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A comparative analysis of organic and conventional farmers in the Czech Republic

Josef KRAUSE*, Ondrej MACHEK

Department of Strategy, Faculty of Business Administration, University of Economics, Prague, Czech Republic

*Corresponding author: krausej@vse.cz

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Abstract: Organic farming has become a topic that receives an increasing academic as well as popular attention. This study examines the financial differences between the organic and conventional farmers, as well as their income volatility. Based on the Student's *t*-test, the regression analysis and the matched-pair investigation on a sample of Czech 291 organic and 4045 conventional farmers over the period 2009–2013, the study indicates that the organic agricultural companies outperform the conventional companies in the terms of profitability. However, their asset turnover is considerably lower. No evidence of different income volatility has been found.

Keywords: ecological agriculture, organic farmers, performance, Czech Republic

Due to the increasing importance of the environment protection, the animal welfare concerns, and the maintenance of soil fertility, organic farming is becoming an area that receives an increasing academic as well as popular attention. However, due to various subsidies and legislation issues, organic farmers operate in a different economic environment, and they also have a different cost and income structures. A number of studies evaluated the comparative performance of organic farmers and conventional farmers, especially in terms of revenues and costs. However, a little academic attention has been devoted to other financial differences such as liquidity, debt use, or asset turnover.

There are several reasons why this topic is very current. The share of land covered by organic farms in the European Union and the Czech Republic has a growing trend (Table 1). Another reason is the necessity of evaluation the efficiency of subsidies. The amount of subsidies devoted to organic farming in the Czech Republic reached 1.272 mil. CZK in 2014 and this figure keeps increasing over the recent years (MA 2015). Further, organic farms also have advantages in other actions of the Rural Development Programme (MA 2015). Finally, one of the general trends in the society is the consumer interest for the environmentally friendly produced products (Makower 2009; Al-Taie et al. 2015).

The goal of this article is to explore the financial differences between the organic and conventional farmers using a quantitative approach. In particular, we focus on profitability, asset use efficiency, and income volatility of the organic and conventional farmers.

Table 1. Share of organic farms on the agricultural land in the selected EU countries (%)

Country	2008	2009	2010	2011	2012
EU (27 countries)	4.4	4.7	5.2	5.5	5.7
Austria	17.4	18.5	19.5	19.6	18.6
Sweden	10.9	12.8	14.3	15.7	15.8
Estonia	9.6	11	12.8	14.1	14.9
Czech Republic	9.0	10.6	12.4	13.1	13.1
Greece	7.8	8.5	8.4	5.2	11.1
Latvia	8.9	8.7	9.2	10.1	10.6
Italy	7.5	8.1	8.6	8.4	8.9
Finland	6.5	7.2	7.4	8.2	8.7
Slovakia	7.3	7.5	9.1	8.6	8.6
Spain	5.3	6.6	6.7	7.5	7.5

Source: Eurostat (2016)

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DIFFERENCES BETWEEN ORGANIC AND CONVENTIONAL FARMERS

The importance of organic farming in the Czech Republic can be illustrated by a quite high proportion in the whole agricultural land area. Table 1 illustrates the share of organic farms in the agricultural land in the selected EU countries. As to this share, the Czech Republic occupies the fourth place within the European Union (13%). Only Austria (with 18%), Sweden (with 16%) and Estonia with (15%) have a greater share of the organic farms area. As the table illustrates, the share of organic agricultural land keeps increasing in most EU countries.

The management of organic farming systems has a number of specifics. The structure of costs and income of organic farms is different from the conventional farms. Some differences arise from the applicable legislation (e.g. the Commission Regulation (EC) No. 889/2008)[1]. The restrictions and regulations given by the legislation affect, in particular, the costs of agricultural enterprises. In the following subsections, we discuss the differences that may affect costs, yields and prices of organic farms as compared to the conventional farms.

Costs

The legislation affects crop as well as livestock production costs.

The main differences in the crop production lie in the prohibition of the use of mineral fertilizers and chemical means of the plant protection (especially herbicides, insecticides and fungicides). However, the use of the biological crop protection products (for instance, plant extracts) is allowed. Organic farms have to resort more to the mechanical means of the plant protection. Therefore, higher average labour input costs of crop production can be assumed. Pimentel et al. (2005) argue that the labour inputs are, in average, higher by 15% in the organic agriculture than in the conventional agriculture. The authors further state that the use of labour is more uniform throughout the year than in the conventional farms. Higher costs of the organic dairy farms have also been confirmed by McBride and Green (2009). On the other hand, according to Crowder and Reganold (2015), organic farms have higher labour costs, but their total costs are not significantly higher. Past research thus presents rather inconsistent results, although the organic farms seem to have higher costs.

