Risks Perceptions and Risk Management Instruments in the European Union: do farmers have a clear idea of what they need?

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Abstract— **This paper explores and analyzes farmers' risk perceptions, risk management instruments' demand and usage in five Member States (Hungary, Spain, the Netherlands, Germany and Poland). A survey completed by 1047 representative farmers of these EU Member Status collected information that allowed us to set apart two focus areas: the first looks at the declared importance of several sources of farms' risk and income instability, and at the actual means that farmers pursue to manage and face them. The second area focuses on the demand for risk management instruments.**

The paper's objective is to determine the factors that explain farmers' responses in the first area, and based on those factors, analyse the demands for two instruments (insurance, and future & option markets). After carrying out basic descriptive statistic analyses, we perform factor analysis in order to establish the linkages between the perceptions and ranking of risks with the declared strategies to manage them. Logit models were fit to determine potential demand of insurance, and futures & options based on the three factors, and other variables like activity types and other controls, like nationality. Results from the factor analysis show that the perception of risk and actual use of risk management are very diverse. Logit models show that insurance is clearly an alternative instrument to diversification, but its demand is poorly explained by the other factors. Furthermore the demand for the use of futures and options is explained by the three factors, with the volatility factor, positively linked; market access /contractual risks; and diversification, negatively linked. In conclusion, policy makers should proceed with caution selecting the most adequate risk management instruments for farmers. It appears that the expected demand of risk management tools does not fit perfectly with the stated perception of risks.

Keywords— **risk, risk management, farmer's perception.**

I. INTRODUCTION

Agricultural risk is a phenomenon that is becoming increasingly important as a result of agricultural trade liberalization and the dismantling of traditional means of income support (Boehlje & Lins, 1998; European Commission, 2005). Agricultural production is long characterised by uncertain prospects and serious difficulties to estimate the probability of unfavourable events (Kostov & Lingard, 2003). It is thus considered as one of the most vulnerable sectors of the economy. Some of the agriculture-specific risks have always been identified in the field of production, marketing and finance (Boehlje & Eidman, 1994).

On the other hand, it is known that different risk management strategies have diverse and concrete effects on farms and livestock (Hardaker et al., 2002). This suggests that none of these strategies can provide a comprehensive protection to cover all the factors of risk in agriculture and livestock production (Patrick, 1998; Hardaker et al., 1997). The specificity of risks suggests that in fact it is better to couple sources of risks and most efficient instruments.

Some studies, such as that of Wilson (1993), have pointed out the complex nature and idiosyncrasy that characterizes both the perception of risk and the evaluation process to determine the adequacy of the mix of instruments. The same thing applies to the demand for tools and policies that help risk management. Musser (1997) concludes that the geographic location and the environment have an influence on the perception of risk and risk management carried out by farmers. Hence there is an interest in establishing relations, on the one hand, between perception and risk management and, on the other hand, between demand of tools and risk management policies. In Table 1, we summarize the findings of the various studies that looked at the main risks perceived by farmers of several countries.

Table 1 Ratings of importance of farmers' risks perceptions and concerns (1 ranked first in importance; NA= Not addressed)

Source	Musser & Patrick (2002)	Meuwissen *et al.* (2001)	Akcaoz and Ozkan (2005)	ENESA 2004	ENESA 2004	Flaten *et al*. (2006)
Type of survey	28 farmers in 4 US Sates (1999)	612 Dutch livestock farmers	112 Turkish farmers (Cukurov region)	1,564 Spanish farmers	290 Spanish cattle farmers	525 convent and organ dairy farmers
Agricultural Policy	5	16	1	NA	NA	1-6 (tax)-9 14 (other)
Environmental Policy	9	07-Oct	NA	NA	NA	3 -12 (organ) 5 17 (anim welf)
Price risks	1	1 (meat) 3(milk)	4	2	2	2 (milk) 4 (cons pref) 7 (org price) 10 (meat) 16 (crops)
Climatic risks	NA	NA	08-Nov	1	NA	
Normal yield reduction	2	NA	Dec-13	3	NA	Aug-15
Animal disease non epidemic	NA	15 -17	NA	NA	1	NA
Animal epidemic	NA	2	NA	NA	3	13 (non-dom) 18 (domest)
Contractual risks	3	NA	20	NA	NA	11 (mkt/sale)
Input costs	7	14	3	NA	NA	NA
Capital inputs	4	Dec-18	21	NA	NA	NA
Tehcnical/ technological	6	5	10	NA	NA	NA
Debts/interest rates	NA	13-19	05-Jul	NA	NA	NA
Economic situation	NA	NA	2	NA	NA	NA
Personal risks	8	4-6-8-9	14-18	NA	NA	May-19

