J. Agr. Sci. Tech. (2016) Vol. 18: 881-894

Economic Performance of Conventional, Organic, and Biodynamic Farms

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ABSTRACT

Organic agriculture in the Czech Republic is taking on a greater importance: the number of the organic farms is increasing and the availability of bio products is rising too. The aim of this study was to evaluate and compare the economic situation of organic, biodynamic, and conventional farms by using financial analysis indicators, performance indicators, economic efficiency indicator, and multidimensional intercompany comparison methods. Furthermore, the subsidies impact on farms' profits, sales, and return on assets indicators by a linear regression model with AR (AutoRegressive 1) process was analyzed. A total of 389 Czech farms receiving subsidies from 2007 to 2012 were selected. From these, 273 farms were conventional, 112 organic, and 4 biodynamic. Organic farms were the most profitable and got the best results on the economic efficiency indicator and took the first place in the intercompany comparison. Subsidies worsen the organic farms' economic situation, however, without statistical significance. Biodynamic farms received the highest amount of subsidies. In some years, these farms did not gain profit. Despite the worst results of economic efficiency indicator, biodynamic farms were placed as second in the intercompany comparison. Subsidies improved the biodynamic farms' economic situation (statistically insignificant) and could play a role as a motivating factor. Conventional farms had the highest values of input and output indicators (except profit) and they received the lowest amount of subsidies. Subsidies had a statistically significantly positive effect on the profitability of these farms, though with a negative effect on sales.

Keywords: Agricultural enterprises, Autoregressive model, Efficiency, Linear regression model, Czech Republic.

[DOR: 20.1001.1.16807073.2016.18.4.16.0]

INTRODUCTION

In recent years, the interest about environmental issues has risen and, consequently, the demand for organically grown products has increased (Haghjou *et al*., 2013). Organic agriculture in the Czech Republic is becoming increasingly important, the number of organic farms is constantly growing and the availability of bio products is also rising. In the year 1990, there were only three organic farms, a year later there were 130 more farms, by 2000, there were 500 more and in 2013, there were 4,060 organic farmers registered in the Czech Republic, their organic agricultural land area totalled nearly 500 thousands hectares (eAgri, 2013). The share of organically managed land out of the total area of the agricultural land of the Czech Republic is 11.68% (eAgri, 2013). The Czech Republic currently belongs to countries with the highest proportion of ecologically managed agricultural land in the European Union (EU) as well as worldwide (Eurostat, 2014; Faostat, 2014).

Special types of organic farms are the biodynamic farms. These farms use unique farming methods that utilize, in addition to the common tools of organic agriculture, specific fermented compost additives and field sprays. Special rules and requirements

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of biodynamic agriculture are issued by the Demeter-International association. This type of agriculture was established by Steiner (2004) in 1924 as a reaction to the deterioration in the quality of land and food in relation to the intensification of agriculture. Currently, 156 thousand hectares of the world's agricultural land is being managed by more than 4,900 certified biodynamic farms, out of which 1,500 are situated in Germany (Demeter, 2014), i.e. more than half of the biodynamic farms in the EU. In the Czech Republic there are 4 biodynamic farms, which are Demeter certified.

Despite the long existence of biodynamic agriculture, the economy of these farms has never been sufficiently analyzed until now. Neither their financial nor their economic situation has ever been evaluated.

Brozova and Vanek (2013) compared the economic performance of the organic farms. In their study, there were more positive results for organic farms in comparison to conventional farms. They also said that organic farms would be operating in a loss without receiving government or EU subsidies. Authors such as Kourilova (2010), McCrory (2001), Connolly (2002) or Moudry (2006) focused on the evaluation of the economic efficiency of organic farms and their difference from the conventional farms. Kumbhakar *et al.* (2009) and Madau (2007) have proven a lower economic efficiency of organic farms compared to conventional farms. Pechrova (2013) compared two methods of technical efficiency: Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA), to prove which of them is more appropriate for analyzing biodynamic farms. Pechrova and Vlasicova (2013) examined the technical efficiency of biodynamic and organic farms in the Czech Republic. The influence of subsidies on production ability and technical inefficiency of the farms was also considered.

From the listed publications, many of the authors have focused on the topic of organic farms (also in comparison to conventional farms). However, according to the authors' available information, until now, not even an elementary economic analysis of biodynamic farms in comparison to organic or conventional farms has been conducted. Therefore, the aim of this study was to evaluate and compare the economic situation of conventional, organic and biodynamic farms and to analyze their dependence on subsidies and the impact of subsidies on farm profitability.

MATERIALS AND METHODS

Owing to the fact that both organic and biodynamic types of farms meet the conditions of organic farming, we expected a close resemblance to the economic results of these farms and different economic results when compared to those of conventional farms. According to the studies by Kroupova and Maly (2010), Offermann *et al*. (2009) or Rizov *et al*. (2013), we assumed that subsidies had a negative effect on the economic management of organic and biodynamic farms.

