

Agricultural Cooperatives and Their Impact on Economic Performance of Farms in Slovakia

Jozef Palkovič, Eva Matejková, Eva Richterová

Department of Statistics and Operations Research, Faculty of Economics and Management, Slovak University of Agriculture in Nitra, Slovakia

Abstract

Effects of membership in cooperative organizations was investigated in many studies, and their results were sometimes controversial. Presented paper contributes to discussion related to cooperative membership by comparing members and non-members, with elimination of self-selection bias, to identify motivation to become member and main effects coming from membership in producer organization. Panel data used in the presented analysis are from Ministry of Agriculture of Slovak Republic at farm level for period of years 2009-2016, which was the most recent available data. Propensity score matching approach was applied to eliminate self-selection bias and to create sample of members and corresponding non-member farms in each year. Difference between these two groups were evaluated by methods of statistical inference. In general, it can be concluded, that in presented period were members of producer organizations more profitable than non-members. Also difference in total revenue was significant in period of year 2010-2013, which means probably successful using of advantage from better bargaining position of producer organization, compared to non-members. Significant difference in profit disappeared in last three years 2014-2016, this could suggest, that membership in producer organization was less attractive to many farms which led to decrease in number of members. Membership in producer organization probably improved economic performance of farms in Slovakia in period 2009-2013, but this advantage disappeared in last years. This could be probably linked to support for producer organizations from European Union in period 2007-2013.

Keywords

Cooperative membership, producer organizations, propensity score matching, economic effects.

Palkovič, J., Matejková, E. and Richterová, E. (2022) "Agricultural Cooperatives and Their Impact on Economic Performance of Farms in Slovakia", *AGRIS on-line Papers in Economics and Informatics*, Vol. 14, No. 2, pp. 85-95. ISSN 1804-1930. DOI 10.7160/aol.2022.140207.

Introduction

Cooperative organizations play important role in agriculture in many countries. Contemporary agricultural market created demand for various method of cooperation, usually in horizontal or vertical way. Many authors claim that current development on the agricultural markets creates demand for more vertically coordinated organizations (Höhler and Köhl, 2014). In European Union cooperatives represent over 50% of market share in agricultural production. This situation is characteristic especially for dairy products, or hog meat market in some European countries (Bijman, 2012; Liang and Wang, 2020). In the milk market in USA (83%) and New Zealand (99%) have cooperative organizations even higher market share (Cakir and Balagtas, 2012; Iliopoulos, Cook et. al., 2012). Motivation of producer to join

cooperative organizations can be various. Usually, farmers join producer organizations if they have some benefits coming from their membership. This also influences their loyalty to their organization and lasting of their membership. According to Gray and Kraenzle (1998) are larger farm units more involved in producer organizations membership than smaller farms, which are less satisfied by membership and have less time available to participate. Main benefits coming from participation in agricultural cooperatives are aggregation, marketing of larger production and advantage of scale economies to inputs. It allows farmers to improve their bargaining position and negotiate better prices. (Bijman and Wijers 2019). Cooperation also helps farmers to disseminate their knowledge, service and technologies, and marketing of their products (Ortmann and King 2007). Vertical cooperation

allows farmer to participate in value-adding process and increase their bargaining power even more. It is also way how farmers can increase their credibility and visibility for potential buyers. On the other hand, for their clients is easier to negotiate a single contract with farmers organized in producer organization. Cooperation therefore plays an important role in the long-run sustainability of the agri-food value chain helping farmers to reach financial viability and solvency (Wang, Cheng, et. al., 2019). Grashuis and Su (2019) suggest, that main channel how cooperative membership helps farmers to increase their profit involves minimizing information asymmetries. In many countries it also includes adoption of food safety labels and certifications amongst farmers. Recent studies focused on the on the effectiveness and inclusion as the outcome of cooperation in agricultural industry. Authors tried to quantify impact of membership on income of cooperatives (World Bank report, 2008; Verhofstadt and Maertens, 2015). According to results of Ma and Abdulai (2016) cooperation increased yields, net returns, and income of farmers. Their results suggest differences between agricultural cooperatives, dependent on commodity, business sector, and geography. Duvaleix-Treguer and Gaigne (2015) suggest, that different producer organization types can impact differently on farmers' performance. According to results of research conducted by Michalek Ciaian and Pokrivcak (2018) in Slovakia, membership in producer organization improves economic performance of farms. Same result was in Slovakia concluded also by Fandel and Bartová (2019) who used metafrontier approach. Similar result was confirmed also by research conducted in China by Ito, Bao and Su (2012) who suggest that cooperative membership contributes substantially to an increase in farm income of farmers. According to these authors is especially in China effect of agricultural cooperatives dependent on commodity, business sector, and geography. In conclusion, cooperative system is important way how to improve economic status of farmers. Cooperative membership also reduces market risks in relation to greater capacity to diversify markets and products and strengthen downstream and upstream integration (Alho, 2015; Cook and Plunkett, 2006; Kyriakopoulos et al., 2004, Valentinov, 2007). On the other hand, Nilsson (1998) states, that current cooperative business models are efficient only under specific economic conditions. This could be either continually declining cost curve with size, or situation when price is not affected by individual firm's sales volume.

