statistics (p-value) V-Cramer coeff.	Type of relationship
Drought	13.780	48 percent of the people most severely struck by drought (whilst only 27.4 percent of those who did not make losses because of drought) rated spring frost risk as the most dangerous
	(0.032)	
	0.09585	
Flood	30.730	41 percent of the people most severely struck by flood (whilst only 23.81 percent of those who did not make losses because of flood) rated spring frost risk as the most dangerous
	(0.000)	
	0.14313	
Hail	9.260	53.13 percent of the people most severely struck by hail (whilst only 33.3 percent of those who did not make losses because of hail) rated spring frost risk as the most dangerous – unfortunately, in the other response variants there are no visible regularities
	(0.160)[a]	
	0.07857	
Spring frost	79.570	76 percent of the people most severely struck by spring frost (whilst only 29.27 percent of those who did not make losses because of spring frost) rated it as the most dangerous risk
	(0.000)	
	0.23032	

Winterkill	244.530 (0.000) 0.40376	64 percent of the people most severely struck by winterkill (whilst only 25 percent of those who did not make losses because of winterkill) rated spring frost risk as the most dangerous
Hurricane	57.622 (0.000) 0.19600	61 percent of the people most severely struck by hurricane (whilst only 35.77 percent of those who did not make losses because of hurricanes) rated spring frost risk as the most dangerous
Plant diseases	42.447 (0.000) 0.16822	42 percent of the people most severely struck by plant diseases (whilst only 26 percent of those who did not make losses because of plant diseases) rated spring frost risk as the most dangerous
Health problems	34.396 (0.000) 0.15143	38 percent of the people most severely struck by health problems (whilst only 33 percent of those who did not make losses because of health problems) rated spring frost risk as the most dangerous.- at the same time a positive relationship is seen in all the feature variants
Rising prices of agricultural input	24.040 (0.002) 0.12660	38 percent of the people most severely struck by this occurrence (whilst only 24 percent of those who did not make losses because of it) rated spring frost risk as the most dangerous
Fluctuations of crop prices	19.640 (0.012) 0.11443	36 percent of the people most severely struck by price fluctuations and 30 percent of those who did not make losses because of price fluctuations rated spring frost risk as the most dangerous. Weak relationship
Political changes	37.370 (0.000) 0.15784	50 percent of the people most severely struck by political changes (whilst only 28.9 percent of those who did not make losses because of political changes) rated spring frost risk as the most dangerous
Property damage	38.810 (0.000) 0.16085	47 percent of the people most severely struck by property damage and 28.6 percent of those who did not make losses because of property damage rated spring frost risk as the most dangerous.. Weak relationship
Technology	62.460 (0.000) 0.20406	45 percent of the people most severely struck by technological changes (whilst only 26.7 percent of those who did not make losses because of technological changes) rated spring frost risk as the most dangerous

occurrence rate spring frost risk as the most dangerous it proves a strong positive relationship. It is rather obvious that the highest percentage of respondents who rated spring frost risk as the most dangerous related to people who had incurred severe losses because of spring frost (76 percent), winterkill (64 percent), hurricane (61 percent) and hail (53 percent). What is also essential, in the case of all the adverse phenomena, the percentage of respondents who gave spring frost risk the highest grade is significantly higher when the adverse occurrence had a serious influence on the farmer's income.

2.3. The logit model in respondent classification according to their spring frost risk perception class

Considering the fact that it was possible to identify several features of the respondents which affect their spring frost risk perception a decision was made to evaluate their diagnostic power by means of constructing a logit model for ordered categories. This model would make it possible to obtain a correct hit ratio for a person with particular characteristics, classifying them into one of the three categories: those who gave spring frost risk low, medium and high rating.