Materials

A database of farms was created combining accounting data (from balance sheets and profit and loss statements of the legal persons that were obtained from the Albertina database, which is managed by Biosnode corporation), information from the register of organic farmers, data from the subsidy recipient register (both registers are administrated by the Czech Ministry of Agriculture) and information from the Demeter-International association, which associates with and certifies biodynamic farmers.

The total number of agricultural holdings in the Czech Republic is about 48,500, of which 91.5% are natural persons, however, three quarters of the agricultural area of the Czech Republic are utilized by legal persons. The final sample of organic and conventional farms was selected randomly from a database of legal persons on the basis of the entirety of all data and information necessary for analysis. Moreover, the data of all biodynamic farms, located in the Czech Republic, were added. In total, we selected 389 Czech farms, which had been receiving subsidies either from the EU, or from the Czech national grants from 2007 to 2012. From these, 273 farms were focusing on conventional agriculture, 112 on organic agriculture, and 4 farms were biodynamic (the total number of biodynamic farms situated in the Czech Republic).

The conventional farms chosen were mainly focused on crop production (ca. 65%). On the other hand, 50% of organic farms and all of the biodynamic farms had mixed production. The average sample size of a conventional farm was 795 ha, almost reaching the average size of a legal person's agricultural land in the Czech Republic, which is ca. 800 ha. Nevertheless, the average size of an organic farm is 88 ha. The lower size of the organic farms' agricultural area is due to the fact that these farms are mainly managed on the basis of family farming. The average size of a biodynamic farm is 225 ha.

Methods

The first step of the analysis was to calculate the indicators of financial analysis. The suitable indicators used for agricultural enterprises' financial situation evaluation according to Novak (2005) are shown in Table 1.

For evaluation of the farms' performance, the following indicators were used. All of the performance indicators have been recalculated per one hectare of agricultural land for the purpose of clarity. The input indicators chosen were: Labour usage (signified by wages and salaries), production consumption (including material consumption, energy and services), total costs (including production costs and financial costs), and production costs (a combination of expenses on sold goods, production consumption, personnel expenses, taxes and fees, depreciations of intangible and tangible assets, net book value of disposed fixed assets and materials, change in operating reserves and adjustments and complex deferred costs and other operating expenses). The output indicators are represented by: Gross value added (calculated as sales margin plus production minus production consumption)

Table 1. The indicators of financial situation evaluation.

$\text{ROA} = \frac{\text{EBIT}}{\text{total assets}}$	ROA means return on assets and EBIT is earnings before interest and taxes. The ROA indicator evaluates an effectiveness of asset usage.
$\text{ROE} = \frac{\text{profit}}{\text{equity}}$	ROE means return on equity. ROE ratio evaluates the profitability of capital inserted by farm owners.
$\text{return on cost} = \frac{\text{added value}}{\text{production consumption}}$	Return on cost measures how much production consumption (cost) must be spent to get one unit of added value.
$\text{debt ratio} = \frac{\text{liabilities}}{\text{assets}}$	Debt ratio indicates the percentage of farms' assets that are financed by liabilities.
$\text{current ratio} = \frac{\text{current assets} - \text{inventory}}{\text{short term payables}}$	Current ratio expresses the ability of farms to pay their payables.
$\text{turnover of assets} = \frac{\text{sales}}{\text{assets}}$	Turnover of assets measures the efficiency of farms' use of their assets in generating a sales income for the farms.

Source: Novak (2005)

and operating revenue (including revenues from the sold goods and revenues from own products and services; revenues from the disposal of fixed assets and materials were not included). As the profitability indicator, profit was chosen (represented by the profit or loss of the current accounting period). Furthermore, the indicator of total received subsidies was used. Based on some performance indicators, an economic efficiency indicator was calculated, which measures the rate of inputs and outputs and was calculated as the ratio of costs to revenues.

All of the aforementioned indicators were calculated for each year (2007–2012) and for each group of the analyzed types of agricultural farms (C: Conventional, O: Organic and B: Biodynamic). We used an average value (mean), standard deviation, standard error, maximum and minimum value and 2012 to 2007 percentage rate for indicators interpretation. An independent *t*-test at 5% statistical significance was used for comparison of the individual indicators within the three mentioned groups of farms.

To compare economic results of the farms, the multidimensional methods of intercompany comparison were used according to Kislingerova and Hnilica (2005) and Synek *et al*. (2009). The criteria were represented by the values of indicators of financial analysis and performance indicators. For greater clarity, the methods are shown in Table 2.

