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Crop insurance effects on the farms' production and investment indicators in Lithuania

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Abstract: The study aims at evaluating crop insurance effects on the farms' production and investment indicators in Lithuania. The Common Agricultural Policy after 2020 considers measures helping farmers to adapt to climate change. For this reason, it is essential to evaluate existing risk management measures in order to propose appropriate schemes for the next programming period. In order to evaluate crop insurance effects on the farms' production and investment indicators farm-level, data from Farm Accountancy Data Network dataset and propensity score matching approach was used. Study period was 2008–2017. The study revealed that participation in crop insurance schemes was influenced by the factors such as age of the farmer, wealth, specialization, and location of the farm. The study also demonstrated that crop insurance did not show statistically significant effects on the selected farms' indicators. The main reason was support from the national and EU funds.

Keywords: CAP, crop insurance, family farms, propensity score matching, sustainable agriculture

INTRODUCTION

Agricultural production is affected by many uncontrollable weather-related events, especially under changing climate conditions. Insurance is one of the measures that agricultural producers can use to cope with this type of risk. Nevertheless, many studies showed that agricultural producers, especially in the EU, rarely participate in agricultural insurance schemes. Reasons for such a situation are usually found on the demand side. For instance, Nurmet *et al.* [2016] found that Estonian farmers were not interested in crop insurance due to high insurance premiums and lack of trust in insurance companies. Kemény *et al.* [2012] reached the same conclusion for Hungarian farms. Lefebvre *et al.* [2014] revealed that Bulgarian farmers' interest in insurance was low, and it was dependent on farm size and location. Similarly, Enjolras and Sentis [2011] concluded that larger French farms were more likely to purchase insurance because it was too expensive for smaller ones. According to Santeramo *et al.* [2016], the demand for crop insurance in Italy was negatively correlated with crop diversification, which is itself a form of insurance, as various crops respond differently to extreme weather events. Also, Santeramo [2018] showed that successful experience in crop insurance was a catalyst for insurance participation. In addition to these reasons, Dragos and Mare [2014] also demonstrated that Romanian farmers did not participate in crop insurance due to lack of information from insurance companies.

When analysing effects of adoption of agricultural insurance, crop insurance may affect production and investment decisions of farmers through several channels. According to Aubert and Enjolras [2018] as well as Möhring *et al.* [2020], crop insurance influenced French and Swiss farmers' behaviour regarding pesticide use. Chang and Mishra [2012] concluded that crop insurance increased fertilizer and chemical expenses. Similarly, Regmi *et al.* [2019] found that insured Kansas farms purchased more fertilizer, pesticide, and seed than uninsured farms. Di Falco *et al.* [2014] showed that Italian farms using large quantities of inputs were more likely to adopt insurance schemes. These results can be explained by the fact that farmers investing more inputs in land have a greater incentive to participate in insurance schemes.

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As regards debt decisions, Ifft *et al.* [2015] revealed that crop insurance influenced short-term, but not long-term, debt use. This relationship may be driven by lenders' requirements to purchase crop insurance as well as the need to cover higher farm production expenses. However, availability of crop insurance may impact various management decisions, which can increase other sources of business risk. According to Ifft *et al.* [2013], higher debt use by farms with crop insurance can have both positive and negative impacts on the agricultural sector. On the one hand, higher debt levels can increase investment and add value to the agricultural sector. Conversely, too high farm debt use can lead to repayment problems.

Another important effect of participation in crop insurance is greater attractiveness of on-farm activities, which leads to an expansion of farms. Kim *et al.* [2020] found that crop insurance had a positive effect on survival of farms and reduced the likelihood of farms' asset reduction, i.e., disinvestment. Cai [2016] revealed that crop insurance increased Chinese farms' investment in production. Nevertheless, Burns and Prager [2018] concluded that crop insurance did not influence U.S. farmers' decisions to expand.

And lastly, participation in crop insurance tends to affect farms' profitability. However, according to Kirwan [2014], crop insurance had no effect on farms' profitability. Similarly, Zhao *et al.* [2016] observed that crop insurance did not contribute to the growth in Chinese farms' income. Also, Spörri *et al.* [2012] revealed that crop insurance had a negative impact on the economic performance of Hungarian farms.