As to the legislation, there are also restrictions applicable to the livestock production. Greater requirements in comparison to the conventional farming are imposed on the animal welfare. For instance, the animals are required to have more space in the breeding facilities, and the slatted floors are prohibited. There are serious restrictions on the use of chemically synthesized pharmaceuticals in the animal breeding. The legislation affects the specific breeds or breeding lines in the organic farming. The possibilities of using intensive farming methods are limited; for example, the minimum slaughter age of poultry is given and the battery cages are totally prohibited.

It should be noted that the above described differences do not mean that organic farmers must necessarily have higher costs per unit area or per the unit of production. Lower unit costs of organic production can be achieved by the extensive organic farming, e.g. breeding a lower number of animals per hectare in less favourite (such as mountainous) areas. However, in the intensive production, the farms use organic fertilizers and biological crop protection products. These products can result in more expensive inputs of the organic farms as compared to the conventional ones.

Yields

In the organic agriculture industry, the crop yields are generally lower than the crop yields in the conventional farming (Moudry et al. 2008). This has been confirmed by the results of the organic production in the Czech Republic. For example, in 2014, the yields per hectare for cereals in the organic farming reached around 41% of the cereals yields in the conventional agriculture. The organic potato yields reached around 39% of the yields of the conventional agriculture (MA 2015).

The study of Mader et al. (2002) shows that the yields in organic agricultural systems are lower by 20%. Klima and Labza (2010) examined the yields of oats

[1]Commission Regulation (EC) No. 889/2008 of 5 September 2008 laying down detailed rules for the implementation of Council Regulation (EC) No. 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and contro. Available at http://eagri.cz/public/web/mze/legislativa/predpisy-es-eu/Legislativa-EU_x2006-2010_NarizeniEK-2008-889-EZ.html (accessed Feb 8, 2016).

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(pure sowing stands and mixed stands of oats, spring barley, triticale and spring) in both farming systems. The crop yields in organic systems have been found to be lower by 12% than those of the conventional systems. Higher yields in the cultivation of strawberries in the conventional system have been found by Conti et al. (2014). At the same time, the authors argued that the organic strawberry production results in a better quality of fruits. Halberg and Kristensen (1997) compared the crop yields on the Danish organic and conventional farms. In organic farms, the yield of grain crops was lower by 21–37% and the yield of fodder beet and grass and clover was lower by 12–18%. The differences have been attributed to the differences in climatic conditions and soil types.

To sum up, the past evidence suggests that organic farmers have lower yields, but on the other hand, it is possible to achieve a better quality of products.

Prices

Another factor that could influence the economic results of organic farms is the possibility of achieving higher prices of agricultural products (Berentsen et al. 2012). At the same time, other studies show that too high prices of organic products represent a barrier to repeated purchases (Marian et al. 2014). Some other studies also found that the customers were willing to pay by 20% more for organic products than for the conventional products (Sgroi et al. 2015a; Ankamah-Yeboah et al. 2016). This suggests that organic farmers have a better reputation in the eyes of customers who can be willing to pay a higher price for their products.

Subsidies

Subsidies play an important role in the management of organic farms. The current subsidies are given by the Rural Development Programme for the period 2016–2020. Subsidies in the organic system are (MA 2014):

– 80 EUR/ha/year for permanent grassland,
– 586 EUR/ha/year for vegetables and special herbs,
– 178 EUR/ha/year for arable land,
– 777 EUR/ha/year for intensively managed orchard,
– 408 EUR/ha/year for other orchards,
– 170 EUR/ha/year for landscaping orchard,
– 871 EUR/ha/year for vineyards and hop gardens.

Organic farming is considered to be a less burdening system of agricultural management for the environment. According to Drinkwater et al. (1995), a greater microbiological richness and a greater biodiversity can be found in the organic managed areas. A later study of Clark (1999) and Dritschilo and Wanner (1980) support this statement, finding that a larger number of ground beetles can be found under the organic managed area. The positive impact of organic farming on the species diversity (mostly depending on the organism groups and landscapes) was also confirmed by Bengtsson et al. (2005) and recently by Tuck et al. (2014).