In the simple sum sequences method, the groups of farms (C: Conventional, O: Organic and B: Biodynamic) were ranked according to each indicator. The group of farms with the best indicator value gained a number of points *n*, then, the second best *n-1,* etc. Subsequently, the groups of farms were sorted by the total number of points. A group of farms that reached the highest number of points ranked the first position, etc. In the simple ratio method, the value of each indicator in the matrix was divided by the arithmetic mean of individual indicators. We used the identical procedure to calculate the total criteria indicator as in the previous method. According to the scoring method, the group of farms that achieved the best indicator value had 100 points, other groups of farms received points in accordance with the criteria above in Table 2 (character +1, -1). In the standardized variable method, we used statistical methods. Individual values were based on normalization converted into dimensionless quantities. This process eliminated the excessive variability of data within the file. Normalisation was captured above in Table 2. The method of distance from an imaginary point is considered as the most accurate method because it shows the "total" distance from the imaginary point (the imaginary farm). It works with normalized variables; furthermore, it implements a reference variable "imaginary farm", which achieved the best values for the given criteria. This imaginary farm serves as a norm. For each group of farms, the distance from the imaginary farm was calculated.

In the last part of the study, the dependence between the subsidies and the chosen indicators of the economic situations was studied within the sample of conventional, organic and biodynamic farms. The Linear Regression Model (LRM) in 3 scenarios (estimation due the ROA indicator, due profit per hectare, and sales per hectare) were developed. Owing to a limited length of disposable time series (only 6 observations), it was not possible for low degrees of freedom to be used in LRM all regressors, which would be more rational from an economic point of view. Therefore, in the end, we used the simple linear regression models (models with constant and one strictly exogenous variable) extended by the AR (AutoRegressive 1) process, i.e. the models had the following form (in fact a dynamic version of the simple LRM):

$$y_t = \beta_0 + \beta_1 y_{t-1} + \gamma_0 x_t + \varepsilon_t, \qquad \varepsilon_t \sim IID(0, \sigma^2) \qquad (1)$$

where

y_t is a dependent variable in time $t = 1$

y_{t-1} is an independent variable, in fact the dependent variable in time $t - 1$

x_t is an independent variable in time $t = 1$

Table 2. The multidimensional methods used for intercompany comparison.

Method	Conditions
Simple sum sequences method $d_{1i} = \sum_{j=1}^{m} s_{ij} p_j$	Where: *i:* 1, 2, …, *n* s_{ij}: Number of farm *i,* for indicator j p_j: Weight of indicator *j*
Simple ratio method Positive value growth: Positive value decrease: $k_{ij} = \frac{x_{ij}}{x_{pj}}$, $k_{ij} = \frac{x_{pj}}{x_{ij}}$,	Where: x_{ij}: The value of indicator *j* in the farm *i,* x_{pj}: Arithmetic mean calculated from the values of indicator *j*
Scoring method character of the indicator +1character of the indicator –1 $b_{ij} = \frac{x_{ij}}{x_{i,\max}} \cdot 100$ $b_{ij} = \frac{x_{i,\min}}{x_{ij}} \cdot 100$ Integral indicator was calculated as weighted arithmetic average of points for individual indicators: $d_{3i} = \frac{\sum_{j=1}^{m} b_{ij} \cdot p_j}{\sum_{j=1}^{m} p_j}$	Where: x_{ij}: Value of indicator *j* in farm *i* $x_{i,\ max}$: Maximal value of indicator *j* (evaluated for 100 points), in case of indicator with character +1 $x_{i,\ min}$: Minimal value of indicator *j* (evaluated for 100 points), in case of indicator with character -1 b_{ij} score evaluation of farm *i* for indicator *j* *i*: 1, 2, …, n
Standardised variable method character of the indicator +1 character of the indicator –1 $u_{ij} = \frac{x_{ij} - x_{pj}}{s_{xj}}$ $u_{ij} = \frac{x_{pj} - x_{ij}}{s_{xj}}$ Integral indicator was calculated as a weighted arithmetic average from the standardised values, calculated for individual indicators in the farm *i*, i.e. standard deviation calculated from the values of indicator *j*. $d_{4i} = \frac{\sum_{j=1}^{m} u_{ij} \cdot p_j}{\sum_{j=1}^{m} p_j}$	Where: x_{ij}: Value of indicator *j* in farm *i* x_{pj}: Arithmetic average calculated from the values of indicator *j* s_{xj}: Standard deviation from the values of indicator j *i:* 1, 2, …, n
Method of distance from an imaginary point $d_{5i} = \sqrt{\frac{\sum_{j=1}^{m} (u_{ij} - u_{oj})^2 \cdot p_j}{\sum_{j=1}^{m} p_j}}$	Where: *i*: 1, 2, …, *n* u_{oj}: Standardised values of indicators for an imaginary farm

Source: Synek *et al*. (2009), Kislingerova and Hnilica (2005).