The study aims to evaluate crop insurance effects on the farms' production and investment indicators in Lithuania. In order to reach the aim of this study three tasks were set: 1) to reveal the current situation of crop insurance in Lithuania; 2) to evaluate factors affecting crop insurance purchase decisions in Lithuania; 3) to determine effects of crop insurance on production and investment indicators of Lithuanian farms.

The article is organized as follows. Section 1 introduces a methodology, data used to evaluate effects of crop insurance in Lithuania. The results are discussed in Section 2, while Section 3 concludes the paper.

STUDY MATERIALS AND METHODS

The first step of using propensity score matching is to estimate each farmer's probability of being treated (in our case, the treatment is the purchase of crop insurance) [Aubert, Enjolras 2018]:

$$P(X_i) = P(I_i = 1|X_i) = E(I_I|X_i) = X_i\beta + \varepsilon_i \qquad (1)$$

where: $P(X_i)$ = the probability of receiving a treatment, X = the matrix of observable farmer personal and farm characteristics, β = the vector of estimated coefficients, I = 1 if the farm is insured and 0 otherwise, i = 1, …, n denotes farms from the sample, ε = the random error.

Based on the literature review and authors' assumptions, we selected the following variables suggested as factors affecting farmers participation in crop insurance: age of the farmer (in years), farm assets (in EUR), farm labour (in Annual Work Unit – AWU), utilized agricultural area (in hectares), share of crop output in total output (in percent), income from other sources (in EUR), a dummy variable for participation in investment measures, a dummy variable for participation in organic farming, and a dummy variable for location in less favoured areas.

No multicollinearity was detected among these variables. Therefore, all the selected variables were used for further analysis. The propensity to purchase crop insurance was estimated using logistic regression.

The nearest neighbour matching technique was used in order to pair treated and non-treated units. The main feature of this technique is that it selects for each treated unit a non-treated unit according to the shortest distance between their propensity scores.

We considered a spectrum of effects by using four different indicators: specific crop costs (in EUR), crop output (in EUR), net investment (in EUR), and short-term liabilities (in EUR).

The treated observations, those who participate in crop insurance, were then matched to the control group. Effects of crop insurance were estimated as the average treatment effect on the treated (*ATT*) [Aubert, Enjolras 2018]:

$$\begin{aligned} ATT &= E(Y_1 - Y_0|P(X),\ I = 1) \\ &= E(Y_1|P(X),\ I = 1) - E(Y_0|P(X),\ I = 1) \end{aligned} \qquad (2)$$

where: Y = the outcome variable.

The data used to estimate models outlined in this section was obtained from Farm Accountancy Data Network (FADN) database [LAEI 2018]. The study encompassed all farms participating in the FADN system. The data covered years 2008–2017. Note that the share of farms with crop insurance fluctuated at around 7% during the research period (Fig. 1). For calculations, R programme with the Matching package was used.

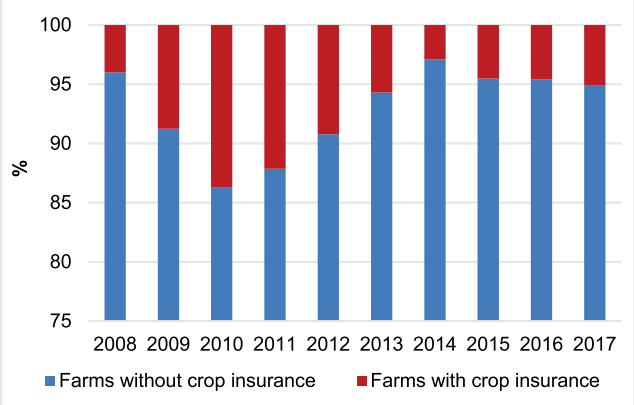

Fig. 1. The share of farms with and without crop insurance in the FADN database, 2008–2017; source: own study based on data from LAEI [2018]

It should be noted that in Lithuania crop production is the dominant activity. The highest share of crop production consists of cereals. During the research period the average farm size in terms of UAA increased rapidly and in 2017 reached 22.2 ha, i.e., the number of farms, especially small-scale, has fallen sharply during 2008–2017. However, as will appear from the next section, the demand for crop insurance products in Lithuania is low.