For practical purposes it is advisable to obtain correct classification only on the basis of objective, easily identifiable features of the farmer and his/her farm. Therefore the first thing was to find significant variables among the objective features of the respondents. Table 10 presents such significant variables for this model along with its assessment of the parameters:

Table 10. Significant variables and logit model parameter assessments – objective features (model 1)

Variables and cut off points of the model	Coefficients	Standard deviation	p-value
Is plant production dominant	0.43571	0.1452	0.0027
Is rape cultivated	0.61021	0.2417	0.0116
Is winter barley cultivated	0.53065	0.1771	0.0027
Wielkopolska Province	0.69714	0.2085	0.0008
Kujawy-Pomerania Province	0.59759	0.2643	0.0238
Łódź Province	0.56519	0.1976	0.0042
Świętokrzyskie Province	0.67596	0.3407	0.0473
Cut1	–1.32877	0.1444	0.0000
Cut2	1.36698	0.1422	0.0000
Confidence ratio test: Chi-sq.(7) = 156.374 [0.0000]			

By looking at the model above (model 1) it can be seen that the set of the significant variables and the parameter signs that accompany them are not surprising. The findings presented here are in accord with the results of the statistical analysis of the relationship between the respondent's objective features and his/her risk perception. Unfortunately whilst the relationships were statistically significant, they were not strong. This results in a very low hit ratio obtained from the model established - it amounts to only 55 percent (Table 11).

When evaluating the model quality it has to be kept in mind that the results obtained should be compared to the minimum hit ratio obtained as a result of random classification. In the case of unequally sized groups, when the researcher aims to obtain the best possible classification quality, the minimum hit ratio in each of the defined groups is established in accordance with proportional chance criterion [Wiśniewska 2012: 112]. In the case analysed it is barely 41.34 percent. Q-Press statistics confirm with quite a high level of confidence that the achieved hit ratio for this research is significantly higher than the assumed minimum. On the other hand it has to be remembered that the hit ratio was established for the estimation group – in the separate validation group the classification quality usually decreases.

Table 11. Classification matrix and hit ratios for model 1

Actual assessment	Classification			Hit ratio (%)
	Low	Medium	High	
Low	0	92	3	0
Medium	0	374	23	94
High	0	221	37	14
Hit ratio (total)				55

Due to the unsatisfactory classification quality on the basis of model 1, the set of exogenous variables was extended to include the variables which characterise the frequency of adverse occurrences and the degree of their influence on income from crops. Table 12 presents the variables in the established model and assessments of significant parameters.

Due to the fact that experiences relating to various adverse occurrences affected spring frost perception to a much larger extent than the objective features, the obtained hit ratio was much more accurate (Table 13). The hit ratio is not only significantly higher than the minimum established on the basis of the proportional chance criterion (41.34 percent), but it would probably exceed the hit ratio based on the maximum chance criterion – it is equal to the observation percentage of the largest class, i.e. it amounts to 53 percent.

The hit ratio for farmers with medium and low levels of risk perception could be considered satisfactory. Unfortunately only slightly more than 50 percent of the persons who presented a high level of risk perception were accurately classified in this category. In an attempt to seek a better classification method, a binary variable was added, which equalled 1 if a person was classified in cluster one (which consisted of people who rated all risks as highly dangerous). Although this variable proved to be statistically significant it only improved the hit ratio accuracy in groups other than "high". Subsequently other variables

Table 12. Significant variables and logit model parameter assessments – objective features and experiences regarding risks (model 2)

Variables and cut off points of the model	Coefficients	Standard deviation	p-value
Is plant production dominant	0.37203	0.1674	0.0262
The number of winterkill problems	0.11543	0.0398	0.0037
Influence of drought on income	0.21106	0.0702	0.0027
Influence of spring frost on income	1.76175	0.1123	0.0000
Influence of hurricanes on income	0.24975	0.0741	0.0007
Influence of crop price fluctuations on income	–0.24791	0.0703	0.0004
Farm located in Lublin Province	0.78787	0.3722	0.0343
Cut1	1.42225	0.2834	0.0000
Cut2	6.26592	0.4036	0.0000
Confidence ratio test: Chi-sq. (7) = 621.265 [0.0000]			

Table 13. Classification matrix and hit ratios for model 2

Actual assessment	Classification			Hit ratio (%)
	Low	Medium	High	
Low	93	2	0	98
Medium	3	334	60	84
High	0	121	137	53
Hit ratio (total)				75

were introduced which were substituted for features relating to the propensity for risk taking and insuring oneself against risk (described in Section 2.2.). Unfortunately these variables were not significant.