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II. DESCRIPTION ON THE SURVEY

This research is based on parts of the survey completed by a total of 1,047 farmers of Spain (with 200 interviewed farmers), Hungary (204), Germany (201), the Netherlands (236) and Poland (206). The questionnaire was handed out in the official language of each country, which was translated from a unique English version. Strata applied in the sampling plan for each country were economic size of the holdings and their type of agricultural activity, both sampling

criterions based on farm typologies included in FADN (European Commission).

management developing links between risk perceptions, present use and demand of risk management instruments.

The questionnaire was divided into seven chapters related to risk, the instrumental part and the institutional part. Specifically, the data for the development of this research have been taken from its second chapter that deals with *knowledge of risk and risk management.*

III METHODOLOGY

We begin with developing a descriptive analysis in order to offer a broader view of the different aspects of the study. Particularly this analysis has helped to expand our knowledge about the perception of farmers with respect to risk in relation to different risk sources, including climatic hazards, institutional risks and market volatility.

With the aim of carrying out an analysis that jointly looks at risk perception and instruments' use, we performed a factor analysis. For the factor analysis, we assumed that Standard parametric statistical procedures are appropriate for dummy variables and variables in the form of Likert type scales. Common factor analysis, from an exploratory perspective, was employed to summarize the information in a reduced number of factors. The latent root criterion (Eigen value > 1) was first used as a guideline for

, which can alter the perception that farmers have on some aspects that adversely affect agriculture and livestock. Table 2 reports a summary of the

This evaluation is based on a *Likert type* scale expanded from 5 to 7 options where the value "1" means "no effect" on production and the value "7" a "high effect". Other equivalent scales have been used in articles relating to agricultural risk perception (Flaten et al., 2004) and other similar *Likert type* not expanded scales or with only five choices (Patrick & Musser, 1997; Meuwissen, Huirne & Hardaker, 2001).

The results clearly show that such aspects as climate and natural disasters are considered as having high

The main objectives of the questionnaire are to explore and analyze the perception of farmers towards to risk and risk

determining how many factors to extract. In order to have the most representative and parsimonious set of factors possible, factor solutions with different numbers of factors were also examined before structures were defined (Hair *et al.*, 1998) The tool used for the realization of this factor analysis is the *principal factors* procedure.

Once the principal factors have been identified and discussed, our focus is placed on the demand for instruments. For this purpose we have run three *logit* models, whose dependent variable is the response of the interviewed farmers about their interest to use three types of instruments, namely, insurance, livestock insurance and futures and option contracts. This approach allows us for comparing the demand among the instruments and policies based on the factors that summarize the perceptions of risk and actual use of risk management instruments.

IV RESULTS AND DISCUSSION

A. Sources of risk perception

Work done by Bogges et al. (1985) and Wilson et al. (1993) argue that there are factors such as geographical location, type of production and institutional environment

assessment made by the farmers in the five European countries, including eight major aspects considered to be at risk for production.

impact on production, and therefore are a major concern for the interviewed farmers. This is manifested by the fact that 46% of the interviewed farmers attributes to weather risk a "7" on the scale. This finding is confirmed by Wilhite (2005), who argues that the high perception of weather risk is mainly due to this factor depends on many variables, having to do with the uncertainty component. It also confirms the studies reported on Table 1.

