Multifactor Productivity, Financial Performance and Economic Value Added of Agriculture in the Czech Republic after the Economic Crisis

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Abstract: - In recent years, a particular emphasis has been placed on the measurement of productive efficiency of agricultural sectors. In this article, the efficiency development of the Czech agricultural sector has been analyzed using the following measures of performance: multifactor productivity, economic value added, and financial performance. The authors also compared the development of the values of these indicators with the development of the GDP growth. No statistically significant correlation between the development of the economy and the performance indicators has been found. This finding supports the hypothesis that agricultural growth does not necessarily follow the overall economic development. The authors also observed a sharp drop of all efficiency measures in 2008/2009 which has been due to the economic crisis which hit all Czech industries and sectors. However, in recent years, the performance of the Czech agricultural sector has been increasing which supports the hypothesis that the Czech economy is recovering from the economic crisis.

Key-Words: -Productivity; economic value added, financial performance; agriculture; Czech Republic.

1 Introduction

The growth of productive efficiency of agricultural sectors isan important goal of economic policies worldwide since agriculture represents an important sector of the economy and provides inputs for other industries. The agricultural sector affects directly and indirectly a significant part of a country's population and its wealth, especially in rural areas.

At the same time, a significant emphasis is placed upon productivity sincedue to environmental policies and urbanization, the arable land is becoming a limited input factor in most developed countries. Other approaches to measuring performance involve financial performance indicators or economic value added (EVA) analyses.

In this article, the authors estimate the multifactor productivity development of the agricultural sector in the Czech Republic and compare it its financial performance and economic value added creation. The differences and implications arising there from are also discussed.

2 Measuring Performance of Agricultural Sector

The output of the agricultural sector may be measured directly in physical units or indirectly in monetary value. The measurement of physical units such as wheat units is a theoretically sound approach (see e.g.[2]) but it is not always feasible because of the lack of data.

A more frequent approach is to measure the output of agriculture by monetary units such as value added or gross output.The gross output is represented by the monetary value of all produced outputs, while the value added is the difference between the value of the production and the value of intermediate inputs. Sometimes, the "final output" measure is used, which is obtained from the gross output by subtracting the value of agricultural inputs only (see[12]).

Inthe Czech agricultural sector, the productivity has been measured by various approaches. Authors have usedtotal factor productivity method ([4], [6]), data envelopment analysis ([8], [1], [13]) or stochastic frontier analysis ([5], [11]). Each of the approaches has its advantages and disadvantages. The problem of DEA and SFA methods is that they requirethe estimation of distance frontier function.Thus, when the sample is too small, the calculation of frontier can be biased and an unacceptably large share of the sample seems to be fully efficient.

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Productivity is often divided into total factor productivity (TFP), which takes into account all possible inputs and outputs, multifactor productivity (MFP) which deals with the relationship between output and multiple input factors, and partial factor productivity (PFP) which deals with the productivities of individual inputs. Perhaps the most popular PFP measure is the labor productivity which is often used in comparisons of productivity across sectors or economies. At the same time, labor productivity reflects the ability to acquire income through sale of agricultural goods or agricultural production (see [2]).

Total factor productivity is often seen as a measure of technological and human capital development. Nelson ([9]and[10]) found out that there is an important relationship between capital formation, labor allocation, technical progress on one side, and productivity on the other hand.

The inputs for productivity analyses generally include land, labor, and capital, sometimes also accompanied by materials, energy and services (KLEMS). Since the amount of land does not change considerably, it is often omitted from the analysis since the year-to-year change (index) of this factor is negligible. The production function then most often contains only two variables: labor (L) and capital (K).

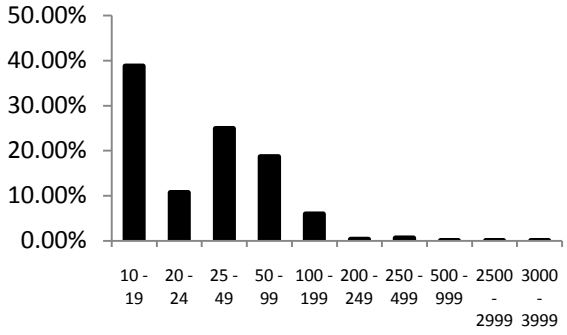
At the same time, productivity is not the single measure of an industry's performance. A common and popular approach is to measure performance using financial indicators, especially profitability ratios such as return-on-assets (ROA) or return-on-equity (ROE). A more modern approach involves measurement of economic value added (EVA) which is an indicator developed by Stern Stewart & Co. in 1993 and captures the cost of equity, which is the most expensive portion of a company's capital.

Machek and Špička [7] found that productivity of agriculture does not necessarily follow the domestic economic cycle, since the output of the agricultural sector is largely dependent on foreign demand as well as weather conditions.In this article, the authors will examine whether an increasing multifactor productivity has been accompanied by stronger financial performance and economic value added (EVA) creation.

