

## Firm Size as a Determinant of Firm Performance: The Case of Swine Raising

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### Abstract

The aim of the paper is to evaluate the effect of firm size to the economic performance of firm belonging to the raising of swine sector (CZ-NACE 01.460). The economic performance is assessed using multiple-criteria evaluation of alternatives methods where the selected coefficients of the profitability ratios, labour productivity and operating ratio are used as the indicator of economic performance. To assess the relationship between firm size and firm performance, the linear regression model is used. The study uses data collected from the database Albertina CZ Gold Edition for the year 2013 that are provided by Bisnode company and from Business Register. The results showed that the larger firms reached higher economic performance compared with smaller ones. These finding indicates that economies of scale are likely to play an important role in sector of raising swine.

### Keywords

Economic performance, firm size, linear regression model, operating ratio, profitability ratios, labour productivity, multi-criteria evaluation.

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### Introduction

The sector of raising of swine belongs to the traditional and very important sector of agricultural animal production in the Czech Republic. According to the Czech Statistical Office data, the production of pigs in tonnes of live weight was 302 thousand in 2014 which represented more than 64 percent of total production of livestock for slaughter. The consumption of swine meat is equally important. It was 40.7 kg per capita which represented more than 50 percent of total consumption of meat in 2014 in the Czech Republic. Nevertheless, the self-sufficiency rate in pig meat production reached approximately 58 percent. The domestic production of pig meat dramatically declined from 1989. Pig production of livestock for slaughter decreased more than half from 763 thousand tons of live weight in 1989 to 302 thousand tons. (Czech Statistical Office, 2016; Ministry of Agriculture, 2015)

The problems of this sector are viewed from various aspects. One comprises the international comparison (IAEI, 2013), another ones uses the deeper description of the situation

in this sector inside the Czech Republic during several years (Machek, 2011; Špička, 2014) or examines differences of economic outcomes and costs in pig breeding (e.g. Boudný and Špička, 2012 or Štolcová and Homolka, 2012). According to Špička (2014), the financial situation of Czech pig breeders differs significantly and there is big gap between top and bottom pig breeders. There could exist more different factors behind this fact such as another farming activity of the company (not only raising of swine) or different cost connected with the pig breeding (own or purchased feed), nevertheless one of the factor could be firm size (Bojnec and Latruffe, 2011) that might be connected with the economies of scales, competitiveness, market and negotiation power.

The main aim of the paper is to evaluate the effect of firm size to the economic performance of firm belonging to the raising of swine sector (according to CZ-NACE classification) in the Czech Republic.

### Review of literature

The performance of the firm and their measurement belong to the very important and discussed issues not only in academic sphere but also at the level

of corporate top management and owners. There are a lot of studies dealing with this issue (for example Hult et al., 2008 or Richard et al., 2009). According to Richard et al. (2009, p. 719) „organizational performance is the ultimate dependent variable of interest for researchers concerned with just about any area of management“. March and Sutton (1997) investigated all articles published in three years (1993-1995) in three prestigious journals – the Strategic Management Journal, the Academy of Management Journal and the Administrative Science Quarterly. Performance occurred as variable in 28% of those articles.

The measurement of performance varies in individual studies and many of them not even define this concept (Hult et al., 2008). The clear definition of the performance can be found in the study of Hult et al. (2008). There are divided three types of performance: financial performance, operational performance and overall effectiveness. The financial performance contains overall profitability (ROE, ROA, ROI, ROS), profit margin, earnings per share, stock price, sales growth of foreign sales, Tobin's Q. The operational performance includes product-market outcomes (e.g. market share, efficiency, innovation) and internal process outcomes (e.g. productivity, employee retention and satisfaction). The overall effectiveness contains reputation, survival, perceived overall performance, achievement of aims and perceived overall performance. Žižlavský (2015) divides performance methods into two groups – financial (Balanced Scorecard, budgeted, cost accounting with or without cost centres, EBITDA, EBIT, economic value added, payback period, revenues from innovation or profitability indicators like ROI, ROE, ROA, ROS) and non-financial tools (cannibalization of existing products by innovation, customer satisfaction indicators, growth of market share, innovativeness, number of new customers, patents or productivity and activity indicators). Fey and Denison (2003) mention that some scholars have criticized subjective indicators of effectiveness. That is one of the reasons why we decided to work only with financial and operational performance measures in this study.