Conclusions

On the basis of the hit ratio matrix one can say that model 2 very well identifies the people who rate spring frost risk perception as low or medium but it undervalues these ratings for people in the "high" group. This means that in order to identify the people who rate spring frost as dangerous additional information would have to be introduced into the model. One of the options to achieve this aim is to use the psychometric paradigm [Fischoff et al. 2000], although its scope in explaining the differences in perception of particular risks is quite limited (up to 20 percent of the variation [Sjöberg, Moen, and Rundmo 2004: 17, 20 and the literature cited there]), and likewise, the cultural theory [Oltedal et al. and the literature cited there]. Furthermore one should examine the possibility of explaining the rating variations by means of introducing (a) different variable(s) concerning trust rather than the composite variable used in the model, which refers to confidence in insurance companies. Unfortunately the available data does not permit such an extension of the study.

The propensity for a given degree of spring frost risk perception is closely related to individual experience concerning the amount and value of the damage caused by some natural perils. In 2011, which was one year before the research was conducted, there was massive damage caused by spring frost, which in turn had been preceded by even more severe losses caused by winterkill. In the course of the following year, i.e. 2012, just before the survey was carried out, catastrophic losses caused by winterkill occurred again and the spring frost season was just about to begin. The value of the losses which were caused by both these occurrences is shown in Table 14 which includes the data relating to compensations paid from subsidised crop insurance policies. What is important is that the data in question is considerably undervalued in comparison with the actual amount of loss in agriculture caused by spring frost. First of all, the data almost exclusively refers to losses of crops, and in the years 2011 and 2012 fewer than 25 percent of crops were insured, including as few as 20 percent of crops being insured against the risks of spring frost and winterkill [justification of the change in the 2014 Act: 9–10]. Secondly, the most vulnerable vegetables and fruits are hardly ever insured as subsidised products (due to exceeding the amount which makes them eligible for obtaining the state subsidy for insurance premium) [justification of the change in the 2014 Act: 2–3, 6], whilst losses in horticulture and fruit farming caused by spring frost were as high as 80 percent in comparison with the long-term mean [Doroszewski et al. 2013: 278].

This sequence of events can explain the strong correlation between the amount of loss caused by winterkill and its effect on income from farming and spring frost perception, as both events were at a similar time, both were connected with freezing weather and both resulted in huge losses for farmers. Additionally this frequency of frost-related occurrences and the scope of loss they had caused could result in overestimating spring frost risk perception. These presumptions are corroborated by other study findings, according to which negative experiences exacerbate the given risk perception [i.a. Riad, Norris, and Ruback 1999; Norris, Smith, and Kaniasty 1999; Keller, Siegrist, and Gutscher 2006 and the literature cited there]. It might be possible that this is the very reason why the model was not exactly suited to people who rated spring frost as highly dangerous.

Assuming this one has to point at the effects of the so-called hedonic adaptation [Fredrick and Loewenstein 1999], which appears in response to unfavourable circumstances. Research carried out by Burns, Peters, and Slovic

Table 14. Compensation paid from subsidised crop insurance in the years 2008–2012 (in PLN)

	2008	2009	2010	2011	2012
Drought	157 832 109	1 357 150	604 312	2 313 371	116 227
Flood	304 347	1 567 676	4 362 625	1 894 610	1 081 410
Winterkill	898 860	2 268 298	31 487 705	160 644 322	587 776 226
Spring Frost	2 910 069	32 922 210	8 049 651	137 249 546	7 386 628
Hail and others	31 445 204	82 688 525	53 144 004	59 736 981	122 345 441
Total	193 390 589	120 803 859	97 648 297	361 838 830	718 705 932

Source: Justification of the change in the 2014 Act: 9.

indicates that after the initial growth in perception of a given risk as dangerous, its negative evaluation decreases with time and becomes relatively stable [Burns, Peters, and Slovic 2012]. Without panel data, however, it is hard to state whether this situation took place with regard to spring frost within the studied period. Judging by the short period of time which elapsed between the occurrences and the survey, it seems highly doubtful.