In general, empirical results investigating the effect of producer organizations on its members performance are limited and mixed in conclusions. Mostly, because it is necessary to distinguish between motivation of producer organizations in developed and developing countries. In developed countries is motivation of producer organizations focused on bargaining position of farmers and better response to changing market conditions. In developing countries is the aim of cooperative organizations to address rural poverty and reduce market barriers. (e.g., Abebaw and Haile, 2013; Bernard et al., 2008; Duvaleix-Treguer and Gaigne, 2015; Chagwiza et al., 2016; Ito et al., 2012; Latynskiy and Berger, 2016; Markelova et al., 2009; Vandeplas et al., 2013; Verhofstadt and Maertens, 2015; Michalek Ciaian and Pokrivcak, 2018, Fandel and Bartová, 2019). Studies are not only mixed in their conclusions, but also failing in describing the mechanism behind the estimated effects. This paper extends the knowledge about impact of membership in cooperative organizations on economic performance of farms in Slovakia and continues further in contrafactual analysis based on results of researchers mentioned above. Analysis includes major determinants of membership in cooperative organizations, but also compares economic performance of members and non-members. Study is focused not only on profit and revenues of farms, but also on structure of their costs. For this purpose, was used data from Ministry of Agriculture of Slovak republic with economic indicators of farms covering period of years 2009-2016. This was currently the most recent available data coming from the last statistical investigation of Slovak farms. Data was anal and matched pairs were compared by procedures of statistical inference. This allowed us to identify main differences in economic performance between members and non-members of agricultural cooperative organizations with elimination of selection bias.

Materials and methods

The main objective of proposed paper is identification of major difference between members of cooperative organizations and non-members. The analysis includes following procedures:

1. Estimation of panel logit model which predict membership of farm in cooperative organization – this model identifies main determinants of membership in cooperative organizations.

2. Panel logit model was used to generate propensity score for each farm, which was used in next step to match similar farms.
3. Members and non-member farms within each year were matched using propensity score matching to create comparable pairs of farms with similar properties – this procedure was conducted to eliminate self-selection bias. Each cooperative member was matched 1:1 to nearest non-member neighbour.

Groups were compared using paired t-test to identify significant differences between members and non-members within each year and overall difference for analysed period. Source of the data is the Slovak Ministry of Agriculture and covers economic indicators of farms for period of years 2009-2016 (currently the most recent data). Every year includes 431 variables for 735 farms in Slovakia, which is 5880 observations in total. Variables covers information about revenue, sales, cost, production, and property structure of farms. Dataset includes variables which are cumulated into aggregated categories. In the first step were selected relevant variables which characterize major proportion of analysed farms and dropped observations with prevalence of missing values. These data were used for estimation of panel logit model with random effects. Parameters of panel logit model were estimated using 5722 observation from dataset. In the next step was conducted propensity score matching. Based on this procedure were created in total 1794 matched pairs of farms which were compared by paired t-test. Aggregated values were calculated into euro per ha, to allow comparison of farms with different size. Only wage category was analysed in total and in euro per ha. The only variable, which was not expressed in euro was number of employees.

Propensity Score Matching

Farms who are members of cooperative organizations are not selected randomly, which can cause the self-selection bias problem. Propensity score matching is method used often in contrafactual studies used to eliminate selection bias and was employed also in this study. Propensity score matching matches farms which are members of cooperative organizations with non-member farms that have similar likelihood of being member based on observed characteristic (Rahman et al., 2018; Gautam et al., 2017; Schreinemachers et al., 2016; Gitonga et al., 2013; Khan et al., 2012; Abebaw et al., 2010). The propensity score was generated by following panel logit model with random effects.

$$\ln \left(\frac{P(Y_{ij} = 1 | x_{ij}, u_j)}{P(Y_{ij} = 0 | x_{ij}, u_j)} \right) = a_1 + \sum_{k=1}^K \beta_k x_{kij} + u_j, \quad (1)$$

Where u_j is normally distributed with mean = 0 and variance σ^2 , and $j = 1, 2, 3, \dots, J$; $i = 1, 2, 3, \dots, n_j$.

With Y_{ij} is dichotomic variable equal 1, if farm participate in agricultural cooperative organization, 0 if farm is not a member, of the i^{th} subject in the j^{th} center, X_{ij} represent covariates, a_1 is the intercept and β_k is the k^{th} regression coefficient, u_j is the random effect representing the effect of the j^{th} center. Here X_{ij} represents explanatory variables number of employees, value added tax (proxy of added value), revenues (measures economic performance), and cost of electric energy (measures energetic intensity of farm production). These explanatory variables are result of model selection process, from the original set of all 431 variables included in the database. Selection process considered explanatory ability of each variable, multicollinearity between variables, quality of the model together with his simplicity and previously published results by other authors mentioned in the introduction. Coefficient β_k measures the effect of increasing X_{ij} by one unit on the log odds ratio. (Li, B. et al., 2011). In the next step was conducted matching of cooperative organization members with non-members by estimated propensity score. Each member was matched with non-member with the same, or the nearest value of their propensity score. The average difference between these groups was considered as the effect of membership in cooperative organization. Significance of this difference was evaluated by paired t-test. This was suggested by Austin (2011) as the more efficient method in relation to propensity score matching compared to test for independent samples. Analysis included evaluation of differences between variables: value added tax (VAT), cost of electric energy, wage per year, wage per ha., cost of fuel, sum of overdue receivables, number of employees, consumption, total cost, received support, saps (single area payment scheme), plants and animal production, sales, revenue, and profit.