There are a lot of methods which are used to evaluate firm performance. This is usually evaluated using the set of indicators. Yang et al. (2010) made a summary of research techniques for performance measurement including: graphical tools (spider and radar diagrams, Z chart), integrated performance indices (e.g. analytic hierarchy process - AHP or principal components analysis

- PCA), statistical methods (e.g. regression analysis) or data envelopment analysis (DEA). Some authors use for measurement of organizational effectiveness multiple-criteria evaluation of alternatives methods as WSA, TOPSIS, ELECTRE or PROMETHEE methods (for example Wang and Hsu, 2004; Yalcin et al., 2012; Kuncová and Štouračová, 2014). There are a lot of studies where only one indicator (most commonly equity ratio, productivity or profitability) is used as a performance measurement (e.g. Coad et al., 2013).

We use multi-criteria evaluation of alternatives method (specifically TOPSIS) to evaluate the economic performance in this study. This method is used in application on the agriculture sector for instance in the studies by Svatoš and Chovancová (2013) or Šišková (2015). Svatoš and Chovancová (2013) investigated the influence of subsidies on the economic performance of farms in the Czech Republic. To evaluate the economic performance they used six proportional indicators of financial analysis (Total Capital Profitability, Operating Profitability of Receipts, Term of Payment of Obligations, Acid Test Ratio, Interest Coverage and Self-Financing Coefficient) and applied WSA and TOPSIS methods. The aim of the paper from Šišková (2015) was to create and to describe application of five type of multi-criterion models for comparison of production options of agricultural biogas plants.

The relationship between firm size and firm performance is a key topic of a lot of scientific studies. These studies usually control other factors that affect the firm performance, mostly age and capital. Most of studies focused on the link between firm size and performance applied linear regression model (for instance Majumdar, 1997; Agiomirgianakis et al., 2006; Liargovas and Skandalis, 2010; Rajčániová and Bielik, 2008) and as explanatory variable were used beside firm size and firm age also selected firm performance indicators.

From the economic theory point of view the relationship between firm size and firm performance is not clear. First view believes in the abilities of large firms to exploit economies of scale and scope and the formalization of procedures or more effective implementation of operations. Thanks to these characteristics larger companies should have better performance than smaller counterparts. Opposite view comes from thesis that firm size is connected with market power and bigger market power creates more x-inefficiencies (Majumdar, 1997).

From a theoretical point of view the relationship between age and firm performance is also ambiguous. Older firms should be more experienced and use the benefits of learning. The older companies can build good network business partners and consumers, and have very good relationship with financial organizations. These facts lead to better firm performance of older firms in comparison with younger ones (Majumdar, 1997; Radipere and Dhliwayo, 2014). Another view suggests that older firms are not so flexible to make rapid adjustments to switching circumstances and this fact speaks in favour of weak performance (Majumdar, 1997; Agiomirgianakis et al., 2006).

The empirical analysis of relationship between firm size, firm age and firm performance is the subject of the study by Majumdar (1997). With the help of a sample of 1020 Indian firms he examined how firm performance is affected by firm size and age. He controls other specific factors as ownership, pro-export orientation, diversity, capital intensity, etc. In this study the firm performance was measured by productivity and profitability. For measuring productivity there was used the ratio of value added to the value of production. Profitability is measured with the help of returns on sales or the margin on sales. The main finding of this study is the fact that larger companies were more productive and less profitable than smaller firms. Older firms were found less profitable and more productive in comparison with younger companies.

Agiomirgianakis et al. (2006) investigated panel of 3094 Greek manufacturing firms for 1995 and 1999 to identify the key indicators of firm profitability and growth. They used return on assets as an indicator for measuring profitability and number of employees as indicator of firm growth. The broad set of explanatory variables was used: firm size, age, location and exports, asset structure, capital structure, reliance on debt, employee productivity and managerial efficiency. The results indicate a statistically positive relationship between firm size and return on assets and only weak statistically significant relationship (at 10% level) between age and profitability.