Another positive effect of organic farming is a lower requirement on the amount of the used fertilizers, pesticides and energy. Mader et al. (2002) found that the input of energy and of fertilizers in organic farms was by 34–53% smaller and the input of the pesticides was by 97% smaller than in conventional systems.

Pimentel et al. (2005) concluded that the soil organic matter and biodiversity were consistently greater in the organic farming systems and further that the inputs of fossil energy were by about 30% lower in the organic systems than for the compared corn production in the conventional systems. Other frequently cited advantages of organic farming are maintaining of the soil and water resources (Pimentel 1993). Using the method of the life cycle assessment, Mohamad et al. (2014) confirmed a lower environmental impact of organic farms.

The most relevant study was presented by Brožová (2011), who found that the Czech organic farms' economic results were better, and were actively influenced by the subsidies. However, the study has several minor weaknesses that this article seeks to overcome. First, the analysis was based on a single year (2008). Second, the author did not employ statistical methods which presents a source of the potential misinterpretation. Third, the author used the absolute indicators (profit). The value added of our study is, therefore, to analyse the economic performance of organic farms within a longer time frame, to evaluate it statistically and to analyse other indicators than profit, especially the relative measures (profitability, liquidity, debt use, and asset turnover).

Obviously, the economic results of organic farms are determined by many positive and negative factors. Organic farmers face greater legal requirements on production processes that may results in higher unit production costs and a lower asset turnover. On the other hand, it seems that the positive effects prevail especially due to the subsidies that may enhance the stability of the organic farmers' profitability, and due

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to a positive reputation that allows organic farmers to set higher prices. Taking into account the above presented arguments, then, we hypothesize that:

Hypothesis 1: Organic farmers are more profitable than the conventional farmers.

Hypothesis 2: Organic farmers have a lower income volatility than the conventional farmers.

Hypothesis 3: Organic farmers have a lower asset turnover than the conventional farmers.

Since there is little evidence on the financial differences of the organic and conventional farms, we will also evaluate other financial differences: liquidity and financial leverage (indebtness).

MATERIALS AND METHODS

The national ID numbers of organic farmers were collected from the Czech Registry of Ecological Entrepreneurs (MA 2016). To collect financial data, we used the Bureau van Dijk's Amadeus database. As to the conventional farmers, we selected all other companies from the Czech Republic operating in the same NACE industries as the organic famers with known financial data. This way, we obtained data on 291 organic and 4045 conventional farmers. The years under consideration were 2009–2013, since the financial data for a number of companies was not available for 2014–2015. It should be noted that we used a non-probabilistic, conventional sampling method. The reason was the unavailability of financial data of a number of organic farmers, since most of them belong to the small- and microcompanies. However, we resort to the general rule of thumb stating that multivariate analysis requires at least ten observations per variable to provide robust results (Long 1997) and we consider the sample size to be large enough to evaluate the financial differences between the two groups, although some extent of undercoverage of certain groups of population could not be avoided.

Methods

All calculations were performed in the Stata 14. To compare the organic and conventional farmers, we used three approaches. First, we tested the mean differences using the Student's *t*-test with unequal variances. Since this approach does not allow for controlling for other factors, we used a linear regression analysis to control for the industry and other factors that are supposed to have impact on the dependent variables.

In the regression analysis, we used the robust (heteroskedasticity-adjusted) standard errors. We also evaluated the possible multicollinearity issues; no strong, statistically significant pairwise correlations between the independent variables have been found.

We also tested the differences using the matched-pair investigation by systematically creating pairs of comparable firms (see e.g. Allouche et al. 2008 or Machek and Hnilica 2015 who adopt this approach, among others), i.e. the firms that have similar operating conditions. The pairs were created as follows. First, to each organic farmer, we assigned a set of conventional farmers operating in the same industry (as defined by the four-digit NACE code). This way, the differences due to the different industry affiliations have been eliminated. Subsequently, from the set of firms that operated in the same industry, we matched firms in the terms of size (as measured by the total assets) – each organic farmer has been matched with one conventional farmer with the closest size. Hence, the differences due to the different business size have been eliminated. This way, we created 193 matched pairs of organic-conventional firms. Finally, a paired *t*-test was applied to the set of pairs.

Measures

To test the research hypotheses, we used the following dependent variables, each of them for a separate regression. We used the mean values for 2009–2013 to capture the year-to-year differences.