Results and discussion

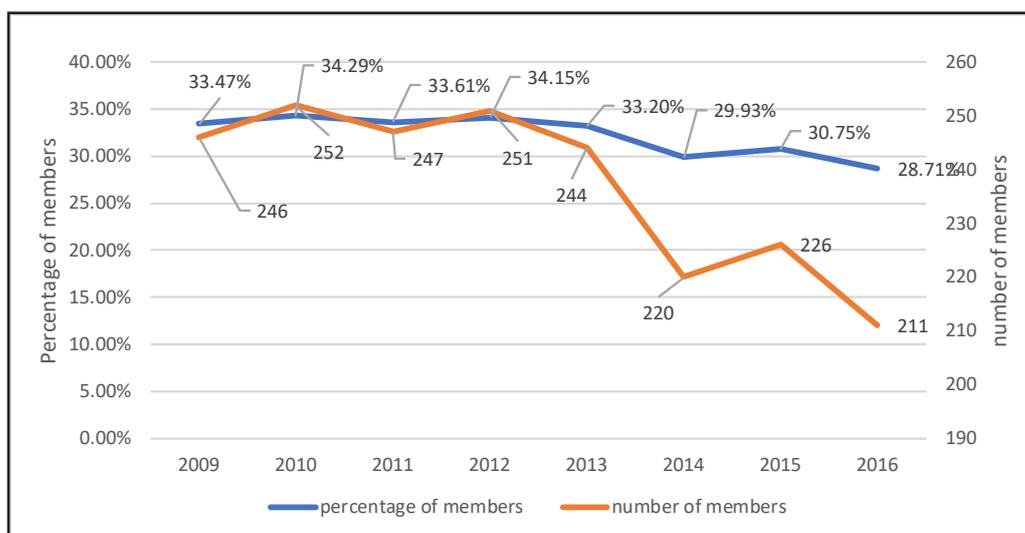
Proportion of cooperative members was slightly decreasing for this period, from initial 33.47% of members (246 farms) in 2009 to 28.71% of members (211 farms) in 2016. Decrease is even more significant in absolute numbers of members

in period 2012 to 2016, where number of members declined by 40 farms in the last four years. Number of members and their proportion on total number of farms is shown in the Figure 1. This decreasing tendency in number of cooperative organization members may suggest, that membership in last years ceased to be an advantage for some farms. Period between 2009 and 2012 was number of members of agricultural cooperative organizations in Slovakia stable in absolute and in relative numbers. We can expect that after this period situation in some member farms changed. Some farms were not motivated enough, to be member of cooperative organization in next years. This could be related to support for producer organizations and producer groups, which are included in group of analysed cooperative organisations from European Union in period 2007-2013. End of this support could also influence decrease in number of cooperatives in Slovak Republic.

Initial dataset of 735 farms for period 2009-2016 was used to estimate panel logit model. This model (Table 1) predicted membership in cooperative organization (dependent variable membership, 1 for members 0 for non-members). From estimation were excluded variables with prevalence of missing values, and it was necessary also to consider strong correlation between some considered explanatory factors. In the variables selection process was considered significance of the variables entering the model using backward elimination, and previous results of other authors. Michalek, Ciaian and Pokrivcak (2018) used in their work panel logit model with following explanatory variables: farm gross value added, farm profit,

farm employment, and labour productivity (gross value added/annual work unit). Considering all the factors mentioned above was conducted modelling procedure with various variables and model types. In final, was selected logit model in the Table 1. estimated with robust standard errors. Likelihood ratio chi-square equals to 64.2 with p-value = 0.0000 which suggest strong significance of the model. Compared to results of authors mentioned above, same variable employees are included in both models. Our model includes variable VAT (value added tax) as proxy of gross value added created by farm. As the measure of economic performance in this model was used revenue, instead of profit in the model mentioned above. Both variables were significantly correlated, and revenue was in this case considered as the variable better predicting membership in cooperative organization in our dataset (according to difference between members and non-members). Intensity of productivity in this case was measured by cost spent on electric energy instead of labour productivity, because this information was not available for major proportion of farms in our dataset. Also, other variables available in our dataset were considered as explanatory, but according to significance and explanatory ability was selected as the best following panel logit model with random effects (parameters shown in table 1). The Table 1 includes estimated coefficients of the model, together with odds ratios and their significance.

According to results of estimated model, subjects with higher use of electric energy, higher number of employees and higher amount of paid value



Source: Author's work based on data from Ministry of Agriculture of SR

Figure 1: Relative proportion and number of cooperative members in dataset.

Cooperative membership = 1	Coefficient	Std. Error	z	P>z	Odds Ratio	Odds ratio 95% confidence interval	
el. energy	0.01	0.003	2.95	0.003	1.010313	1.003451	1.017222
revenues	0.00	0.00	-3.09	0.002	0.999815	0.9996976	0.9999324
VAT	0.001	0.00	2.62	0.009	1.001045	1.000264	1.001826
employees	0.033	0.008	4.11	<0.001	1.033097	1.017194	1.049249
constant	-4.44	0.478	-9.29	<0.001			

Source: Author’s work, based on data from Ministry of Agriculture of SR

Table 1: Panel random effect logit model, dependent variable: membership in cooperative organizations.