Table 2 Knowledge of risk the percentage distribution of respondents over categories

Factor / Effect	*1 No effect (%)*	*2 (%)*	*3 (%)*	*4 Moderate effects (%)*	*5 (%)*	*6 (%)*	*7 Large effects (%)*	*Total %*	*Std. Dev*
Weather and natural disasters	2.16	3.04	3.04	12.84	12.06	20.98	45.88	100	1.53
Volatility of prices	1.48	2.08	3.85	20.36	19.07	20.75	32.41	100	1.44
Difficulties in selling farm products	9.32	9.83	9.03	22.97	15.95	15.25	17.65	100	1.87
Input market	23.04	14.86	14.14	23.36	10.25	8.3	6.05	100	1.82
Debt	29.83	12.36	8.17	21.55	9.4	8.38	10.31	100	2.04
Political measures	9.72	9.22	11.02	23.55	16.33	14.63	15.53	100	1.82
Technological processes	11.84	9.29	11.84	31.63	17.24	9.08	9.08	100	1.84
Animal disease	20.76	5.78	6.57	14.59	9.72	14.72	27.86	100	2.28

Climate and natural disasters are not the only aspects that received the highest ratings. Thus, a large proportion of the surveyed sample considered that the volatility in prices has a large effect on their business, with over 37 % of respondents giving it a "7". This aspect is important on a liberalization context of agricultural markets, as a result of which grater price volatility is a likely scenario (Morales, 2007). Meuwissen, Huirne & Hardaker (2001) found important and different points of view and disagreements between the volatility of prices and the farmer's perception of its risk.

Some other aspects, like technological processes, show a moderate importance in terms of farmers' perceptions, and its effect on agriculture has been classified as "medium effect". These results are in contradiction with other authors, like Kwanon & Chavas (2003) who consider technology as a risk reduction factor for productive systems.

With regard to the aspects that are related to the operation of markets, the survey shows that its effect on farmers' activity is not considered severe, and received a low rating. An example is the marketing contracts, whose evaluation contrasts with the risk decrease levels that some commercial public companies offer to national farmers. This is the case of the Australian CBOT (Alizadeh & Nomikos, 2005).

B. Risk Management

Findings on the usage of risk management tools, conform to what other researches have added to this issue, as the one did by Akcaoz & Ozkan (2005). We analyzed both crop and livestock. First, data on agricultural insurance show that this tool is used by only a 38 percent of the interviewed, well in line with what is expected as other documents have also reported (OECD, 2002). On the other hand, only a 25 percent of the farmers in the countries of study have contracted livestock insurance. A review of the current usage of livestock insurance can be found in European publications (European Commission, 2006).

Another main aspect of the analysis is the usage of futures and options contracts. With regard to these tools, and in spite of their documented advantages (Williams, 2001; and Meulenberg & Pennings, 2002), these are used only by 2.33 percent of farmers. Holding financial reserves is a strategy followed by 64 percent of the interviewed individuals. It is interesting to note that some strategies for reducing risk as production diversification is pursued also by growers contracting crop and livestock insurance but by only 22 percent of participants.

With the idea to develop a joint approach, we pooled together risk management and the perception of risk, as a way to have a clearer outlook about risk planning and management. This approach is thus considered as illustrative for the potential demand of

alternative instruments enabled by different risk management policies. To achieve this task, we used an analysis based on *principal factors* (Hair *et al*., 1995). The use of such statistical tool aims to reduce the number of original indicators to generate a smaller number of dimensions that also reflects the perception of risk, as its management through a variety of policies and management tools. Applying this method has important advantages, including a more efficient management of data (Comrey, 1985).

It is pertinent to mention that because of multicollinearity problems (Gifi, 1990), not all the perception and management variables that were available could be used in the factor analysis. Only 20 variables were used in the calculation and the *principal factors* identification. These variables pick up risk perceptions with respect to climate, volatility of prices, policies, the sale difficulties, and other variables related to risk management, such as crop and livestock production, insurance, futures and options markets, and financial reserves. Upon carrying out standard checks, we identified a beginning list of 10 *principal factors*.

Further, in order to get a correct interpretation of each of the factors, we proceeded with its rotation through a normal *varimax* rotation. Such rotation brings a greater clarity on data that allows for a better interpretation. From this point and following researchers like Basille *et al*. (2008), we selected the first three factors which, in this case, have an *eigenvalue* greater than 0.5, and a proportion greater than 15 percent.

The first factor is always the widest and explains the largest percentage of variance (78%, with an eigenvalue of 1.9). Table 3 contains the matrix of factors and the variables that were considered in the factor analysis. It displays the variance of each variable that is explained by each factor. Considering the variables whose loading is greater than 0.40, it is clear that the first factor represents various components, including debt, difficulties in sale, input markets, farm programs and technological processes. This factor is thus associated to 'access to markets'.