3 Data Characteristics

To collect data on the Czech agricultural sector, the Albertina database which contains about more than2700000 subjects with registered ID in Czech Republic has been used.The authors focused on companies with complete data having more than 10 employees operating in the agricultural domain.The total sample contained 2237 company-years. The authors present the basic characteristics in terms of number of employees, legal forms and geographical location in the Czech Republic. The period under consideration was 2007-2012.

Fig.1: Classification according to number of employees (2007-2012)



Source: Albertina database, own calculations.

Figure 1 suggests that most companies are small with less than 50 employees. A minor part of agricultural companies belongs to the class of medium-sized companies (50-250 employees), which the class of large-sized companies is negligible.

It is also possible to compare the legal forms of Czech agricultural firms (Table 1). Most companies are limited companies (39%), followed by stock companies (25.3%), cooperatives (21.3%) and private entrepreneurships (12.7%). The proportion of other legal forms is non-significant.

Table 1: Legal forms of Czech agricultural companies(2007-2012)

Legal form	Count
Limited liability company	873
Stock company	567
Cooperative	476
Private entrepreneur	284
Allowance organization	16
Co-partnership	7
State company	5
Others	9

Source: Albertina database, own calculations.

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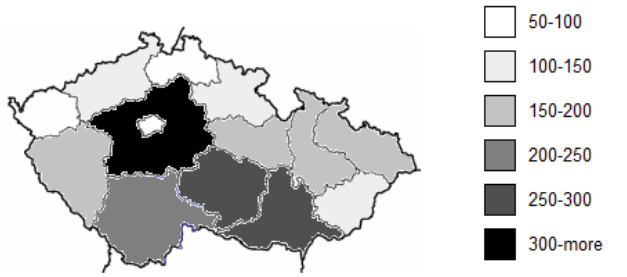
Unsurprisingly, most Czech agricultural companies are located in rural areas, as depicted on the map on Figure 2. Central Bohemia is the area with most agricultural firms (13.6%), followed by Southern Moravia (12.38%), Vysočina (11.18%) and Southern Bohemia (10.91%) regions.

Fig. 2: Location of Czech agricultural companies



Source: Albertina database, own calculations.

4 Methods

In order to evaluate the performance of agricultural companies, three methods have been chosen:

- Multifactor productivity (MFP);
- Financial profitability;
- Economic value added (EVA).

4.1 Multifactor productivity

Multifactor productivity is the ratio of an index of agricultural output to an index of agricultural inputs. In economics, it is often measured indirectly: the amount of growth not explainable by the increase of input factors (also referred to as Solow residual). In this article, the classical MFP formula has been used.

Equation 1

$$\frac{Y_1}{Y_0} = \frac{A_1}{A_0}\left(\frac{K_1}{K_0}\right)^{1-\alpha}\left(\frac{L_1}{L_0}\right)^{\alpha}$$

whereY_1/Y_0represents the index of gross value added (in constant prices), $K_1/K_0$is the index of net assets in constant prices, $L_1/L_0$is the index of working hours, α is the ratio of labor compensation over gross value added and $A_1/A_0$is the multifactor productivity (see e.g.[13]).

4.2Financial profitability

Financial performance is often measured by profitability ratios. These ratios are used to evaluate a business's ability to generate earnings compared to its expenses incurred during a period of time. In order to measure the financial performance of the Czech agricultural sector, the authors employed well-known measures of profitability: return on assets (ROA), return on equity (ROE) and return on sales (ROS).

4.3 Economic value added

Perhaps the most contentious is the measurement of economic value added which involves measurement of the cost of equity, which should reflect the required rate of return to equity investors. One of the possible formulas to calculate economic value added (EVA) is

Equation 2

$$EVA = (ROE - r_e) \times E$$

whereROE denotes return on equity (net earnings over equity),E denotes equity andr_e denotes cost of equity. All variables except r_e can be obtained from financial statements of the companies. In order to estimate r_e, the CAPM model has been used (see e.g.[17]). Under this approach, the cost of equity is estimated as

Equation 3

$$r_e = r_f + \beta_{lev} ERP$$

Where r_f is the risk-free rate, β_{lev} is the levered (equity) beta and ERP denotes equity risk premium, the difference between expected market return and the risk-free rate. While the values of yearly country-specific ERP and unlevered betas β_{unl} were obtained from the database of prof. Damodaran[5], the risk-free rate was proxied by the average return on Czech 10-year government bonds [3]. The unlevered betas were converted into levered betas using the formula

Equation 4

$$\beta_{lev} = \beta_{unl}\left[1 + \frac{D}{E}(1-t)\right]$$

5 Results and Discussion

Before the interpretation of results, it should be noted that the agricultural sector often represents an aggregation of heterogeneous activities, and that the only output taken into account is the gross output, which means the authors don't work with physical units and the real productivity may be biased due to changes in output and input prices.