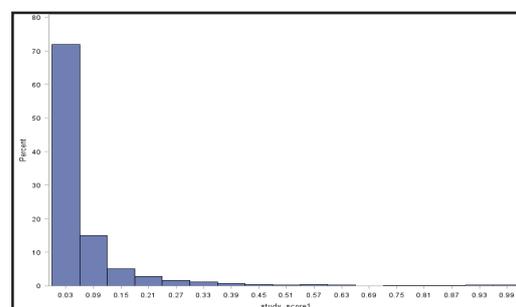
Matching score	Group	Mean	Median	Variance	Std. Dev	Coeff. of Variation	Kurtosis	Skewness
before matching	nonmembers	0.06	0.02	0.02	0.12	212.82	27.11	4.94
	members	0.10	0.04	0.03	0.18	174.76	12.33	3.44
after matching	control- nonmembers	0.07	0.04	0.01	0.11	157.66	27.98	4.64
	study - members	0.07	0.04	0.01	0.11	154.68	28.48	4.69

Source: Author’s work, based on data from Ministry of Agriculture of SR

Table 2: Score before and after matching.

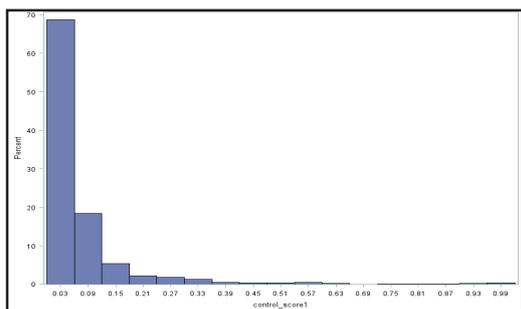
added tax tend to be more likely members of agricultural cooperative organizations. On the other side, with increasing revenues are odds in favour of being member decreasing. This could suggest that motivation of farms to be a member is decreasing with higher revenues. In such case is also decreasing advantage from being part of cooperative organization. On the other side, with increasing cost are farms more likely looking for ways how to use economics of scale in their favour. This result is in line with expectations and confirms results of other researchers. According to results of the model was the most significant factor influencing membership in cooperative organizations number of employees. With increasing number of employees are also increasing odds in favour of being a member. Panel model was used for generation of score (probability of being member) for each farm. Based on this score was conducted propensity score matching. Each member farm was matched to non-member with the same or very similar value of propensity score within each year (accuracy 0,01). As the result was constructed database including 1794 pairs of matched observations in total. Table 2 compares distribution of score (predicted probability of being member in cooperative organization) before and after matching. Dataset before matching included 5880 observations. After matching was created 1794 of member and non-member pairs which is in total 3588 farms observations, which were used for further comparison (1:1 matching). Efficiency of matching is shown in the Table 2.

Before matching was significant difference in score between members and non-members, with higher variability in non-members group. This suggests higher variability in data, a larger difference between farms caused by self-selection bias. This means, that samples are not selected randomly, but each farm can decide to be a cooperative member by itself. After matching was average score in both groups equal to 0,07 with variability measured by standard deviation equal to 0,109. Also, the shape of distribution measured by kurtosis and skewness in both distributions was similar. Matching procedure found for each cooperative farm, non-member farm with similar score generated by the panel logit model within the same year. Distribution of score in both groups is shown in the Figure 2 and 3 below. After matching procedure should both samples include farms with similar character, which makes them comparable.



Source: Author’s work, based on data from Ministry of Agriculture of SR

Figure 2: Distribution of score for members.



Source: Author’s work, based on data from Ministry of Agriculture of SR

Figure 3: Distribution of score for non-members.

Both distributions are significantly right-skewed, with most of values on the left side. Similar shape of distribution suggests proper conducted matching procedure. In further analysis will be these two groups treated as matched samples. It means,

that analysis will be focused more on average difference between mean values in each matched pair than on average difference between groups. It also means that compared will be farms within the same year. From the initial data set, which included 431 variables, were selected main categories of costs and revenues (15 variables) which are compared in Table 3 shown below. It is necessary to remind, that most of the variables are in euro per ha. Names of the cost categories variables are in bold. Bold notation of mean values denotes statistically significant difference according to test results. All variables are characterized by high variability in both groups. In overall comparison were most of significant differences recorded in cost categories, particularly in value added tax, wage, fuel, overdue receivables, and number of employees. In most cases, were significantly smaller costs