ε_t is a random variable with zero mean and constant variance σ^2 (σ is the standard deviation)
β_0 is a constant
β_1 is an estimated parameter of the independent variable y_{t-1}
γ_0 is an estimated parameter of the independent variable x_t

In fact we estimated 9 models, in three of them the subsidies were separately regressed on *ROA*. The second part of the models was based on the same regressors, but the dependent variable was profit per hectare. In the third part, the dependent variable was sales per hectare. As we mentioned and as is evident from the Equation (1), the particular dependent variable was regressed on its fist-order lag, assuming continuous development and, thus, a dependence on the previous period. The AR (1) process was mainly used to deal with the autocorrelation of residuals. Naturally, a coefficient of determination was computed for every regression (informing us of the tightness of the regression and the value of R^2 can be interpreted as a percentage indicating by how many percent the changes in the explained variable are dependent on the changes in explanatory variables), as well as the correlation coefficient (expressing the dependence between variables, without causality restriction). Every estimated model was tested, especially for residual's autocorrelation using Durbin at 5% statistical significance. For more details in construction and verification of the models used see Green (2012). Software Gretl and SPSS were used for the analysis in this study.

RESULTS AND DISCUSSION

The results of the financial analysis indicators are shown in Table 3. Organic farms had the best values of *ROA*, *ROE*, and return on costs. The higher the values of these indicators, the better the economic results (a minimum value of ROA should be 0.08 and ROE 0.1). Organic farms had the

Table 3. Financial analysis indicators.

Indicator	Group of farms	Mean	Standard deviation	Standard error	Minimum value	Maximum value	2012 to 2007 % growth rate
ROA	C [a]	0.04	0.02	0.007	0.02	0.07	79.09
	O [b]	0.08	0.02	0.009	0.05	0.11	37.07
	B [c]	0.07	0.02	0.010	0.04	0.10	-49.77
ROE	C	0.05	0.03	0.011	0.01	0.09	94.75
	O	0.11	0.03	0.013	0.06	0.14	32.25
	B	0.07	0.02	0.007	0.06	0.11	-27.00
Return on costs	C	0.12	0.01	0.004	0.10	0.13	-4.81
	O	0.22	0.07	0.027	0.11	0.29	-25.12
	B	0.07	0.04	0.016	0.02	0.11	-70.94
Debt ratio (in %)	C	38.83	1.78	0.727	37.41	41.77	-2.00
	O	19.01	10.50	4.288	2.36	28.78	10.51
	B	30.74	4.35	1.778	25.79	37.55	-30.39
Current ratio	C	0.71	0.04	0.018	0.63	0.75	7.27
	O	1.04	0.08	0.031	0.96	1.15	6.09
	B	1.44	0.34	0.140	0.85	1.79	110.12
Turnover of assets	C	0.68	0.04	0.016	0.64	0.73	-5.90
	O	0.36	0.04	0.015	0.31	0.41	-12.90
	B	0.19	0.03	0.014	0.15	0.24	-38.98

[a] Conventional; [b] Organic, and [c] Biodynamic. Source: Own elaboration.

lowest debt ratio, i.e. they used their equity for operation, instead of liabilities. The values of the debt ratio indicator should be within the limit of 50%. The condition of the current ratio indicator (the values should be in the interval from 1 to 1.5) was also fulfilled and these organic farms were able to pay the payables. On the other hand, organic farms, as well as other groups of farms, dealt with a low turnover of assets, which should be turned over at least once a year. Assets of organic farms, on an average, turned over 0.36 times per year. The reason for the low turnover of assets was not in high amounts of the current assets, but in the fixed assets. This fact is also reflected in the above mentioned low indebtedness of the organic farms. Biodynamic farms had the lowest return on costs and turnover of asset values. These farms did not meet the *ROA* and *ROE* conditions; nevertheless, they fulfilled the current ratio and debt ratio requirements. The lowest values of *ROA*, *ROE* and current ratio reached the conventional farms. These farms also had the highest indebtedness. On the other hand, conventional farms had the best turnover of assets, however, their assets, on average, turned over only 0.68 times per year.

The statistically significant differences between the financial analysis indicators of organic and biodynamic farms were found by the t-test, except the parameter *ROA*, which was almost the same, and *ROE*, which was slightly different, but not significantly. Moreover, the statistically significant differences in all of the financial analysis indicators were found by comparing organic and biodynamic farms to conventional farms.

The performance indicators and economic efficiency indicator results are reviewed in Tables 4 and 5.

Apart from the subsidies, according to the t-test, all of the performance indicators were statistically significantly different between biodynamic and organic farms. Besides, statistically significant differences in these indicators were found when we compared those farms to conventional farms. Apart from the profit of organic and conventional farms which was different, but without statistical significance.