- *Return on assets* (earnings before interests and taxes over assets) as a measure of profitability.
- *Gearing* (debt over equity) as a measure of the financial leverage (indebtness).
- *Net assets turnover* as a measure of the asset use efficiency.
- *Current ratio* (current assets over current liabilities) as a measure of liquidity.
- *Volatility of profit margin* was measured as the standard deviation of the profit margin (return on sales) over 2009–2013.
- *Volatility of sales* was measured as the standard deviation of sales over 2009–2013.

We also used the following independent/control variables:

- *Organic* – a dummy variable taking the value of 1 if the firm is an organic farmer.

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Table 2. Descriptive statistics and mean differences

Variable	Organic (N = 291)		Conventional (N = 4 318)		t-statistics
	mean	std. dev.	mean	std. dev.	
Return on assets	6.364	7.402	5.428	9.332	2.050*
Gearing (D/E)	0.674	0.967	0.526	0.920	2.530*
Net asset turnover	0.882	1.195	1.702	2.051	–10.689**
Current ratio	4.408	5.260	4.801	7.052	–1.204
Firm age	16.698	6.229	15.807	6.747	2.347*
Firm size	10.781	1.324	9.510	1.898	15.337**
Volatility of profit margin	3.791	17.007	6.098	82.184	–1.443
Volatility of sales	0.266	0.264	0.319	0.369	–3.200**

**significant at 0.01 (two-tailed), *significant at 0.05 (two-tailed)

– *Industry affiliation* (4 dummy variables representing the broad industries based on the NACE classification) since the performance differs across the industries, e.g. mature industries tend to have declining profits, and industries have different levels of risk or extent of market imperfections.
– *Firm age* (by 2013) since the performance of firms depends on the stage of its lifecycle.
– *Firm size* (measured by the natural logarithm of the total assets) since the performance of firms also depends on the economies of scale (see e.g. Barbera 2013).

RESULTS

Table 2 presents the descriptive statistics including the results of the Student's t-test for mean differences. The results suggest that the organic farmers tend to have a higher profitability (as measured by the return on assets, significant at 0.05), use more debt (gearing, significant at 0.05) and have a lower asset turnover (significant at 0.01) which suggest a less efficient use of the productive assets. Further, we observe that the organic farmers tend to be older and larger firms. Organic farmers also experienced a lower volatility of sales (significant at 0.01). However, as we already mentioned, a simple t-test does not allow for controlling for the external factors, so the results should be interpreted with caution.

Table 3 presents the regression results. The regression controls for the industry, firm age, and firm size. *Organic* denotes the dummy variable representing the organic farmers. The results suggest that the organic farmers tend to be more profitable (significant at 0.01), and have a lower asset turnover (significant at 0.01). According to the regression, there are no statistically significant differences between the organic and conventional farmers in terms of liquidity, gearing and volatility of sales and profit margin. For the ROA, gearing, and the volatility of profit margin, the intercepts are not statistically significant. This means that we cannot rule out that they are equal to zero – i.e. there are no "autonomous" values of the return on assets, gearing or the volatility of profit margin that are due to other factors not included in the model. In other words, the response variables could possibly be equal to zero if the values of all the predictor variables were equal to zero. From the practical point of view, however, it is not realistic, since the age and size of firms never equal to zero, and the intercept is not of a great value for the results. The other explanatory variables account for most of the variation in the data.

Table 3. Regression results (N = 6941 observations)

Explanatory variable	Dependent variable					
	return on assets	gearing	asset turnover	current ratio	volatility of profit margin	volatility of sales
Intercept	3.946	0.030	2.018**	9.749**	13.804	0.895**
Age	–0.171**	–0.006**	–0.031**	0.070**	0.236	–0.005**
Size	0.495**	0.042**	–0.032	–0.670**	–1.512	–0.051**
Organic	1.484**	0.032	–0.378**	–0.378	–1.899	0.032

**significant at 0.01; besides the displayed explanatory variables, the regression also contained 4 dummy variables representing industry affiliations

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Table 4. Matched-pair test (N = 193 matched pairs)

Variable	Mean organic	Mean conventional	Difference
Return on assets	6.364	3.791	2.573**
Gearing (D/E)	0.674	0.538	0.137
Net asset turnover	0.882	1.086	–0.205**
Current ratio	4.408	4.620	–0.212
Volatility of profit margin	3.791	3.446	0.344
Volatility of sales	0.266	0.244	0.023

**significant at 0.01 (two-tailed), *significant at 0.05 (two-tailed)

The regression provides support for the hypotheses H1 and H3, but not for the hypothesis H2.