By comparing the hit ratios in models 1 and 2 one can state that in order to identify a given farmer's propensity for a particular spring frost perception, knowledge about his/her prior experience is indispensable. This causes difficulty in the application of model 2 by insurance companies with reference to new customers if their damage record is unknown.

The analyses carried out also indicate that spring frost perception primarily depends on a farmer's experience in terms of most natural perils as well as others (price-related in particular). Any kind of loss, regardless of its cause, is conducive to ranking spring frost risk as more dangerous. Simultaneously the assessment is not contingent on the level of loss in crops, which may either be perceived as normal or may lead to farm's bankruptcy.

Identifying a farmer's perception of sources of risk enables adjustment of the products offered and their prices as well as cost cutting in marketing and distribution. From a product analysist' s point of view it is very useful to answer two questions concerning insurance cover – the range of the perils covered and the level of integral franchise. As has been demonstrated spring frost perception is not reliant on an acceptable or catastrophic level of loss – and vice versa. Perception of spring frost as dangerous is, on the other hand, correlated with a similar perception of winterkill and to a slightly smaller extent, hail and hurricanes. This means that one of the products offered at present, which involves a 10 percent level of integral franchise and a package covering perils such as spring frost, winterkill, hail or hurricane can be viewed as an appropriate market solution.

Moreover, there is a correlation, albeit a weak one, between the respondents' perception of spring frost risk and the fact that they were insured against it. Therefore there are by no means any grounds on which H1 could be rejected. It has to be emphasised that this poor correlation is quite likely to result from a generally low level of crop insurance, as only 30 percent of the farmers had any crop insurance [Kaczała and Wiśniewska 2015: 104]. In years 2008–2013 the average losses in insured crops caused by spring frost ranged from 40 to 1964 PLN, as far as subsidized insurance is concerned. In 2014 the premium rates for this insurance, for a single risk of spring frost, ranged from 0,5% to 10% depending on the type of crop. Unfortunately the available data does not allow to calculate the average loss per hectare and to compare it with hypothetical cost of insurance, therefore an assessment of rationality of choices made by growers with regards to purchase of insurance is not possible.

References

Act of 7 July 2005 on livestock and crop insurance subsidies, Journal of Laws, no. 150, item 1249, incl. subsequent amendments.

Act of 7 March 2007 on changing the act on crop and livestock insurance subsidies and some other acts, Journal of Laws, no. 49, item 328.

Act of 25 July 2008 on altering the crop and livestock insurance act and the national producers' register, national farms register and subsidy applications register, Journal of Laws, no. 145, item 918.

Assefa, T.T., Meuwissen, M.P.M., Oude Lansink, A.G.J.M., 2014, *Price Volatility Perceptions and Management Strategies in European Food Supply Chains*, Working paper Ulysses, http://www.fp7ulysses.eu/publications/ULYSSES%20Scientific%20Paper%206_Price%20volatilty%20peceptions%20and%20management%20strategies%20in%20European%20food%20supply%20chains.pdf.

Beal, D.J., 1996, *Emerging Issues in Risk Management in Farm Firms*, Review of Marketing and Agricultural Economics, no. 64 (3): 336–347.

Boholm, Å., 2003, *The Cultural Nature of Risk: Can There Be an Anthropology of Uncertainty?*, Ethnos: Journal of Anthropology, no. 68(2): 159–178.

Burns, W.J., Peters, E., Slovic, P., 2012, *Risk Perception and the Economic Crisis: A Longitudinal Study of the Trajectory of Perceived Risk*, Risk Analysis, no. 32 (4): 659–677.

Chiotti, Q., Johnston, T., Smit, B., Ebel, B., 1997, *Agricultural Response to Climate Change: A Preliminary Investigation of Farm-level Adaptation in Southern Alberta*, in: Ilbery, B., Chiotti, Q., Rickard, T. (eds.), *Agricultural Restructuring and Sustainability: A Geographical Perspective*, CAB International, Wallingford, UK: 167–183.