The highest item of the total costs (see Table 4) were production costs which included both production consumption and labour usage, and additionally also other items (see the section on the materials and methods). Conventional farms had the highest amount of total costs. One of the main items in the conventional farms costs e.g. high intermediate consumption, such as usage of industrial fertilizers and chemical protection agents, are used minimally, if any, by organic farms. Moreover, according to Jansky *et al*. (2006), organic farmers use their own seedlings while the conventional farmers mainly used the purchased ones. The larger Czech farmers, who mostly have conventional farms, often rent agricultural land, while smaller farmers, with organic farms, possess the land. Furthermore, conventional farms usually have paid employees, while in organic farms it is often family members who do the work.

As we can see, the total costs per one hectare of agricultural land are lower in the case of organic farms than conventional farms, nevertheless, significantly lower yields per hectare result in higher costs per one ton of a crop product (Jansky *et al*., 2006).

A conventional farms' high amount of costs is reflected in the earned revenues. In addition, these farms had the highest gross value added. On the contrary, the organic farms had the highest profit per hectare. Even though biodynamic farms are basically organic farms, their economic situation differs significantly from the organic farms. Generally, biodynamic farms use their own made fertilizers and seedlings. They also use their own farm crop products for feeding animals and labour usage costs are minimal owing to the use of family labor living on farm. Moreover, biodynamic farms usually do not need to pay for renting the land. All of the mentioned factors are reflected in the biodynamic farms lower costs. Despite the low costs, these farms had the lowest profit,

Table 4. Performance indicators (in thousands CZK per hectare of agricultural land).

Indicator	Group of farms	Mean	Standard deviation	Standard error	Minimum value	Maximum value	2012 to 2007 % growth rate
Labour consumption	C [a]	14.29	0.83	0.34	13.14	15.63	-10.37
	O [b]	6.81	0.89	0.36	5.53	7.90	6.33
	B [c]	0.36	0.15	0.06	0.14	0.60	20.69
Production consumption	C	61.63	5.63	2.30	54.77	67.55	9.46
	O	19.84	2.56	1.04	16.30	23.93	20.43
	B	5.41	0.76	0.31	4.10	6.37	55.37
Total costs	C	109.15	7.56	3.08	100.34	119.45	7.01
	O	37.23	4.94	2.02	30.07	43.38	7.67
	B	7.74	0.83	0.34	6.95	9.31	3.47
Production costs	C	106.41	7.83	3.20	97.38	116.72	6.57
	O	36.32	4.79	1.96	29.42	42.50	8.39
	B	6.76	0.98	0.40	5.42	8.15	19.18
Gross value added	C	16.60	1.49	0.61	14.63	18.54	7.98
	O	4.56	1.87	0.76	1.49	6.06	-4.29
	B	-0.50	0.54	0.22	-1.29	-0.12	-12.50
Operating revenue	C	111.12	8.16	3.33	101.47	119.28	10.23
	O	41.81	5.97	2.44	33.16	50.34	15.51
	B	6.90	0.86	0.35	5.71	7.99	13.11
Profit	C	2.92	1.81	0.74	0.65	5.62	205.43
	O	4.76	1.94	0.79	3.08	7.71	120.29
	B	0.41	0.46	0.19	-0.22	0.92	-134.92
Subsidies	C	9.40	1.50	0.61	8.33	12.24	2.52
	O	12.78	1.79	0.73	10.75	16.08	17.77
	B	14.37	2.61	1.07	11.49	17.99	9.14

[a] Conventional; [b] Organic, and [c] Biodynamic. Source: Own elaboration.

Table 5. Economic efficiency indicator (%).

Indicator	Group of farms	Mean	Standard deviation	Standard error	Minimum value	Maximum value	2012 to 2007 % growth rate
Economic efficiency indicator	C	98.27	1.84	0.75	95.77	100.46	-2.92
	O	89.20	2.94	1.20	85.60	92.46	-6.79
	B	112.46	7.27	2.97	103.62	121.67	-8.54

Source: Own elaboration.

as well as gross value added and operating revenue. They prefer quality over quantity even at the expense of the low profitability, which was compensated by the subsidies higher value.

Although we have mentioned the possible explanations for a different amount of some indicators among the various groups of farms, a deeper analysis with a wider dataset needs to be done.

Apart from the same amount of subsidies that was given to conventional farms, organic and biodynamic farms received more subsidies within organic farming. Agricultural products are essential for provision of a society's needs and

[DOR: 20.1001.1.16807073.2016.18.4.16.0]

governments normally pay subsidies for their production in order to both strengthen the agricultural sector and keep prices lower for consumers (Azamzadeh Shouraki *et al*., 2013). The organic farming subsidies are primarily intended to compensate the higher positive externalities, which organic farms with comparison to conventional farms cause, and for payment of internalizing negative externalities. As a consequence of positive externalities existence, a lower quantity of goods is produced than an optimum in relation to social prosperity is (Soukupova *et al*., 2004). However, Kroupova and Maly (2010) found that subsidies to support organic farming demotivate organic producers, because they provide a sufficient income even at low production performance. On the other hand, Ansari *et al*. (2014) claim that the removal of subsidies from the agriculture sector may adversely affect low-income households.