The second factor explains a very low percentage of the variance in comparison with the first one, including only 24 per cent. There are two variables that take relevancy in this factor, namely, volatility of prices, and marketing difficulties. Finally, the third factor is clearly connected to diversification and off-farm income, and explains only 21 percent of the variance.

C. Demand of Instruments and Risk Management Policy

We now discuss the logit models, in which the dependent variables are the stated willingness to use three specific instruments, namely, crop insurance, livestock insurance and futures and options.

We assume a farmer I demands on of our three instruments if:

$$\Pr(Y_i = 1 \mid X \ , Z) = \Pr(\alpha Z + \beta X \ + \varepsilon_t > 0) \qquad (1)$$

Where X are idiosyncratic variables, and Z those that capture more general factors. In our case, X are our three factors and the farm type. This allows us to distinguish whether the respondent's farm is a crop, livestock or mixed crop-livestock farm. Z picks up the effect of the respondent's state, with four dummy variables (Poland, The Netherlands, Spain and Germany; Hungary's effect being captured in the intercept).

Table 4 reports the three logit results. The models' goodness of fit results are reasonably good based on the McFadden R2 (0.25 being the minimum), Sensitivity (correct classifications of real 1s) and Specificity (correct classification of real 0s). The results show that f1 (market access) and f2 (volatility of prices) are not significant in the three models. This last result is especially striking in the last of the three equations which tests the demand for futures and options.

Perhaps the most significant finding is the fact that f3 (diversification) is significant across equations and negative. This indicates that diversified farmers are those in lesser need to contract insurance and less interested to hedge with futures and options.

Akcaoz & Ozkan (2005) verify this result by linking diversification with other aspects such as non-agricultural insurances and markets security or placing insurances away from this factor. It might not be surprising that the resulting R^2 from the logit models with the livestock insurance demand variable does not reach very high values (0.74). The resulting coefficient is -0.76, the sensitivity over 80 per cent and the specificity higher than 94 per cent.

These data clearly reveal the opposition between Factor 3 and the livestock insurance

Table 3 Rotated factor loadings (pattern matrix) and unique variances

Variable	*Factor 1*	*Factor 2*	*Factor 3*	*Factor 4*	*Factor 5*	*Factor 6*	*Factor 7*	*Factor 8*	*Factor 9*
Weather and natural disasters	0.1048	0.3332	-0.035	-0.0425	-0.1749	0.0378	-0.045	-0.0794	0.057
Volatility of prices	0.2104	0.5092	-0.0427	-0.0575	-0.0137	-0.0861	-0.0209	-0.0001	0.0152
Debt	0.5315	0.0915	-0.0733	0.0199	0.2662	-0.0809	-0.0886	-0.0232	0.0146
Difficulties in selling farm products	0.4167	0.5415	0.0834	0.0858	0.0602	0.0539	0.0139	0.0222	-0.0191
Input market	0.6267	0.1945	0.1245	0.0281	-0.0735	0.0568	0.0499	0.011	-0.0417
Political measures	0.4892	0.0944	0.074	-0.0459	0.0388	-0.2953	0.0488	-0.0165	0.0266
Technological processes	0.6153	0.063	-0.0618	-0.0403	-0.0754	-0.0149	-0.0033	-0.0085	0.0284
Crop insurance	-0.1016	0.013	-0.2221	0.1258	0.0497	0.274	-0.0337	-0.0131	0.0035
Livestock insurance	-0.2718	0.2127	0.4488	-0.1456	-0.0833	0.2212	0.0169	0.0382	0.0711
Diversification	0.0788	0.0267	0.533	0.13	0.1562	-0.0197	-0.0954	0.006	-0.0217
Marketing contracts	-0.0046	0.0663	0.0215	0.3834	0.1036	0.0185	0.0448	-0.0052	-0.0031
Production contracts	-0.0274	0.0044	0.0719	0.2608	-0.0938	0.1108	0.0057	0.1041	-0.0025
Property insurance	0.0941	-0.0413	0.0652	0.1466	-0.0359	-0.0826	0.2683	-0.0064	-0.0015
Off farm investment	0.0647	0.0294	0.047	-0.0406	-0.0521	-0.0416	0.0992	0.003	0.0105
Vertical integration	-0.1676	0.1744	0.2192	0.0139	0.2069	-0.0768	-0.0638	0.1237	0.0112
Futures and options	0.0254	0.0647	0.0358	0.092	0.1028	0.0733	-0.0056	0.184	-0.0009
Financial reserves	0.0072	-0.0165	0.1593	0.1205	0.3149	0.0404	0.0198	0.0158	-0.0096