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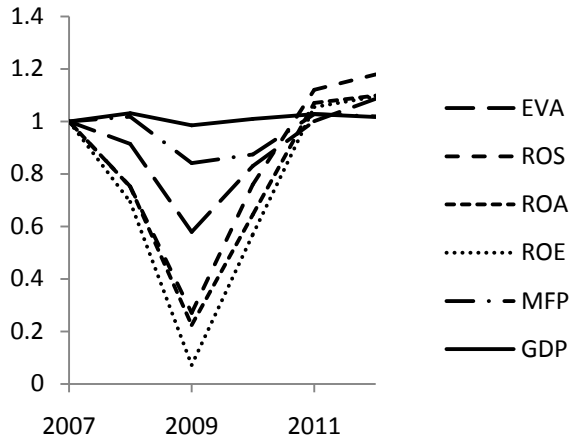
Agriculture is characterized by a relatively high degree of competition, which is generally accompanies by a higher level of productivity than in more concentrated markets (see e.g.[8]). The main source of gross output volatility in agriculture is fluctuation of prices and year-by-year changes in yields as the result of changeable weather conditions. However, partially or fully decoupled payments serve as a "financial pillow" increasing the level of the farmers' income and extending the companies' decision-making possibilities[19].

On Fig. 3 and Tab. 2, the development of performance indicators in the period 2007-2012 is illustrated in terms of fixed-base indexes. The authors also compared the development of performance indicators with the overall growth of the Czech economy measured by the GDP growth [3]. Since the agricultural sector provides basic inputs for the peoples' livelihood and is highly dependent on changing natural conditions, there should be only a relatively low sensitivity to the overall economic growth.

Fig. 3: Development of performance indicators (fixed-based indexes)



Source: Authors

Table 2: Development of performance indicators (fixed-based indexes)

	EVA	ROS	ROA	ROE	MFP	GDP
2007	1.00	1.00	1.00	1.00	1.00	1.00
2008	0.91	0.75	0.75	0.69	1.02	1.03
2009	0.58	0.27	0.22	0.07	0.84	0.98
2010	0.83	0.76	0.65	0.57	0.87	1.01
2011	1.00	1.12	1.07	1.05	1.03	1.03
2012	1.09	1.18	1.10	1.09	1.02	1.02

Source: Authors

In the first year, the multifactor productivity followed the GDP growth, as opposed to other indicators which decreased considerably. The drop of performance has been significant in 2008/2009, especially in terms of profitability. This negative development of performance has been followed by a substantial increase in the next year. Since 2010, all indicators have been growing. The comparison reveals that the performance of agricultural companies does not always move with the economic cycle which is consistent with prior findings ([9], [10]). However, on Fig. 3, it's possible to clearly identify the negative impact of the 2008-2009 economic crisis.In 2007 and 2011, agricultural enterprises in the Czech Republic attained the best economic results since the EU accession. Even though EVA has been negative in all years under consideration, it seems that the Czech agricultural sector has recovered from the economic crisis.

The authors also determined the correlation coefficient between individual variables using the MATLAB software (see Tab. 3). Although the time series is not long enough, it is possible to see that the performance measures were not significantly correlated with the GDP growth. The correlation analysis also revealed that EVA is significantly correlated with profitability in terms of return on sales (profit margin), return on assets and return on equity.Return on sales is significantly correlated with the return on assets and return on equity. Multifactor productivity is not significantly correlated with other performance measures, although in theory, there could be some degree of dependence [7].

Table 3: Correlation coefficients

	EVA	ROS	ROA	ROE	MFP	GDP
EVA	1.00					
ROS	0.98*	1.00				
ROA	0.99*	0.99*	1.00			
ROE	0.99*	0.99*	1.00*	1.00		
MFP	0.89	0.82	0.88	0.88	1.00	
GDP	0.83	0.76	0.80	0.81	0.89	1.00

Note: * Significant at $\alpha = 0.05$

6 Conclusion

Agriculture is an important economic sector which affects directly or indirectly a significant part of a country's population. In recent years, a particular emphasis has been placed on the measurement of productive efficiency of this sector.

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In this article, the authors analyzed theefficiency development of the Czech agricultural sector using the following measures of performance: multifactor productivity measured by the Solow residual approach, economic value added, and financial performance measured by three profitability ratios: return on equity, return on assets and return on sales. The authors also compared the development of the values of these indicators with the development of the GDP growth.

No statistically significant correlation between the development of the economy and the above-mentioned performance indicators has been found. On one hand, the authors had only a limited time series, but on the other hand, this finding supports the hypothesis that agricultural growth does not necessarily follow the overall economic growth due to its dependence on foreign demand and sensitivity to weather conditions. It was also possible to observe a sharp drop of all efficiency measures in 2008/2009 which has been due to the economic crisis which hit all Czech industries and sectors. However, in recent years, the performance of the Czech agricultural sector has been increasing which is a positive finding and supports the hypothesis that the Czech economy is recovering from the economic crisis.In should also be noted that a longer time period is needed to test the dependence more accurately. This will be one of the directions of the future research.

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