Based on the economic efficiency indicator (Table 5), organic farms were the most efficient, followed by conventional farms, while biodynamic farms were inefficient. The differences within all groups of farms are statistically significant.

According to Brozova and Vanek (2013), the organic farms' production efficiency per hectare of farmland (measured by yields and costs) is higher mainly due to the subsidies and other factors such as higher retail price of bio-products, activities diversification etc. Production efficiency is also influenced by non-economic factors such as natural and climate conditions, production focus of the farms, market position, managerial skills, and also quality information availability and accessibility. Brozova and Vanek (2013) also mentioned a lower total production efficiency of organic farms in comparison to conventional farms, which is mainly resulting from stricter norms, limited number of processors, tradability of commodities, objective risks, etc.

Some authors used a different methodology to determine the efficiency of farms. Brozova and Vanek (2013) analysed the economic efficiency based on the amount of profit and financial analysis. They evaluated the organic farms as more efficient than conventional farms. Pechrova and Vlasicova (2013) also came to similar conclusion as we did. They reported that organic farms have a higher technical efficiency than biodynamic farms. The technical efficiency according to Bravo-Ureta *et al*. (2007) is the company's ability to produce the maximum amount of output with a given volume of inputs and with the given technology.

In contrast with our results, Kroupova (2010), Kumbhakar *et al.* (2009) and Madau (2007) determined that the technical efficiency of organic farms were lower than the efficiency of conventional farms. These different results indicate that further research is needed. The efficiency of farms is not determined only on the inputs and outputs but also other aspects need to be included, such as technology, management, marketing, etc. This multidimensional analysis could identify not only efficiency, but the overall effectiveness of farms.

Based on the calculated indicators of performance and indicators of financial analysis, methods for multidimensional intercompany comparison were used, which determine the economic results order of farms (1: Group of farms with the best results, 3: Group of farms with the worst results). Analysis was elaborated for 2012 and for comparison also the year 2007 was included. The results are shown in Table 6.

The best economic results were unambiguously reached by the organic farms, which in all methods (except M2) ranked the first place. On the contrary, the conventional farms can be classed as farms with the worst economic results due to ranking the third place. The category of biodynamic farms was rated variously. The simple ratio method even put this group in the first place. This method works with the middle value of the indicators, by which the value of the indicators is divided. Organic farms achieved the best results, on the other hand, the conventional farms the worst and the results of the biodynamic farms moved

[DOR: 20.1001.1.16807073.2016.18.4.16.0]

Table 6. Multidimensional intercompany comparison.[a]

Group of farms	Year	M1 [a]	M2 [b]	M3 [c]	M4 [d]	M5 [e]
Conventional	2007	3	3	3	3	2
	2012	2.5	3	3	3	2
Organic	2007	1	2	1	1	1
	2012	1	2	1	1	1
Biodynamic	2007	2	1	2	2	3
	2012	2.5	1	2	2	3

[a] Simple sum sequences method; [b] Simple ratio method; [c] Scoring method; [d] Standardised variable method, [e] Method of distance from an imaginary point. Source: Own elaboration.

around the average and that is why they received the first place in the simple ratio method.

Furthermore, the influence of subsidies on the *ROA* indicator, on profit and on sales per hectare of agricultural land was tested. The results are recorded in Table 7.

Subsidies significantly influenced *ROA* and sales of conventional farms. When the subsidy increased by 1 CZK, sales were reduced by 4.92 CZK (see first line of regression parameter of interest). This change is 92.18% explained by the estimated model (according to the R^2). The statistical significance of the change was confirmed by the *P*-value 0.04 (in the square brackets) which was compared with the 5% significance level. On the other hand, the conventional farms' *ROA* indicator was significantly increased by the subsidies. Each further 1 CZK of subsidy increased *ROA* by 0.001%. This change is 97.76% explained by the estimated model. Profit of conventional farms was also increased (the 1 CZK subsidy increase brought almost 1 CZK of profit), however, the subsidies impact was insignificant. In the case of organic farms, the negative impact of subsidies on all three analysed indicators was detected, but without statistical significance. Each 1 CZK of organic farms' subsidy obtained decreased their profit by 0.57 CZK, sales by 2.41 CZK, and *ROA* by 0.001%. On the contrary, subsidies had a positive impact on biodynamic farms. Each further 1 CZK of subsidy increased profit by 0.08 CZK, sales by 0.14 CZK and *ROA* by 0.0004%, nevertheless, the significance in any of the cases was not confirmed.