Variable	Mean	Median	Variance	Std Dev	Coeff. of Variation	Kurtosis	Skewness
members_VAT	19.26	0.43	307632.49	554.65	2879.74	1653.00	39.86
non-members_VAT	56.84	1.00	77617.21	278.60	490.15	57.02	7.02
members_el. energy	45.63	26.58	132532.01	364.05	797.91	1636.88	39.77
non-members_el. energy	40.34	30.63	2253.04	47.47	117.67	42.11	4.72
members_wage per year	329964.11	279540.00	81134352921.00	284840.93	86.32	6.22	1.98
non-members_wage per year	337978.13	257347.00	80654042860.00	283996.55	84.03	5.51	1.71
members_wage per ha	254.15	201.68	833885.71	913.17	359.30	1609.65	39.16
non-members_wage per ha	367.89	227.19	591187.28	768.89	209.00	72.23	7.89
members_fuel	106.50	91.65	17829.48	133.53	125.37	860.85	25.20
non-members_fuel	132.49	81.17	20376.10	142.74	107.74	47.09	5.51
members_overdue receivables	113.34	41.99	56507.81	237.71	209.74	68.75	4.57
non-members_overdue receivables	135.40	31.94	154548.06	393.13	290.33	124.51	9.59
members_employees	39.48	33.00	936.53	30.60	77.52	4.89	1.73
non-members_employees	38.08	34.00	933.35	30.55	80.23	9.93	2.25
members_consumption	791.18	517.91	38875563.89	6235.03	788.07	1732.88	41.33
non-members_consumption	622.13	444.33	375367.14	612.67	98.48	62.87	4.96
members_total cost	1920.21	1308.38	84419005.22	9187.98	478.49	1657.79	40.01
non-members_total cost	2369.20	1464.44	17600405.02	4195.28	177.08	81.74	8.39
members_recieved support	322.65	298.19	69326.23	263.30	81.60	465.11	18.01
non-members_recieved support	370.14	369.70	22120.29	148.73	40.18	1.61	-0.05
members_saps	151.59	155.14	1843.94	42.94	28.33	4.23	-1.17
non-members_saps	153.52	155.36	1603.23	40.04	26.08	2.38	-1.20
members_revenue plants and animal production	1136.85	729.81	94321346.19	9711.92	854.29	1744.60	41.53
non-members_revenue plants and animal production	952.44	559.70	1248083.42	1117.18	117.30	32.47	3.51
members_sales	1381.06	828.16	106696579.00	10329.40	747.94	1380.65	35.99
non-members_sales	1511.89	868.26	16319067.48	4039.69	267.19	95.24	9.33
members_revenue	1926.88	1292.05	90605459.04	9518.69	493.99	1645.65	39.81
non-members_revenue	2313.09	1466.50	18543511.86	4306.22	186.17	84.92	8.62
members_profit	6.74	8.38	381661.58	617.79	9166.20	422.61	17.90
non-members_profit	-64.36	-4.59	140527.21	374.87	-582.45	18.84	-0.71

Source: Author’s work, based on data from Ministry of Agriculture of SR

Table 3: Descriptive statistics in matched groups.

in category of cooperative organization members. Only number of employees was significantly higher in this category, compared to non-members category. This is in contrast with higher amount of wage in members group. In other cost variables was not identified significant differences, no matter what the difference between mean values was. On the other side, in category of revenues was significant difference between amount of support which was higher in non-members category. Significant differences in costs and insignificant difference in revenues was reflected in significantly higher profit in group of cooperative member farms. Members of cooperative organizations take advantage from their membership, and economics of scale coming from cooperation, allows them to lower their cost, compared to non-members. On revenues side was not confirmed significant differences between members and non-members. This overall comparison led to conclusion, that for the period of years 2009-2016 member farms took advantage in more efficient using of cost to reach significantly higher profit compared to non-members.

Results in the Table 4 are aggregated average values for whole analysed period and can lead to general conclusion. This means, that also significance of difference between member and non-members was based on the average difference over the whole period 2009-2016. On the other side, condition in the market changed over years, which may lead also to different impact of membership in cooperative organization. This can be expected especially from the development of chart in the Figure 1, where number of cooperative

members started to decrease in 2013. How the significance of these differences developed over years is shown in table 4. Last two columns include information about significance of overall comparison and in case of significant result is in last column comparison of member a non-member group. For example, in case of value added tax was between members and non-members significant difference only in years 2010, 2011, 2012 and then in 2015 and 2016. In other years, this difference was not significant. In overall comparison for the whole period of years can be concluded, that members and non-members paid significantly different amount of value added tax, with higher value on the side of non-members. As can be seen in the table, differences between members and non-members significantly changed over period 2009-2016. Only in case of revenues from animal and plant production was not recorded significant difference between members and non-members in any year from analysed period. In case of other variables was identified significant difference at least in one year.

At the beginning of analysed period, in 2009 was identified significant difference between members and non-members only in case of wage per year, overdue receivables and profit. At the end of analysed period was identified significant difference between members and non-members in all variables except energy cost, consumption, revenue from plant and animal production, sales, and total revenue. Difference in total cost and saps was significant at 0,1 level of significance. Year, when the results of cooperative organization members and non-members were the most similar was 2014.

Difference pvalues	2009	2010	2011	2012	2013	2014	2015	2016	Overall comparison	Overall difference
VAT	0.91	0.00***	0.00***	0.00***	0.38	0.83	0.02**	0.00***	0.01**	non-memb.>members
energy	0.26	0.62	0.00***	0.19	0.01**	0.66	0.8	0.01**	0.54	-
wage per year	0.01**	0.32	0.68	0.07*	0.00***	0.00***	0.53	0.05*	0.04**	non-memb.>members
wage per ha	0.63	0.00***	<0.0001***	0.03**	0.18	0.01**	0.45	0.00***	<0.0001***	non-memb.>members
overdue receivables	0.00***	0.00***	0.02**	0.8	0.00***	0.49	0.01***	0.38	0.03**	non-memb.>members
employees	0.12	0.77	<0.0001***	0.34	0.62	0.22	0.99	<0.0001***	0.01**	non-memb.<members
consumption	0.3	0.15	0.46	0.34	0.22	0.43	0.01***	0.54	0.25	-
total cost	0.63	0.09*	<0.0001***	0.00***	<0.0001***	0.4	0.37	0.00***	0.06*	non-memb.>members
received support	0.92	<0.0001***	0.00***	0.01**	<0.0001***	<0.0001***	<0.0001***	<0.0001***	<0.0001***	non-memb.>members
SAPS	0.97	0.00***	0.00***	0.21	<0.0001***	0.54	<0.0001***	0.00***	0.09*	non-memb.>members
plant and animal production revenue	0.31	0.61	0.1	0.54	0.09*	0.32	0.38	0.35	0.43	-
sales	0.52	0.39	0.03**	0.13	0.61	0.42	0.42	0.00***	0.61	-
total revenues	0.58	0.04**	0.00***	0.03**	<0.0001***	0.52	0.12	0.01**	0.11	-
profit	0.02**	0.00***	<0.0001***	<0.0001***	<0.0001***	0.36	0.87	0.08*	<0.0001***	non-memb.<members