Liargovas and Skandalis (2010) discovered positive relationship between firm size and financial performance indicator return of equity of 102 listed companies in the Athens Stock Exchange in the period 1997-2004. No significant link was found between firm size and two other indicators – return on assets and return on sales. The authors also investigated

if firm performance was affected by firm age. They confirmed significant negative link between firm age and two financial indicators – return of equity and return on sales. In the case of return of assets this negative link was not statistically significant. In this study they control seven other variables, which might affect firm performance: leverage, liquidity, capitalization ratio, investment, location, export, and management efficiency.

According to Gaur and Gupta (2011), large companies achieve better performance than their smaller counterparts. They focused on the Indian IT industry and tested firm for two different years (2001 and 2008) separately. They worked with Tobin's q as an indicator of firm performance. There was also found a positive link between the age and the firm performance. In this study they control for leverage and group affiliation as other determinant of performance.

Coad et al. (2013) focused on Spanish manufacturing companies over the period 1998 to 2006 and examined the relationship between firm age and firm performance. They used three indicators of firm performance: productivity, profitability and equity ratio. They confirmed that firm age has positive effect on productivity (defined as value added divided by employees) and on the equity ratio and negative effect on profitability (measured as the ratio of profits over sales). They controlled firm size, short term and long term debt ratios. As regards the firm size the link between firm size and firm performance was positive for all three indicators of firm performance.

Radipere and Dhliwayo (2014) used the set of subjective indicators to assess the firm performance. The respondents were asked to state how their enterprise (areas: income, profit, market share, return on investment, number of employees and product line) performed in the past five years. Using the sample of 500 SMEs in retail industry they concluded that there is no statistical significant link between business size and firm performance.

Empirical studies also show that the initial size of company, specifically amount of start-up capital, could be other factor affecting the firm performance, specifically in the case of new companies and capital-intense industries. Cooper et al. (1994) focused on the influence of initial capital on new venture performance. The venture performance was measured with two indicators – survival and growth of venture. The impact of initial resources on subsequent performance was found strong. The similar conclusion is indicated

in the study by Gottschalk and Niefert (2011). They examined the influence of start-up capital on selected performance indicators – sales and return on sales. The effect of start-up capital is positive whereas the impact of start-up capital on return on sales is insignificant.

There are some studies that address the issue of performance of agriculture firms and the determinants of their performance. Rajčániová and Bielik (2008) analysed the determinants of firm-level profitability (measured by return on assets) on a sample of 111 agriculture enterprises from Slovakia. They use linear regression model that contains beside firm size (measured by total assets) also market share (the proportion of firm sales in industry sales), gearing ratio (non-current liabilities plus loans divided by shareholder funds), profit of previous year and liquidity ratio measured by current assets minus stock divided by current liabilities. They found no statistically significant link between the firm size and the profitability. Firm-level profitability was positively influenced by profitability from previous year, gearing ratio and liquidity ratio. Mugerá and Langemeier (2011) dealt with a question whether technical efficiency is affected by firm size or specialization using the sample of more than 500 Kansas farms. To estimate the technical efficiency they used the input oriented framework. One of the findings of the study is a fact that smaller farms are less technically efficient than their larger counterparts.

Bojnec and Latruffe (2013) examined the role of agricultural subsidies and farm size on Slovenian farms' performance. As indicators for measuring farm performance they used technical efficiency, allocative efficiency, economic efficiency and profitability. The technical efficiency is calculated with the help of DEA model under the assumption of constant returns to scale. Allocative efficiency indicates whether inputs are used in an optimal combination given their respective prices and whether substitution among inputs is required. Economic efficiency indicates overall efficiency of farms and it is a product of technical and allocative efficiencies. The profitability is measured with the help of cost-revenue ratio which is computed as the total costs from production to total revenue from production. They revealed significant positive link between farm size and technical efficiency and economic efficiency. On the other hand they found negative effect of farm size on profitability.