On the whole, subsidies can contribute to a better economic situation for biodynamic farms and can be a motivating factor that increases their products sales. Subsidies have a beneficial effect on the profitability of conventional farms, but a negative impact on the sales. Additional financial resources can represent a financial assurance, which, however, can be demotivating to increase or improve farms' activities. Conventional farms can see a confident financial support in subsidies, which may decrease motivation to sell and produce more products. Subsidies may worsen the economic situation of organic farms. Kroupova and Maly (2010) also found the negative impact of subsidies on organic farms' economic results. They claim that these farms can lose up to 15% of profit by receiving subsidies and, in addition, subsidies for organic farms can increase their costs and reduce the level of technical efficiency.

Nevertheless, to prove the results of the subsidies influence on different types of farms' economics situation, a deeper analysis with a wider dataset should be done. A questionnaire survey or interviews with farmers could evaluate those impacts more specifically. The survey could bring information about the subsidies usage, such as for what purposes they were used and whether they were used effectively, or whether subsidies brought farmers what they expected.

Table 7. Results of regression and correlation analysis. [a]

Indicator	Intercept coeff (β_0)	AR (1) coeff (β_1)	Regress par of interest (Γ_O)	Coeff of determ (R^2)	Correl coeff	Durbin *h*	Durbin *h* *P*-values
ROA–C	-0.1411 (0.0248) [0.0323]	2.3303 (0.2608) [0.0123]	1.0977e-05 (1,9592e-06) [0.0304]	0.9776	-0.1592	-1.5871	0.5766
ROA–O	0.1857 (0.0813) [0.14987]	0.4399 (0.4175) [0.4025]	-1.0471e-05 (5.3650e-06) [0.1902]	0.7343	-0.5606	-1.5658	0.4609
ROA–B	-0.0222 (0.0894) [0.8273]	0.2906 (0.4729) [0.4555]	4.3166e-06 (04.7015e-06) [0.4555]	0.314	-0.1237	2.2522	0.8902
Profit–C	-11 204.9 (4 237.67) [0.1182]	2.0335 (0.4046) [0.0374]	0.9875 (0.3567) [0.1095]	0.9347	-0.1941	-0.9532	0.2413
Profit–O	8 280.38 (5 133.07) [0.24805]	1.0292 (0.3996) [0.1235]	-0.5733 (0.3456) [0.2481]	0.8478	-0.2842	-1.5361	0.4856
Profit–B	-872.458 (2 383.55) [0.7494]	-0.008 (0.8998) [0.9938]	0.0829 (0.1435) [0.6215]	0.1643	-0.2029	1.7635	0.7082
Sales–C	82 222.1 (24 469.5) [0.0783]	0.6409 (0.2756) [0.1456]	-4.9208 (1.044) [0.0422]	0.9218	-0.1941	-1.2579	0.6866
Sales–O	40 687.8 (1215.93) [0.0009]	0.6202 (0.258) [0.1381]	-2.4088 (0.2953) [0.0147]	0.8112	-0.7239	0.2598	< 0.0001b
Sales–B	4 232.43 (5 144.96) [0.4972]	-0.6444 (1.291) [0.6671]	0.1427 (0.1149) [0.3403]	0.4503	0.5967	1.1872	0.3456

[a] Group of farms: Conventional, O: Organic and B: Biodynamic. [b] Autocorrelation with the use of higher order, then AR (1) cannot be removed because of the low number of observations. Therefore, the robust estimation of covariance matrix of the vector of estimated parameters was selected. Source: own elaboration.

CONCLUSIONS

We expected close similarities in economic results of organic and biodynamic farms and different economic results when compared to those of conventional farms. Moreover, we presumed that subsidies have a negative effect on the economic management of organic and biodynamic farms.

Although both types of farming, biodynamic and organic, belong to organic agriculture, according to the results of the above analysis, the assumption about a close resemblance of their economic results was not verified. From the financial analysis point of view, the statistically significant differences between organic and biodynamic farms indicators, apart from the parameters *ROE* and *ROA*, were found to be slightly different but not significantly. Besides, the

[DOR: 20.1001.1.16807073.2016.18.4.16.0]

statistically significant differences in these indicators were found when we compared organic and biodynamic farms to conventional farms.

Generally, all analyzed groups of farms belong to farms with low indebtedness. These farms tend to have a low *ROA, ROE*, and return on costs indicator. A liquidity of these farms measured by the current ratio was normal, except conventional farms, which had this indicator rather lower. However, none of the categories of farms abided the rule that says the assets in a farm should be turned over at least once a year.

Based on the perspective of the performance indicators and the economic efficiency indicator, we found all of the parameters as significantly different between biodynamic and organic farms, except the subsidies. Furthermore, the statistically significant differences in all of the indicators were found, when we compared those farms to conventional farms. However, the profits gained in organic and conventional farms were different, but not significantly.