Note: *** significance at $\alpha=0,01$ ** significance at $\alpha = 0.05$ * significance at $\alpha = 0.1$

Source: Author's work based on data from Ministry of Agriculture of SR

Table 4: Significance of differences between members and non-members over the years.

In this year was not significant difference even in profit of these two groups. In case of profit is interesting, that significant differences were recorded in period 2009-2013. This could be linked with significant support of producer organizations, which ended in 2013. There was recorded significant difference in received support between members and non-members, but significant difference in revenues and profit corresponds with supporting period. In period 2014-2016 was not significant difference in profit between cooperative members and non-members. Similarity between members and non-members could lead to continuously decreasing number of members in this period. In 2014 and 2015 the differences in cost variables were not so common which resulted in similar profit. In 2016 were differences in cost variables more frequent, but there were also recorded more differences in revenues compared to other years. Difference in profit in 2016 was only significant at $\alpha = 0.1$. It is interesting, that almost in whole period was significant difference between non-members and members in amount of received support. In non-members group are probably farms, which can easier receive support without membership in cooperative organization. On the other hand, decrease in total cost seems to be important motivation for membership in agricultural cooperative organization. At the beginning of analysed period were farms motivated to cooperate also by European support for producer groups and producer organizations, which finished in 2013 and probably significantly affected revenues and profit of cooperatives in this period.

Conclusion

Objective of this paper was analysis of membership in cooperative organizations on economic performance of farms. This was investigated using propensity score matching approach. Analysis was conducted on the panel of farms covering period of years 2009-2016. In general, it can be concluded, that in presented period was members of cooperative organizations more profitable than non-members. This was caused especially by difference in cost structure between members and non-members. The Reason was probably fact, that members successfully used advantages of scale economics, when joined together in cooperative organization. Also difference in total revenue was significant in period of years 2010-2013, which means probably successful using of advantage from better bargaining position of cooperative organizations, compared to non-members, and which was influenced also

by European support for producer organizations in period 2007-2013. Significant difference in profit disappeared in last three years 2014-2016, when there was not significant difference in profit between members and non-members. Membership in cooperative organization probably improved economic performance of farms in Slovakia in period 2009-2013, but this advantage disappeared in 2014-2016. This result corresponds to period of support for producer organizations from EU, which finished in 2013 and which was motivation for farms to cooperate. This loss of advantage from membership in cooperative organizations reflected also into decreasing number of members in these years. Interesting fact was, that non-member group had significantly larger amount of received support in whole analysed period of years. Farms with high amount of received support are probably not motivated to join cooperative organization. Another interesting result was that non-members had significantly higher wage cost compared to members in most of analysed years. Similar result was found also in case of total cost. On the other side, number of employees was significantly different only in two years and was higher in members group. In general, it can be concluded that economic conditions in analysed period changed over time and members of agricultural cooperative organizations in 2014 and 2015 had problem to achieve full advantage from their membership compared to economic performance of non-members, as it was in previous years. This was also influenced by the end of European support for producer organizations in 2013, which led to disappearance of significant economic advantage from membership in cooperative organisation. Agricultural producer organizations significantly benefited from this support, which confirms also results of Bijman, Iliopoulos et. al. (2012). If membership does not bring farms significant economic advantage, it will be probably reflected in decreasing number of cooperative farms. Slightly improvement in position of members was in 2016, which could indicate better future for agricultural cooperative organizations. This could be confirmed by more actual data, which will be available in 2020.

Acknowledgements

Research was supported by the Scientific Grant Agency grant no. 1/0845/17 and Grant Agency FEM SPU project No 01/2021/GA FEM SPU.

Corresponding authors

Ing. Jozef Palkovič, PhD.

Department of Statistics and Operations Research, Faculty of Economics and Management

Slovak University of Agriculture in Nitra, Tr. A. Hlinku 2, 94976, Nitra, Slovak Republic

