Arych M.I.
PhD in Economics, associate professor at the Department of Finance
National University of Food Technologies

THE INTERCONNECTION BETWEEN INSURANCE AND FOOD MARKET SECURITY

Introduction. It was investigated the interconnection between insurance and food market security. The literature review shows that insurance has significant impact on food market security. Thus, according to *Isaboke et al. (2016)* it was analyzed the impact of weather index based micro-insurance on food security status of smallholders. These study results show the positive effect of index insurance on food security [1]. Besides, *Mârzaa et al. (2015)* argued that insurance alone cannot provide food security [2]. Also, based on the *Agricultural Insurance Conference (2014)* agricultural insurance should be seen as one component of the ACS and it is related to food security [3-4]. Furthermore, *Kim Y.*, *Pendell D.L.* and *Yu J. (2018)* suggest that one of the key study points of the influence of insurance on food market security were focused on the effects of crop insurance on farm disinvestment and exit decisions [5]; besides, according to *Zhao Y.* and *Preckel P. (2016)* an empirical analysis of the effect of crop insurance on farmers' income [6]; the effects of subsidized crop insurance on crop choices [7]; risk management in the ACS with special attention to insurance [8; 9].

Materials and methods. The research model was based on correlation-regression analysis between total gross insurance premiums: X_1 (US Dollar, billions) and food market security indicators: food exports: Y_1 (% of merchandise exports), and food imports: Y_2 (% of merchandise imports). These study indicators were collected and processed for the 1960-2018 for the following 17 countries: Australia, Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Spain, Turkey, Switzerland and United Kingdom (UK). Thus, it was calculated the coefficient of pair correlation or Pearson correlation coefficient (r) and coefficient of determination (r^2), Significance **F**, as whole, **P**-value for regression coefficient and one-factor regression equations that have a liner form.

Results and discussion. As a research result, we ranked all 17 countries in four groups by statistical significance of impact of insurance on food market security. Thus, these groups are listed below.

Group 1, where between target functions Y_1 and Y_2 and factor variable X_1 there is a strong uphill (downhill) linear relationship because here we have $0.700 \leq \mathbf{r} < 0.900$ ($-0.900 < \mathbf{r} \leq -0.700$). These calculations are presented in Table 1.

Table 1

The list of countries where insurance (X_1) have a strong uphill (downhill) linear relationship with food market security (Y_1, Y_2)

Country	**r**	**r^2**	**Regression equations**	**Significance F** for regression	**P-value** for Y_0
The impact of X_1 on Y_1					
Australia	-0.896	0.803	26.844-0.167·$\mathbf{X_1}$	1.45513E-13	2.85208E-29
Iceland	-0.760	0.578	86.270-77.309·$\mathbf{X_1}$	7.37118E-08	5.10918E-22
Netherlands	-0.737	0.543	21.464-0.109·$\mathbf{X_1}$	2.94157E-07	2.02296E-24
France	-0.732	0.536	16.066-0.015·$\mathbf{X_1}$	3.99359E-07	1.59596E-27
Turkey	-0.723	0.523	22.660-1.176·$\mathbf{X_1}$	6.28314E-07	1.82409E-18
Belgium	-0.720	0.518	10.631-0.045·$\mathbf{X_1}$	7.33948E-07	2.28486E-34
The impact of X_1 on Y_2					
Belgium	-0.865	0.748	11.752-0.088·$\mathbf{X_1}$	9.75368E-12	1.48657E-33
Germany	-0.829	0.687	12.188-0.016·$\mathbf{X_1}$	4.26001E-10	4.40288E-26
Italy	-0.760	0.578	13.328-0.025·$\mathbf{X_1}$	7.63441E-08	1.11158E-27
Norway	0.757	0.573	5.970+0.114·$\mathbf{X_1}$	8.49455E-07	3.76502E-19

Group 2 – a moderate uphill (downhill) relationship (table 2), where Pearson correlation coefficient $0.500 \leq \mathbf{r} < 0.700$ ($-0.700 < \mathbf{r} \leq -0.500$).

Table 2

The list of countries where insurance (X_1) have a moderate uphill (downhill) linear relationship with food market security (Y_1, Y_2)

Country	**r**	**r^2**	**Regression equations**	**Significance F** for regression	**P-value** for Y_0
The impact of X_1 on Y_1					
UK	-0.674	0.454	7.488-0.004·$\mathbf{X_1}$	1.23018E-05	2.10764E-26
Switzerland	0.615	0.378	2.454+0.017·$\mathbf{X_1}$	6.50024E-05	5.40321E-16
Italy	0.608	0.370	6.337+0.009·$\mathbf{X_2}$	8.41566E-05	3.05761E-26
The impact of X_1 on Y_2					
France	-0.682	0.465	11.001-0.008·$\mathbf{X_1}$	4.66551E-06	1.06589E-28
Switzerland	-0.682	0.465	7.528-0.028·$\mathbf{X_1}$	4.56204E-06	1.79667E-26
UK	-0.670	0.449	10.910-0.005·$\mathbf{X_1}$	1.47878E-05	3.46945E-28
Netherlands	-0.577	0.333	14.810-0.061·$\mathbf{X_1}$	0.000227624	2.91139E-21
Spain	-0.512	0.262	12.106-0.023·$\mathbf{X_1}$	0.001428828	7.13785E-28

Group 3 – a weak uphill (downhill) linear relationship (table 3), where correlation coefficient $0.300 \leq \mathbf{r} < 0.500$ ($-0.500 < \mathbf{r} \leq -0.300$).