RESULTS AND DISCUSSION

The situation of participation in crop insurance is not homogeneous across the EU as different countries and even their regions face different types of risk [Le Den *et al.* 2017; Trestini

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et al. 2018]. Also, the cultural and political environment varies widely across member states [Meuwissen *et al.* 2018]. For example, according to Zubor-Nemes *et al.* [2018], in Hungary, crop insurance is obligatory if farm is larger than 5 ha (vegetable farms) or 10 ha (arable farms). Similarly, in Poland, crop insurance is obligatory for farmers receiving direct payments (farmers must insure at least 50% of their farmland), as described by Wąs and Kobus [2018].

Lithuanian farmers' interest in crop insurance is rather low. However, as can be seen in Figure 2, insured crop area in Lithuania showed an upward trend during the research period. This can be explained by both government subsidisation and increased weather volatility. However, major drops in insured crop area were observed during 2009 and 2011. In 2009, this was related to elimination of investment support requirement of compulsory insurance. A similar drop in 2011 was due to changes in insurance conditions [Vereinigte … 2017].

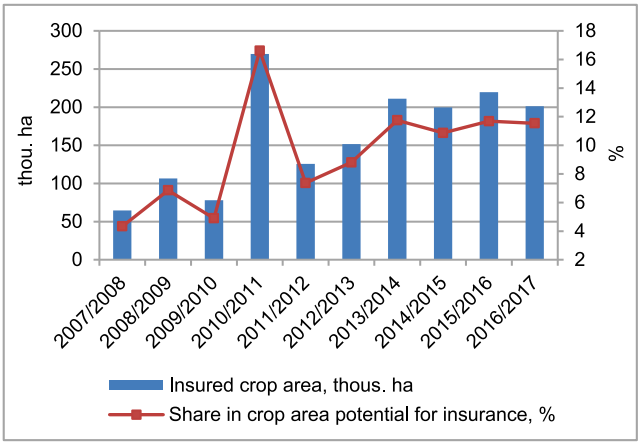

Fig. 2. Insured crop area and its share in crop area potential for insurance in Lithuania, 2007/2008–2016/2017; source: own study based on data from Vereinigte … [2017]

Importantly, geographic heterogeneity is observed in Lithuania. The situation is outlined in the Figure 3, where five levels of insurance premiums and indemnities with according colour intensity are presented starting from the palest to the most intense (1 level – up to 0,1; 2 level – 0,1–0,25; 3 level – 0,25–0,5; 4 level – 0,5–1,0; and 5 level – above 1 mln EUR). During 2007/2008–2016/2017, most contracts were taken by farmers located in the central part of Lithuania. This is mainly due to the predominance of monocultures in these regions. Another

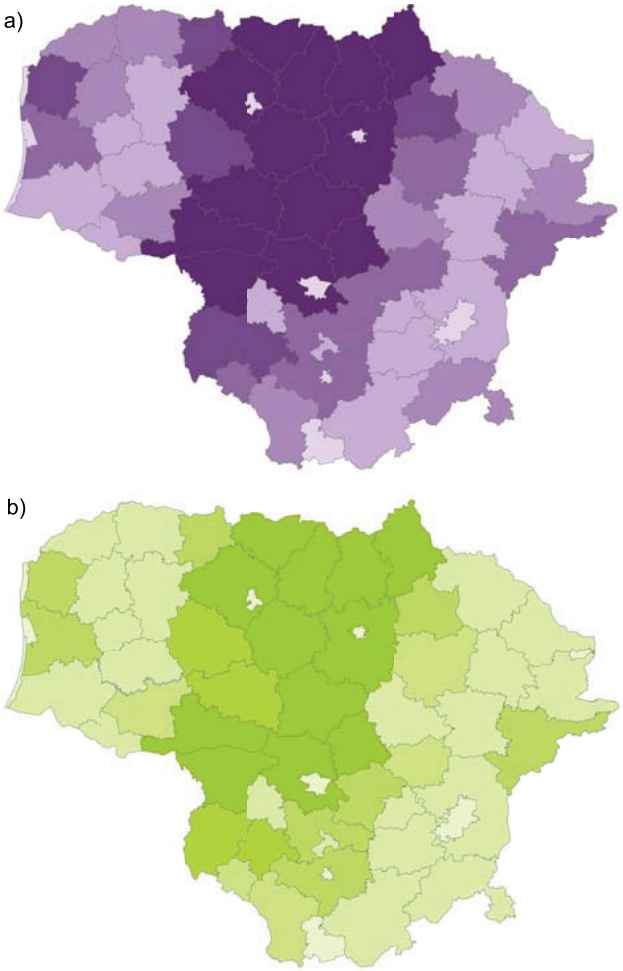

Fig. 3. Crop insurance premiums (a) and indemnities (b) in Lithuania, averages for 2007/2008 – 2016/2017; source: own study based on data from Vereinigte … [2017]

important reason is that farms from this part of Lithuania are larger, more productive, and wealthier than those located in other regions of the country. These findings reflect the recent trends in other EU countries, as described by Enjolras *et al.* [2012], Di Falco *et al.* [2014] and Santeramo *et al.* [2016] (Fig. 3).