Phone: +421376414162, E-mail: jozef.palkovic@uniag.sk

References

- [1] Abebaw, D., Fentie, Y. and Kassa, B. (2010) "The impact of a food security program on household food consumption in northwestern Ethiopia: a matching estimator approach", *Food Policy*, Vol. 35, No. 4, pp. 286-293. ISSN 0306-9192. DOI 10.1016/j.foodpol.2010.01.002.
- [2] Abebaw, D. and Haile, M. G. (2013) "The impact of cooperatives on agricultural technology adoption: empirical evidence from Ethiopia", *Food Policy*, Vol. 38, No. 2, pp. 82-91. ISSN 0306-9192. DOI 10.1016/j.foodpol.2012.10.003.
- [3] Alho, E. (2015) "Farmers' self-reported value of cooperative membership. Evidence from heterogeneous business and organization structures", *Agricultural and Food Economics*, Vol. 3, No. 1, pp. 1-22. ISSN 2193-7532. DOI 10.1186/s40100-015-0041-6.
- [4] Austin, P. C. (2011) "Comparing paired vs non-paired statistical methods of analyses when making inferences about absolute risk reductions in propensity-score matched samples", *Statistics in Medicine*, Vol. 30, No. 11, pp. 1292-1301. ISSN 1097-0258. DOI 10.1002/sim.4200.
- [5] Bernard, T., Taffesse, A. S. and Gabre-Madhin, E. (2008) "Impact of cooperatives on smallholders' commercialization behavior: evidence from Ethiopia", *Agricultural Economics*, Vol. 39, No. 2, pp. 147-161. ISSN 1574-0862. DOI 10.1111/j.1574-0862.2008.00324.x.
- [6] Bijman, J. (2012) "*Support for Farmers' Cooperatives: sector report fruit and vegetables*", Wageningen UR. [Online]. Available: <https://edepot.wur.nl/244941> [Accessed: June 25, 2020].
- [7] Bijman, J., Iliopoulos, C., Poppe, K. J., Gijssels, C., Hagedorn, K., Hanisch, M., Hendrikse, G. W. J., Kühl, R., Ollila, P., Pyykkönen, P. and Van der Slangen, G. (2012) "Support for Farmers' Cooperatives; Final Report", Wageningen UR.
- [8] Bijman J. and Wijers G. (2019) "Exploring the inclusiveness of producer cooperatives", *Current Opinion in Environmental Sustainability*, Vol. 41, pp. 74-79. ISSN 1877-3435. DOI 10.1016/j.cosust.2019.11.005.
- [9] Cakir, M. and Balagtas, J. V. (2012) "Estimating market power of US dairy cooperatives in the fluid milk market", *American Journal of Agricultural Economics*, Vol. 94, No. 3, pp. 647-658. ISSN 0002-9092. DOI 10.1093/ajae/aar136.
- [10] Cook, M. L. and Plunkett, B. (2006) "Collective entrepreneurship: an emerging phenomenon in producer-owned organizations", *Journal of Agricultural and Applied Economics*, Vol. 38, No. 2, pp. 421-428. ISSN 1074-0708. DOI 10.1017/S1074070800022458.
- [11] Duvaleix-Tréguer, S. and Gagné, C., (2015) "Producer Organizations and Members Performance in Hog Production", *AAEA & WAEA Joint Annual Meeting*, July 26-28, San Francisco, California, Agricultural and Applied Economics Association. DOI 10.22004/ag.econ.205494.
- [12] Fandel, P. and Bartová, E. (2019) "The effect of Slovak farms membership in the producers organisations. A metafrontier approach ", In *10th International Conference on Applied Economics*, 1st ed., 293 p. ISBN 978-83-65605-10-8. Olsztyn, Institute of Economic Research, pp. 82-83. [Online]. <http://economic-research.pl/Books/index.php/eep/catalog/view/39/42/63-1> [Accessed: 22 July 2020].
- [13] Gautam, S., Schreinemachers, P., Uddin, M. N. and Srinivasan, R. (2017) "Impact of training vegetable farmers in Bangladesh in integrated pest management (IPM)", *Crop Protect*, Vol. 102, pp. 161-169. ISSN 0261-2194. DOI 10.1016/j.cropro.2017.08.022.
- [14] Gitonga, Z. M., De Groote, H., Kassie, M. and Tefera, T. (2013) "Impact of metal silos on households' maize storage, storages losses and food security: an application of a propensity score matching", *Food Policy*, Vol. 43, pp. 44-55. ISSN 0306-9192. DOI 10.1016/j.foodpol.2013.08.005.