On the whole, conventional farms had the highest costs, revenues and gross added value. Organic farms reached the highest profit and biodynamic farms received the highest amount of subsidies. Based on the economic efficiency indicator, organic farms were the most efficient, followed by conventional farms, while biodynamic farms were inefficient.

With reference to the multidimensional intercompany comparison, the organic farms reached the best economic results, while the conventional farms had the worst. Biodynamic farms were placed as second.

The negative impact of subsidies on the organic farms was detected in all three analyzed indicators including *ROA*, profit, and sales, but without statistical significance. A significant negative impact on the sales of the conventional farms was found. On the other hand, the positive impact of subsidies on the economy of the biodynamic farms was detected, but without statistical significance. Subsidies significantly increased the *ROA* of conventional farms, without statistically significant impact on their profit. Overall, subsidies may improve the economic situation of biodynamic farms; however, they can worsen that of organic farms.

All facts considered, we found significant differences among the economic results of various groups of farms. Farms were divided according to their approach to farming in organic, biodynamic, and conventional groups of farms, however, better distribution into groups could have been done and, for instance, groups such as farms' production types or sizes could have been included. Moreover, a deeper input and output analysis as well as a subsidies usage analysis should be carried out; nevertheless, it means that a deeper and wider dataset must be prepared. For a more accurate future evaluation, we suggest including more aspects e.g. amount of production, type of production, size of farms, used technology, or marketing and management aspects. A multidimensional analysis may be created because not only economic factors but also non-economic factors play an important role in the overall economic situation of farms.

Above all, the number of farms' sample was low, especially the biodynamic farms' number. As a result, this data cannot be generalized or considered representative for the whole Czech agricultural sector. Therefore, a good opportunity for research in other countries such as Germany, Italy, Switzerland or Austria arises, where the total number of biodynamic farms is higher.

ACKNOWLEDGEMENTS

This study was conducted within the projects of IGA, FEM, and CULS Prague: "Analysis of executing efficiency of awarded grants for the agricultural companies" (Reg. No. 20131019).

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چکیده

کشاورزی ارگانیک در جمهوری چک به تدریج از اهمیت بیشتری برخوردار می شود چرا که شمار مزارع ارگانیک و نیز دسترسی به محصولات زیستی رو به افزایش است. این پژوهش با هدف ارزیابی و مقایسه وضعیت اقتصادی مزارع ارگانیک، بیودینامیک و مزارع معمولی از طریق نشانگرهای تجزیه تحلیل مالی ، نشانگر های عملکردی، نشانگر های کارآیی اقتصادی و روش های چند بعدی مقایسه ای بین شرکت ها انجام شد. همچنین، تاثیر یارانه روی نشانگر های سود مزارع، فروش آنها و بازدهی دارایی (return on assets) با استفاده از مدل رگرسیون خطی با کاربرد فرایند اتورگرسیون (AR 1) تجزیه وبررسی شد. در این پژوهش، مجموعا ۳۸۹ مزرعه در جمهوری چک که طی سال های ۲۰۰۷ تا ۲۰۱۲ یارانه دریافت کرده بودند انتخاب شدند. در میان آن ها، ۲۷۳ مزرعه معمولی ، ۱۱۲ مزرعه ارگانیک و ۴ مزرعه بیودینامیک بودند. مزارع ارگانیک از همه بیشتر سوددهی داشت و بهترین نتیجه را در مورد نشانگر کار آیی اقتصادی داشت و در مقایسه بین شرکت ها رتبه نخست را کسب کرد. نتایج حاکی از آن بود که یارانه ها وضعیت اقتصادی مزارع ارگانیک را تضعیف می کند، هر چند که این نتیجه از نظر آماری معنی دار نبود. مزارع بیو دینامیک بیشترین یارانه ها را دریافت کردند. در بعضی سال ها، این مزارع سودی نداشتند. با وجود آن که مزارع بیو دینامیک بدترین نتایج را از نظر نشانگر کارآیی اقتصادی داشتند، در مقایسه بین شرکت ها در مقام دوم قرار گرفتند. پرداخت یارانه به طور معنی داری موجب بهبود وضعیت اقتصادی مزارع بیودینامیک شد و نقش عامل انگیزه را داشت. از سوی دیگر، مزارع معمولی که بالاترین مقدار عددی نشانگرهای نهاده و ستانده را (به استثنای سود) داشتند کمترین مقدار یارانه را دریافت می کردند. نیز، یارانه ها اثر مثبت معنی داری روی سوددهی این مزارع نشان دادند هر چند که اثرشان روی میزان فروش منفی بود.

[DOR: 20.1001.1.16807073.2016.18.4.16.0]