There was already some research focused

on economic results of the Czech pig breeders. For instance Boudný and Špička (2012) examined differences of economic outcomes in pig breeding which is affected by the production efficiency of sows and fattening pigs. They measured the economic performance with the help of profitability of pig farming. Špička (2014) investigated financial results of Czech firms in pig breeding area in the period 2007 – 2013. For the evaluation of financial situation he used profitability ratios (ROE, ROA and ROS), capital structure indicators (Debt-Equity ratio, Debt Ratio and Financial Leverage), liquidity ratios (Current Ratio, Acid Test Ratio and Cash Ratio), cash conversion cycle indicators (Days Inventory Outstanding, Days Sales Outstanding and Days Payable Outstanding) and other financial ratios (The Share of Net Working Capital in Total Assets, Labour Productivity and Investment Activity). He found big differences among companies in profitability (measured by ROA, ROE and ROS) because of differences in labour productivity. The best companies had four times higher labour productivity in comparison with the worst quarter.

## **Materials and methods**

As it was mentioned before we compared the economic performance of the companies belonging to the sector CZ-NACE 01.460 – Raising of swine in the year 2013. These companies have raising of swine as a main activity. The used data come from database Albertina CZ Gold Edition that is provided by Bisnode company and from Business Register. According to the database Albertina 45 companies had this type of activity in 2013. Because of the fact that some data for 3 companies were missing we excluded them from the analysis. The final dataset covers the data of 42 companies.

To evaluate the economic performance of companies we use multiple criteria evaluation of alternatives. These methods are usually used in the situations where it is necessary to compare a lot of different alternatives according to the selected criteria in order to find the best alternative, to separate the alternatives into acceptable and non-acceptable or to create the order of alternatives (Yoon and Hwang, 1995). Firstly the aim of the decision-making process must be specified and then the criteria, alternatives and the preferences of the decision maker must be defined. The preferences can be described by aspiration levels (or requirements), criteria order or by the weight of the criteria (Hwang and Yoon, 1981).

The model of multi-criteria evaluation of alternatives contains a list of alternatives  $A = \{a_1, a_2, \dots, a_p\}$ , a list of criteria  $F = \{f_1, f_2, \dots, f_k\}$  and an evaluation of the alternatives by each criterion in the criteria matrix with information about the evaluation of each alternative by each criterion (Fiala, 2008). The theory of multi-criteria evaluation of alternatives offers many different methods for this kind of problems. For the analysis we selected TOPSIS method in which the minimization from the ideal alternative principle is included (Laly and Liu, 1994; Fiala, 2008).

TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method is able to rank the alternatives using the relative index of distance of the alternatives from the ideal and negative ideal (also called basal or nadir) alternative. Higher relative index  $c_i$  of distance means better alternative. The user must supply only the information about the weights of criteria (Laly and Liu, 1994). This method can be used not only for the evaluation of companies (like in Yalcin et al., 2012; Wang and Hsu, 2004 or Kuncová and Štouračová, 2014) but also for the evaluation of different products, services or for the ranking of countries according to the selected criteria (Kuncová and Doucek, 2011).

The output provided by TOPSIS is a complete arrangement of possible alternatives with respect to the distance to both the ideal and the basal alternatives incorporating relative weights of criterion importance. The required input information includes decision matrix  $\mathbf{Y}$  with the information about all selected alternatives  $a_1, \dots, a_p$  according to all criteria  $f_1, \dots, f_k$  and weight vector  $\mathbf{v}$  of these criteria. This decision-making approach can be summarized in the following steps (detailed description of steps and notation in Yoon and Hwang, 1995 or Fiala, 2008):

- normalize the decision matrix according to Euclidean metric:

$$r_{ij} = \frac{y_{ij}}{\sqrt{\sum_{i=1}^p y_{ij}^2}}, \quad \forall i = 1, \dots, p, \quad j = 1, \dots, k, \quad (1)$$

where  $r_{ij}$  is the normalized value for each alternative  $i$  and criterion  $j$  (i.e. the value between 0 and 1) when the real value of the given criterion and alternative is represented by value  $y_{ij}$ . In our case study we have 42 companies as alternatives and 5 criteria (Return on assets, Return on equity, Return on sales, Labour productivity and Operating ratio).