Chromow, S.P., 1977, *Meteorologia i Klimatologia* [Meteorology and Climatology], PWN, Warszawa.

Coble, K.H., Knight, T.O., Patrick, G.F., Baquet A.E., 1999, *Crop Producer Risk Management Survey: A Preliminary Summary of Selected Data*, Agricultural Economics Information Report 99–001, Department of Agricultural Economics, Mississippi State University.

Dessai, S., Adger, W.N., Hulme, M., Turnpenny, J., Köhler, J., Warren, R., 2004, *Defining and Experiencing Dangerous Climate Change,* Climatic Change, no. 64: 11–25.

Doroszewski, A., Wróblewska, E., Jóźwicki, T., Mizak, K., 2013, *Ocena szkód w roślinach sadowniczych i ogrodniczych spowodowanych przez przymrozki w maju 2011 roku* [Damage assessment in fruit farming and horticulture caused by spring frost in May 2011], Acta Agrophysica, no. 20(2): 269–281.

Dudek, S., Żarski, J., Kuśmierek-Tomaszewska, R., 2012, *Tendencje zmian występowania przymrozków przygruntowych w rejonie Bydgoszczy* [Trends in the occurrence of ground frosts in the region of Bydgoszcz], Woda-Środowisko-Obszary Wiejskie, vol. 12, no. 2 (38): 93–106.

Eakin, H., 2006, *Weathering Risk in Rural Mexico: Climatic, Institutional, and Economic Change*, University of Arizona Press, Tucson.

Fischoff, B., Slovic, P., Lichtenstein, S., Read, S., Combs, B., 2000, *How Safe Is Safe Enough? A Psychometric Study of Attitudes toward Technological Risks and Benefits*, in: Slovic, P. (ed.)., *The Perception of Risk*, Earthscan, London: 80–104.

Fraser-Mackenzie, P., Sung, MCH., Johnson. J.E.V., 2014, *Toward an Understanding of the Influence of Cultural Background and Domain Experience on the Effects of Risk-Pricing Formats on Risk Perception*, Risk Analysis, vol. 34, no. 10: 1846–1869.

Fredrick, S., Loewenstein, G., 1999, *Hedonic Adaptation*, in: Kahneman, D., Diener, E., Schwarz, N. (eds.), *Well-being: The Foundations of a Hedonic Psychology*, Russell Sage Foundation, New York: 302–329.

Grabowski, J., 2010, *The Occurrence of Ground Frost in the Mazurskie Lakeland between the Years 1966 and 2005*, Acta Agrophysica, no. 185, Rozprawy i Monografie (6): 99–110.

GUS, *Statistical Yearbook of Agriculture 2013*, http://stat.gov.pl/en/topics/statistical-yearbooks/statistical-yearbooks/statistical-yearbook-of-agriculture-2013,6,8.html [access: 10.02.2015].

Harwood, J., Heifner, R., Coble, K., Perry, J., Somwaru, A., 1999, *Managing Risk in Farming: Concepts, Research, and Analysis*, Agricultural Economics Report, no. 774. U.S. Department of Agriculture, Washington.

IMGW 2013, *Niebezpieczne zjawiska meteorologiczne – geneza, skutki, częstość występowania* [Dangerous meteorological phenomena – their origin, effects and frequency of occurrence], p. 1, wiosna, lato, Warszawa.

Justification of the bill on changing the act on crop and livestock insurance subsidies, 2014, http://legislacja.rcl.gov.pl/lista/2/projekt/56568/katalog/56606 [access: 30.09.2014].

Kaczała, M., Wiśniewska, D., 2015, *Risks in the Farms in Poland and Their Financing – Research Findings*, Research Papers of Wrocław University of Economics (Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu), iss. 381, www.ceeol.com.

Kalbarczyk, R., 2010, *Spatial and Temporal Variability of the Occurrence of Ground Frost in Poland and Its Effect on Growth, Development and Yield of Pickling Cucumber (Cucumis Sativus L.)*, 1966–2005, Acta Sci. Pol., Hortorum Cultus, no 9 (3): 3–26.