- [15] Grashuis, J. and Su, Y. (2019) "A Review of the Empirical Literature on Farmer Cooperatives: Performance, Ownership and Governance, Finance, and Member Attitude", *Annals of Public and Cooperative Economics*, Vol. 90, No. 1, pp. 77-102. ISSN 1467-8292. DOI 10.1111/apce.12205.
- [16] Gray, T. W. and Kraenzle, Ch. A. (1998) "Member Participation in Agricultural Cooperatives: A Regression and Scale Analysis", Rural Business-Cooperative Service, Research Report 165, United States Department of Agriculture, December 1998. DOI 10.22004/ag.econ.280009.
- [17] Hohler, J. and Kuhl, R. (2014) "Position and performance of farmer cooperatives in the food supply chain of the EU-27", *Annals of Public and Cooperative Economics*, Vol. 85, No. 4, pp. 579-595. ISSN 1467-8292. DOI 10.1111/apce.12052.
- [18] Chagwiza, C., Muradian, R. and Ruben, R. (2016) "Cooperative membership and dairy performance among smallholders in Ethiopia", *Food Policy*, Vol. 59, pp. 165-173. ISSN 0306 9192. DOI 10.1016/j.foodpol.2016.01.008.
- [19] Iliopoulos, C., Cook, M., Hendrikse, G. and Chymis, A. (2012) "Support for Farmers' Cooperatives: Experiences of Non-EU OECD Countries", Technical Report, Agricultural Economics Research Institute, Wageningen UR.
- [20] Ito, J., Bao, Z. and Su, Q. (2012) "Distributional effects of agricultural cooperatives in China: Exclusion of smallholders and potential gains on participation", *Food Policy*, Vol. 37, No. 6, pp. 700-709. ISSN 0306-9192. DOI 10.1016/j.foodpol.2012.07.009.
- [21] Khan, M. A., Alam, M. F. and Khan, J. I. (2012) "The impact of co-management on household income and expenditure: an empirical analysis of common property fishery resource management in Bangladesh", *Ocean & Coastal Management*, Vol. 65, pp. 67-78. ISSN 0964-5691. DOI 10.1016/j.ocecoaman.2012.04.014.
- [22] Kyriakopoulos, K., Meulenbergh, M. and Nilsson, J. (2004) "The impact of cooperative structure and firm culture on market orientation and performance", *Agribusiness*, Vol. 20, No. 4, pp. 379-396. ISSN 1520-6297. DOI 10.1002/agr.20021.
- [23] Latynskiy, E. and Berger, T. (2016) "Networks of rural producer organizations in Uganda: what can be done to make them work better?", *World Development*, Vol. 78, pp. 572-586. ISSN 0305-750X. DOI 10.1016/j.worlddev.2015.10.014.
- [24] Li, B., Lingsma, H. F., Steyerberg, E. W. and Lesaffre E. (2011) "Logistic random effects regression models: a comparison of statistical packages for binary and ordinal outcomes", *BMC Med Research Methodology*, Vol. 11, No. 77. ISSN 1471-2288. DOI 10.1186/1471-2288-11-77.
- [25] Liang, Q. and Wang, X. (2020) "Cooperatives as competitive yardstick in the hog industry?-Evidence from China", *Agribusiness*, Vol. 36, No. 1, pp. 127-145. ISSN 1520-6297. DOI 10.1002/agr.21630.
- [26] Ma, W. and Abdulai, A. (2016) "Does cooperative membership improve household welfare? Evidence from apple farmers in China", *Food Policy*, Vol. 58, pp. 94-102. ISSN 0306-9192. DOI 10.1016/j.foodpol.2015.12.002.
- [27] Markelova, H., Meinzen-Dick, R., Hellin, J. and Dohrn, S. (2009) "Collective action for smallholder market access", *Food Policy*, Vol. 34, No. 1, pp. 1-7. ISSN 0306-9192. DOI 10.1016/j.foodpol.2008.10.001.
- [28] Michalek, J., Ciaian, P. and Pokrivcak, J. (2018) "The impact of producer organizations on farm performance: The case study of large farms from Slovakia", *Food Policy*, Vol. 75, pp. 80-92. ISSN 0306-9192. DOI 10.1016/j.foodpol.2017.12.009.
- [29] Nilsson, J. (1998) "The emergence of new organizational models for agricultural cooperatives", *Swedish Journal of Agricultural Research*, Vol. 28, No.1, pp. 39-47. ISSN 0049-2701.
- [30] Ortmann, G. F. and King, R. P. (2007) "Agricultural Cooperatives I: History, Theory and Problems", *Agricultural Economics Research, Policy and Practice in Southern Africa*, Vol. 46, No.1, pp. 18-46. ISSN 2078-0400. DOI 10.1080/03031853.2007.9523760.

- [31] Rahman, M. S., Norton, G. W. and Rashid, M. H.-A. (2018) "Economic impacts of integrated pest management on vegetables production in Bangladesh", *Crop Protection*, Vol. 113, pp. 6-14. ISSN 0261-2194. DOI 10.1016/j.cropro.2018.07.004.
- [32] Schreinemachers, P., Wu, M., Uddin, M. N., Ahmad, S. and Hanson, P. (2016) "Farmer training in off-season vegetables: Effects on income and pesticide use in Bangladesh", *Food Policy*, Vol. 61, pp.132-140. ISSN 0306-9192. DOI 10.1016/j.foodpol.2016.03.002.
- [33] Valentinov, V. (2007) "Why are cooperatives important in agriculture? An organizational economics perspective", *Journal of Institutional Economics*, Vol. 3, No. 1, pp. 55-69. ISSN 1744-1374. DOI 10.1017/S1744137406000555.
- [34] Vandeplas, A., Minten, B. and Swinnen, J., (2013) "Multinationals vs. cooperatives: the income and efficiency effects of supply chain governance in India", *Journal of Agricultural Economics*, Vol. 64, No. 1., pp. 217-244. ISSN 1477-9552. DOI 10.1111/1477-9552.12004.
- [35] Verhofstadt, E. and Maertens, M. (2015) "Can agricultural cooperatives reduce poverty? Heterogeneous impact of cooperative membership on farmers' welfare in Rwanda", *Applied Economic Perspectives and Policy*, Vol. 37, No. 1, pp. 86-106. ISSN 2040-5790. DOI 10.1093/aep/ppy021.
- [36] Wang, B., Cheng, P. Y., Lee, B., Sun, L. C. and Chang, H. H. (2019) "Does Participation in Agricultural Cooperatives Affect Farm Sustainability? Empirical Evidence from Taiwan", *Sustainability*, Vol. 11, No. 18. ISSN 2071-1050. DOI 10.3390/su11184987.
- [37] World Bank (2007) "*World Development Report 2008: Agriculture for Development*", Washington DC: The World Bank; License: CC BY 3.0 IGO. [Online]. Available: <https://openknowledge.worldbank.org/handle/10986/5990> [Accessed: 22 July 2020].