Table 1 provides selected characteristics of Lithuanian family farms with and without crop insurance. The data shows certain differences between these two groups. During the research period, farms with crop insurance were, on average, larger in terms of all selected indicators than farms without crop insurance.

Table 1. Selected characteristics of Lithuanian family farms with and without crop insurance

Variable	2008		2017		Change 2017, compared to 2008, %	
	farms with crop insurance	farms without crop insurance	farms with crop insurance	farms without crop insurance	farms with crop insurance	farms without crop insurance
Total utilized agricultural area (ha)	221.8	129.9	394.0	138.9	77.6	6.9
Total labour input (AWU)	3.0	2.6	4.6	2.5	53.3	–3.8
Total assets (EUR)	472,724	253,939	1,201,453	382,749	154.2	50.7
Short-term liabilities (EUR)	52,958	28,650	174,639	37,152	229.8	29.7
Net investment (EUR)	101,258	24,973	42,750	15,456	–57.8	–38.1

Source: own study.

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A more detailed analysis suggests that all indicators with exception of net investment, showed an upward trend during 2008–2017. The key reason for the decrease in net investment was high level of investment activity of farms at the beginning of research period which resulted in rather high endowment of capital at the end of the period.

As mentioned in Section 1, a logistic regression model was used in order to estimate propensity scores. Table 2 shows that during the research period multiple factors affected the probability of participation in crop insurance. At the beginning of research period the probability of participation in crop insurance was higher among younger and wealthier farmers. Additionally, participation in crop insurance was more likely for farms specializing in crop production. The probability of participation in crop insurance was also higher among farms participating in investment measures. This is mainly due to investment support requirement of compulsory insurance.

The situation was somewhat different at the end of the research period. The probability of participation in crop insurance was more likely among farms located outside agriculturally disadvantaged areas. The effect of farmer's age, a proxy of farmer's experience, on participation in crop insurance remained significant, however, showed an opposite trend. When analysing the effect of farmer's age on participation in crop insurance, previous studies also revealed mixed results. For example, Wąs and Kobus [2018] showed that farmer's age did not have any effect on crop insurance uptake. Okoffo *et al.* [2016] found that participation in crop insurance was higher among older famers. However, Liesivaara and Myyrä [2014] concluded that the demand for crop insurance products in Finland was higher among younger farmers. Similar results were also obtained by Dragos and Mare [2014], who observed a negative relationship between farmer's age and adoption of crop insurance in Romania. An assessment of the reasons for these mixed results could be the subject of future research.

Table 3 shows the effect of farmers' participation in crop insurance on production and investment indicators. As can be seen, with only a few exceptions, crop insurance did not show statistically significant effects on the selected farms' indicators. There are several reasons for these results. First, governmental ad hoc disaster payments could help farmers to recover financially from natural disaster events. Second, support payments under the

Table 2. Factors of farmers' participation in crop insurance in Lithuania

Variable	2008	2011	2014	2017
Age of the farmer	−0.034 (0.014)**	−0.005 (0.008)	0.003 (0.015)	0.037 (0.012)***
Farm assets	0.000 (0.000)**	−0.000 (0.000)	−0.000 (0.000)	0.000 (0.000)
Farm labour	−0.029 (0.077)	0.016 (0.032)	0.015 (0.035)	−0.003 (0.052)
Total utilized agricultural area	−0.001 (0.001)	0.001 (0.001)*	0.002 (0.001)***	0.001 (0.001)
Share of crop output in total output	0.037 (0.008)***	0.017 (0.004)***	0.024 (0.009)***	0.046 (0.010)***
Income from other sources	−0.000 (0.000)	0.000 (0.000)***	0.000 (0.000)	0.000 (0.000)
Participation in investment measures	1.672 (0.313)***	0.158 (0.222)	−0.448 (1.047)	0.279 (0.431)
Organic farming	−0.893 (0.624)	−0.178 (0.310)	−0.758 (0.759)	−0.843 (0.753)
Location in less favoured areas	0.531 (0.331)	−0.715 (0.211)***	0.183 (0.401)	−1.066 (0.393)***

Explanations: cells contain binary logistic regression coefficients with standard errors in parentheses (*** = $p < 0.01$; ** = $p < 0.05$; * = $p < 0.1$).
Source: own study.