Table 3

The list of countries where insurance (X_1) have a weak uphill (downhill) linear relationship with food market security (Y_1, Y_2)

Country	**r**		**Regression equations**	**Significance F** for regression	**P-value** for Y_0
The impact of X_1 on Y_1					
Portugal	0.445	0.198	$7.727+0.156 \cdot \mathbf{X_1}$	0.000868851	6.51736E-17
Japan	-0.408	0.166	$0.822-0.001 \cdot \mathbf{X_1}$	0.013431794	6.99466E-13
Ireland	0.403	0.162	$8.279+0.028 \cdot \mathbf{X_1}$	0.12125173	1.21725E-07
Denmark	-0.397	0.158	$23.811-0.050 \cdot \mathbf{X_1}$	0.020022608	1.48651E-23
The impact of X_1 on Y_2					
Australia	0.486	0.236	$4.896+0.011 \cdot \mathbf{X_1}$	0.002675861	3.24979E-25
Finland	0.451	0.203	$5.350+0.149 \cdot \mathbf{X_1}$	0.005714771	9.66024E-16
Japan	-0.435	0.189	$16.925-0.012 \cdot \mathbf{X_1}$	0.008037497	5.96517E-13
Denmark	0.401	0.226	$12.269+0.009 \cdot \mathbf{X_1}$	0.018607674	1.41551E-37

Group 4 – no linear relationship: $0.000 \leq \mathbf{r} < 0.300$ ($-0.300 < \mathbf{r} \leq 0.000$). It is related to the all our countries and cases of relationships except as described in tables 1, 2 and 3. In addition, it is important to notice that there is not any cases of relationship between target functions and factor variables where we have a perfect uphill (downhill) linear relationship: $0.900 \leq \mathbf{r} \leq 1.000$ ($-1.000 \leq \mathbf{r} \leq -0.900$).

Conclusions. This research study develops a new model by identifying the type of influence of insurance (total gross insurance premiums) on food market security. The results indicate four groups by level of interconnection between these economic indicators as follow below. First, a strong uphill (downhill) linear relationship that related to the following: to impact of insurance on food export in Australia, Iceland, Netherlands, France, Turkey and Belgium; to impact of insurance on food import in Belgium, Germany, Italy and Norway. Second, a moderate uphill (downhill) linear relationship that related to the following: to impact of insurance on food export in United Kingdom, Switzerland and Italy; to impact of insurance on food import in France, Switzerland, United Kingdom, Netherlands and Spain. Third, a weak uphill (downhill) linear relationship that related to the following: to impact of insurance on food export in Portugal, Japan, Ireland and Denmark; to impact of insurance on food import in Australia, Finland, Japan and Denmark. In addition, the fourth group include a list of all other countries in cases where between Y_n and X_n there is negligible correlation (not linear relationship).

References:

1. Isaboke H.N., Zhang Q., Nyarindo W.N. (2016), The effect of weather index based micro-insurance on food security status of smallholders, *Agricultural and Resource Economics: International Scientific E-Journal*, 2(3), Available at: www.are-journal.com.

2. Bogdan Mârzaa, Carmen Angelescub, Cristina Tindecheb (2015), Agricultural Insurances and Food Security. The New Climate Change Challenges, *Procedia Economics and Finance, 27*, pp. 594–599.

3. How can we make insurance work for food security? *Conference Report, Agricultural Insurance Conference*, Berlin.

4. Akinrinola O.O., Okunola A.M. (2014), Effects of Agricultural Insurance Scheme on Agricultural Production in Ondo State, *MPRA Paper*, 74558.

5. Kim Y., Pendell D.L., Yu J. (2018), Effects of Crop Insurance on Farm Disinvestment and Exit Decisions, *Available at: https://arefiles.ucdavis.edu*.

6. Zhao Y., Preckel P. (2016), An empirical analysis of the effect of crop insurance on farmers' income, *China Agricultural Economic Review*, 8(2), pp. 299–313.

7. Jisang Yua J., Sumnerb D.A. (2017), Effects of subsidized crop insurance on crop choices, *Agricultural Economics*, 49, pp. 533–545.

8. Bachev H. (2012), Risk Management in the Agri-food Sector, *CONTEMPORARY ECONOMICS*, 7(1), pp. 45–62.

9. Lorant A., Farkas M.F. (2015), Risk management in the agricultural sector with special attention to insurance, *POLISH JOURNAL OF MANAGEMENT STUDIES*, 11(2).