Keller, C., Siegrist, M., Gutscher, H., 2006, *The Role of the Affect and Availability Heuristics in Risk Communication*, Risk Anal., vol. 26, no. 3: 631–639.

Klimkowski, C., 2002, *Istota, skutki i zarządzanie ryzykiem katastroficznym w rolnictwie polskim* [The nature, effects and management of catastrophic risk in agriculture in Poland], Inst. Ekonomiki Rolnictwa i Gospodarki Żywnościowej, Warszawa.

Koźmiński, C., Michalska, B., 2001, *Atlas klimatycznego ryzyka uprawy roślin w Polsce*, [Atlas of climatic risk to crop cultivation in Poland], Akademia Rolnicza w Szczecinie, Uniwersytet Szczeciński, Szczecin.

Kundzewicz, Z., 2012, *Zmiany klimatu, ich przyczyny i skutki – możliwości przeciwdziałania i adaptacji* [Climate changes, their causes and effects – potential precautions and adaptation possibilities], Studia BAS, no. 1 (29): 9–30.

Meuwissen, M., Huirne, R., Hardaker, B.,1999, *Perceptions of Risk and Risk Management Strategies: An Analysis of Dutch Livestock Farmers*, American Journal of Agricultural Economics, no. 81: 1284–1285.

Norris, F.H., Smith, T., Kaniasty, K., 1999, *Revisiting the Experience-behavior Hypothesis: The Effects of Hurricane Hugo on Hazard Preparedness and Other Self-protective Acts*, Basic Appl. Soc. Psychol., no. 21(1): 37–47.

Ogurtsov, V.A., van Asseldonk, M.A.P.M., Huirne, R.B.M., 2009, *Purchase of Catastrophe Insurance by Dutch Dairy and Arable Farmers*, Appl. Econ. Perspect. Pol., no. 31 (1): 143–162.

Oltedal, S., Moen, B.E., Klempe, H., Rundmo, T., 2004, *Explaining Risk Perception. An Evaluation of Cultural Theory*, Rotunde publikasjoner Rotunde, no. 85.

Peacock, W.G., Brody, S.D., Highfield, W., 2005, *Hurricane Risk Perceptions among Florida's Single Family Homeowners*, Landscape Urban Plann., no. 73 (2–3): 120–135.

Riad, J.K., Norris, F.H., Ruback, R.B., 1999, *Predicting Evacuation in Two Major Disasters: Risk Perception, Social Influence and Access to Resources*, J. Appl. Soc. Psychol., no. 29 (5): 918–934.

Sherrick, B.J., Barry, P.J., Ellinger, P.N., Schnitkey, G.D., 2004, *Factors Influencing Farmers' Crop Insurance Decisions*, Am. J. Agr. Econ., no. 86 (1): 103–114.

Sjöberg, L., Moen, B.E., Rundmo, T., 2004, *Explaining Risk Perception. An Evaluation of the Psychometric Paradigm in Risk Perception Research*, Rotunde publikasjoner Rotunde, no. 84.

Slovic, P., Flynn, J.H., Layman, M., 1991, *Perceived Risk, Trust, and the Politics of Nuclear Waste*, Science, no. 254: 1603–1607.

Tucker, C.M., Eakin, H., Castellanos, E.J., 2010, *Perceptions of Risk and Adaptation: Coffee Producers, Market Shocks, and Extreme Weather in Central America and Mexico*, Global Envi-ronmental Change-Human and Policy Dimensions, no. 20 (1): 23–32.

Tucker, C.M., Eakin, H., Castellanos, E.J., 2010, *Perceptions of Risk and Adaptation: Coffee Producers, Market Shocks, and Extreme Weather in Central America and Mexico*, Global Envi-ronmental Change-Human and Policy Dimensions, no. 20 (1): 23–32.

Wiśniewska, D., 2012, *Analiza dyskryminacyjna w prognozowaniu zmian cen akcji. Nowa koncepcja konstruowania prognoz jakościowych*, Wydawnictwo Uniwersytetu Ekonomicznego w Poznaniu, Poznań.