Finally, we employed a matched-paired investigation by systematically matching the pairs of similar (i.e. operating in the same industries and having the same size) organic and conventional farmers. Due to the data issues, we were able to match 193 pairs only. Table 4 presents the matched-pair test results. The results provide support for the hypothesis H1 and H3, but no support for the hypothesis H2. Organic farmers seem to be more profitable (significant at 0.01) and less efficient in terms of the asset turnover (significant at 0.01).

DISCUSSION

The results provide a strong support for the hypotheses H1 and H3 stating that the organic farmers are more profitable and have a lower asset turnover. On the other hand, we didn't find any significant evidence supporting the hypothesis H2 according to which the organic farmers have lower income volatility. We did not find any significant differences in liquidity and gearing. In this section, we discuss the findings in light of the prior research.

The results of the past studies are not unambiguous. According to Taube et al. (2005), the type of farms (specialized arable versus mixed farms) substantially affects the results. According to Nieberg and Offer (2003), profits of comparable organic and conventional farms are very similar. Profitability of organic farms is very dependent on higher prices of production. According to these authors, it was easier for the organic farms to achieve higher prices for the crop production, but more difficult for the livestock production. The authors also emphasized the high variability of the economic outcomes in different countries and in different types of farms. Volatility of profits was also confirmed by Burgoyne et al. (1995) who researched dairy farms. They noted that it is possible for the organic farms to achieve at least the same profitability as the conventional farms.

The results of the research of Acs et al. (2007) are consistent with our results. Organic arable farms in the Netherlands had better economic results than the conventional farms. These better economic results were caused mainly by higher prices of organic products as compared to the identical conventional products. This could be also one of the main reasons supporting our hypothesis H1. However, in the study of Acs et al. (2007), the effect of higher prices was mitigated by the lower yields and by the higher variable costs (in particular, labour costs). A better profitability of organic farms was also found by Sgroi et al. (2015b). These authors studied farms growing lemon orchards. In contrast with the previous authors, they concluded that the organic farms had lower labour costs. At the same time, they agreed with the importance of higher prices of organic production as compared to the conventional production. Shrestha et al. (2014) found better economic results of organic farms growing vegetables. Dobbs et al. (1996) researched the productivity and profitability of the conventional and organic farms over 8 years. According to their research profitability was higher by the conventional farms. Klíma and Labza (2010) found that the economic income of the organic farmers was higher despite the lower production in their farms. Our findings are consistent with these studies.

However, not all past studies found better economic results of the organic farms. Uematsu and Mishra (2012) examined the economic performance of the conventional and organic farmers in the US in terms of the farm household income. This research did not confirm any significantly higher household income of organic farms. The organic farms had higher revenues, but at the same time, they had higher production expenses mainly due to the higher labour, marketing and insurance costs. Debts measured by the indicator "debt to asset ratio" has been higher for the conventional farms as compared to the organic farms (Uematsu and Mishra 2012), which is, however, not consistent with our results.

Unlike the most relevant study of Brožová (2011), we used the cross-sectional data from the period 2009–2013 to control for the year-to-year variation of economic performance. We also employed statisti-

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cal methods to test hypotheses, and instead of the absolute values of income, we focused on various financial ratios, including the volatility of revenues and the profit margin.

CONCLUSION

The growing importance of organic farms across Europe is very clear. However, organic farms face challenges but also opportunities that are different to those of the conventional farms.

In this study, we evaluated the financial differences between the organic and conventional farms. We found that the organic farms had a better profitability and a lower asset turnover. On the other hand, we have not found any statistically significant differences in terms of the income and profit margin volatility, liquidity and use of debt. Our findings are mostly consistent with the prior literature and extend the state-of-the-art by evaluating other indicators than just profitability.

As we already mentioned in the introduction, a little academic attention has been devoted to the financial differences between the organic and conventional farms in general. Our study is one of the few which analysed other financial indicators than profitability.

This study also has its limitations. The most important one is the sampling technique. Due to the unavailability of financial data for very small organic farms, we were able to compare only a limited number of agricultural companies, especially the legal entities, not the individuals. However, even though the sample is not comprehensive, we believe that the results suggest that there are differences between the organic and conventional farms. The second limitation was the use of the Czech data only. Profits of agricultural firms are very country-dependent. We also evaluated only financial data from a limited (five-year) period.

The further research should be directed towards evaluating other differences, both financial (such as various kinds of costs) and natural indicators. The research should also be concerned with comparing the organic and conventional farmers in multiple countries to eliminate the country-dependent differences.

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