Table 3. Average treatment effect on the treated (*ATT*) of farmers' participation in crop insurance on production and investment indicators of Lithuanian farms (in EUR)

Year	Specific crop costs			Crop output			Net investment			Short-term liabilities		
	estimate	*SE*	*p*-value	estimate	*SE*	*p*-value	estimate	*SE*	*p*-value	estimate	*SE*	*p*-value
2008	−6 229	4 676	>0.05	−6 864	12 344	>0.05	189 153	8 595	<0.05	−22 972	7 028	>0.05
2009	−3 078	1 695	>0.05	−33 260	2 749	>0.05	−16 414	3 138	>0.05	−5 155	3 577	>0.05
2010	8 088	1 364	>0.05	9 538	2 320	>0.05	−56 609	1 923	<0.05	−29 667	2 174	>0.05
2011	19 263	1 336	>0.05	10 515	3 019	>0.05	34 079	2 827	>0.05	−22 743	2 931	>0.05
2012	4 807	2 376	>0.05	35 000	4 790	>0.05	64 819	3 025	<0.05	15 978	3 224	>0.05
2013	39 716	4 704	>0.05	20 954	7 181	>0.05	−137 043	9 280	>0.05	58 115	7 490	>0.05
2014	75 493	12 972	>0.05	74 465	18 646	>0.05	−49 483	12 674	>0.05	−12 457	19 711	>0.05
2015	32 109	1 782	<0.05	35 991	3 553	>0.05	12 368	3 481	>0.05	32 054	3 718	>0.05
2016	22 932	1 776	>0.05	62 973	2 888	<0.05	14 497	3 523	>0.05	−5 705	3 536	>0.05
2017	39 730	4 350	>0.05	91 363	7 747	>0.05	43 270	9 516	>0.05	7 178	9 752	>0.05

Explanation: *SE* = standard error.
Source: own study.

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Common Agricultural Policy (CAP) could improve some indicators of farms, i.e., enable farmers to apply more inputs, invest in fixed assets. Third, farmers could have other tools to manage production risk, such as off-farm income, savings etc.

The results presented above have important policy implications. Also, the findings complement those of prior studies on crop insurance take-up and impact. Nevertheless, this research proposes avenues for future research. It could be firstly covering a longer time series. Use of panel data could allow for changes in production and investment decisions over time to be analysed. Secondly, future research could assess the effects of crop insurance in more homogeneous groups of farms, i.e., the presented methodology could be applied on different samples in order to determine their specificities. And lastly, based on previous studies (e.g., Velandia *et al.* [2009]), future research could examine simultaneous adoption of different risk management tools and assess their effects, as farmers have several options in managing production risk and many of them use risk management instruments simultaneously. These findings would present a complete picture of effects of crop insurance.

CONCLUSIONS

Adoption of crop insurance in Lithuania from 2007/2008 to 2016/2017 was rather low. However, insured crop area in Lithuania showed an upward trend during the research period. This was mainly due to government subsidisation and increased weather volatility.

The study revealed that participation in crop insurance schemes was influenced by the factors such as age of the farmer, wealth, specialization, and location of the farm. However, the results were somewhat different at the beginning and the end of the research period. Specifically, at the beginning of the research period participation in crop insurance schemes was higher among younger and wealthier farmers. Moreover, the demand for crop insurance was higher among farms specializing in crop production. At the end of the research period there was observed a positive relationship between farmer's age and participation in crop insurance schemes. Additionally, participation in crop insurance schemes was higher among farms located outside agriculturally disadvantaged areas. These findings are useful for researchers and policy makers to support the development of crop insurance in Lithuania and predict farmers' responses to any changes in an existing system. Furthermore, these results can be applied to other countries with similar features.

The study also demonstrated that crop insurance did not show statistically significant effects on the selected farms' indicators. The main reason was support from the national and EU funds. However, more detailed research is needed to get a complete picture of effects of crop insurance.

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