Aims and Scope

Economics and Business Review is the successor to the Poznań University of Economics Review which was published by the Poznań University of Economics Press in 2001–2014. The Economics and Business Review is a quarterly journal focusing on theoretical and applied research work in the fields of economics, management and finance. The Review welcomes the submission of articles for publication dealing with micro, mezzo and macro issues. All texts are double-blind assessed by independent reviewers prior to acceptance.

Notes for Contributors

1. Articles submitted for publication in the Economics and Business Review should contain original, unpublished work not submitted for publication elsewhere.
2. Manuscripts intended for publication should be written in English and edited in Word and sent to: review@ue.poznan.pl. Authors should upload two versions of their manuscript. One should be a complete text, while in the second all document information identifying the author(s) should be removed from files to allow them to be sent to anonymous referees.
3. The manuscripts are to be typewritten in 12' font in A4 paper format and be left-aligned. Pages should be numbered.
4. The papers submitted should have an abstract of not more than 100 words, keywords and the Journal of Economic Literature classification code.
5. Acknowledgements and references to grants, affiliation, postal and e-mail addresses, etc. should appear as a separate footnote to the author's name[a, b, etc] and should not be included in the main list of footnotes.
6. Footnotes should be listed consecutively throughout the text in Arabic numerals. Cross-references should refer to particular section numbers: e.g.: See Section 1.4.
7. Quoted texts of more than 40 words should be separated from the main body by a four-spaced indentation of the margin as a block.
8. Mathematical notations should meet the following guidelines:
   - symbols representing variables should be italicized,
   - avoid symbols above letters and use acceptable alternatives (Y*) where possible,
   - where mathematical formulae are set out and numbered these numbers should be placed against the right margin as... (1),
   - before submitting the final manuscript, check the layout of all mathematical formulae carefully (including alignments, centring length of fraction lines and type, size and closure of brackets, etc.),
   - where it would assist referees authors should provide supplementary mathematical notes on the derivation of equations.
9. References in the text should be indicated by the author's name, date of publication and the page number where appropriate, e.g. Acemoglu and Robinson [2012], Hicks [1965a, 1965b]. References should be listed at the end of the article in the style of the following examples:

   Acemoglu, D., Robinson, J.A., 2012, *Why Nations Fail. The Origins of Power, Prosperity and Poverty*, Profile Books, London.

   Kalecki, M., 1943, *Political Aspects of Full Employment*, The Political Quarterly, vol. XIV, no. 4: 322–331.

   Simon, H.A., 1976, *From Substantive to Procedural Rationality*, in: Latsis, S.J. (ed.), *Method and Appraisal in Economics*, Cambridge University Press, Cambridge: 15–30.
10. Copyrights will be established in the name of the E&BR publisher, namely the Poznań University of Economics Press.

More information and advice on the suitability and formats of manuscripts can be obtained from:

Economics and Business Review
al. Niepodległości 10
61-875 Poznań
Poland
e-mail: review@ue.poznan.pl
www.puereview.ue.poznan.pl

Subscription

Economics and Business Review (E&BR) is published quarterly and is the successor to the Poznań University of Economics Review. The E&BR is published by the Poznań University of Economics Press.

E&BR is listed in ProQuest, EBSCO, and BazEkon.

Subscription rates for the print version of the E&BR: institutions: 1 year – €50.00; individuals: 1 year – €25.00. Single copies: institutions – €15.00; individuals – €10.00. The E&BR on-line edition is free of charge.

Correspondence with regard to subscriptions should be addressed to: Księgarnia Uniwersytetu Ekonomicznego w Poznaniu, ul. Powstańców Wielkopolskich 16, 61-895 Poznań, Poland, fax: +48 61 8543147; e-mail: info@ksiegarnia-ue.pl.

Payments for subscriptions or single copies should be made in Euros to Księgarnia Uniwersytetu Ekonomicznego w Poznaniu by bank transfer to account No.: 96 1090 1476 0000 0000 4703 1245.