Table 5.Principal logit models of demand variables

	Insurance		*Livestock Insurance*		*Futures and Options*	
	Coeficients	*Std. Err*	*Coeficients*	*Std. Err*	*Coeficients*	*Std. Err*
F1 (market access)	(-) 0.1015**	0.117	(-) 0.407**	0.522	0.206	0.179
F2 (volatility of prices)	0.148	0.139	0.558	0.579	0.017	0.194
F3 (diversification)	(-) 1.86**	0.180	(-) 0.764**	1.400	(-) 0.446**	0.188
Crop productions	0.016**	0.474			(-) 0.703**	0.610
Livestock production	(-) 0.092**	0.474	2.937	3.031	(-) 1.310**	0.617
Crop + livestock	(-) 0.068	0.509	(-) 0.923*	1.480	1.295**	0.669
Poland	1.681**	0,294	1.567	1.208		
Netherlans	0.436**	0,326	(-) 1.884**	1.885	(-) 3.082**	0,415
Spain	0.951	0,322	1.683	1.856	(-) 3.082**	0,415
Germany	0.128**	0,320	(-) 8.101**	3.470	(-) 3.504	0.511
Sensitivity Pr(+I D)		0.453		88,89%		0.642
Specificty Pr (-I-D)		0.945		96,50%		0.904
Positive Predictive Value		0.773		85,11%		0.612
Negative Predictive Value		0.808		97,47%		0.915
R2 Mc Fadden´s		0.257		0,744		0,365
Number of obs		906		245		734

Naturally coded; country 1 (Hungary) omitted
p < 0.01 *
p > 0.05 **
Livestock insurance out model crop productions

The coefficients of the countries' dummies do also convey messages about instruments' demands. In the first model (crop insurance demand) Poland's and Germany's are significant and positive; Hungary's, captured in the intercept, is negative and significant; but The Netherlands'' and Spain's are not significant. In the second model (livestock) results are similar, but Spain's is positive and significant. In the third equation, all dummies

A striking result coming out of the countries' dummies is the fact that Spanish respondents do not demand crop insurance. This may be due to the fact that most farmers purchase insurance or know they can do it, which in fact they presently can do for all crops and low coverage.

The factors Hungary and Poland do not offer similar results or interpretations. There is not an 'Eastern European Membership' factor that sets these farmers apart from old Member States.

V CONCLUSIONS

This paper looks at the relation between risk perceptions, and at the actual usage and demand of risk management instruments. We survey data collected from 1047 EU farmers from Germany, Hungary, the Netherlands, Poland and Spain.

In general, aspects like climate and natural disasters received the highest concern among all surveyed farmers. Price volatility and animal diseases are thought to impose serious harm on productive activities. We also found that farmers are concerned with farm debt or marketing difficulties, but these were rated as of intermediate importance.

From the risk management point of view: future and option markets are rarely used and diversification is a good practice for risk management. On the other hand, managing risk with crop or livestock insurances is the main used instrument, but still keeping cash balances and using saving is the primary strategy to meet unexpected outcomes.

Our logit models showed that countries' differences are important as explanatory factors of farmers' potential demand for crop insurance, livestock insurance, and futures and options. We found that farm diversification is clearly a substitute to insurance, and futures and option markets.

In conclusion, policy makers should proceed with caution on the risk management policy that will be implemented, since the expected demand of risk management tools does not fit perfectly with stated perception of risks. Compounding the difficulties of finding instruments that match farmers' risk perceptions and demand, we found that alternative instruments are not perceived as complements, but as substitutes. We did not find major differences across Member States that could be explained by the fact of being old or new Member States.

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