- calculate the weighted decision matrix  $\mathbf{W} = (w_{ij}) = v_j \cdot r_{ij}$ , and from the weighted decision matrix  $\mathbf{W}$  identify vectors of the hypothetical ideal  $H$  and basal  $D$  alternatives over each criterion

$$H_j = \max_i (w_{ij}), \quad \text{for } j=1,2,\dots,k \quad (2)$$

$$D_j = \min_i (w_{ij}), \quad \text{for } j=1,2,\dots,k \quad (3)$$

- measure the Euclidean distance of every alternative to the ideal and to the basal alternatives over each attribute:

$$d_i^+ = \sqrt{\sum_{j=1}^n (w_{ij} - H_j)^2} \quad \text{and} \\ d_i^- = \sqrt{\sum_{j=1}^n (w_{ij} - D_j)^2}, \quad \forall i = 1, \dots, p, \quad (4)$$

- for all alternatives determine the relative ratio of its distance to the basal alternative

$$c_i = \frac{d_i^-}{d_i^+ + d_i^-}, \quad \forall i = 1, \dots, p, \quad (5)$$

- rank order alternatives by maximizing ratio  $c_i$  that represents the relative distance from the ideal alternative.

TOPSIS method is appropriate to our problem according to its main characteristics: (1) values for each criterion must be given by numbers; (2) the range of the values is not limited (when the negative value appears all values in the given criterion are increased by the absolute value of the most negative one); (3) each criterion is in the first step analysed (normalised) separately with respect to the ranges of best and worst values (the worst value stays the worst after the normalisation procedure but there are different normalised worst values for each criterion according the criterion range – it is different than in for example WSA method where all worst values change into zero after normalisation). For our problem it is very important as the difference between the best and the worst value for our criteria is so big that the WSA principle changing the best value into 1 and the worst value into 0 could influence the results in a negative way. Also methods that use pairwise comparison are not appropriate for our case as they might take any difference as important (ELECTRE methods) or it is necessary to define limits for the importance of the difference (PROMETHEE methods); (4) the results are numbers on the scale 0-1 that can be interpreted not only as the relative distance but also as the coefficient of how successful the company was.

As we stated above the important part in application of multi-criteria evaluation model is the defining the criteria for evaluation. When setting the criteria we use data from the database Albertina. This database consists of only quantitative data from financial statements and there is no information about intangible assets which are the important factor of economic performance of the firms (Šiška, 2013). To evaluate the economic performance of companies we use five financial ratios arranged into three groups:

- Profitability ratio. This group consists of three ratio indicators: Return on equity (ROE) = Earnings after tax (EAT)/Equity; Return on assets (ROA) = Earnings before interest, taxes, depreciation and amortization (EBITDA)/Total assets; and Return on sales (ROS) = Earnings before interest, taxes, depreciation and amortization (EBITDA)/Sales. To calculate ROA and ROS we use EBITDA as the profit. EBITDA is computed as the sum of profit/loss before tax, interest expenses and depreciations of intangible and tangible assets. We prefer EBITDA before earnings before interests and taxes (EBIT) to no penalize firms for their decision to buy new fixed assets. For calculation of ROS the amount of the sales is computed as the sum of revenues from sale of goods and revenues from sales of own products and services. For computing of ROE as EAT is used profit/loss of current accounting period.
- Labour productivity. Labour productivity = Value added/Personnel expenses. Labour productivity is usually calculated using data on the number employees. However, the exact number of employees is not available in our database, so we use this alternative form of indicator.
- Operating ratio. Operating ratio = (Operating expenses - Depreciation)/(Revenues from sold goods + Production). Where production is the sum of revenues from own products and services, changes in inventory of own products and capitalization.

Indicators of profitability ratio are used as the measurement of financial performance. Labour productivity and operating ratio are a measure of operational performance. ROE, ROA, ROS and labour productivity are MAX-indicators which means that the higher value of this indicators implies the higher economic

performance. Operating ratio is MIN-indicator. The lower value of this indicator means better economic performance.

Using multi-criteria evaluation method we set the same weight for all three groups of indicators (0.333 for each group and 0.111 for every indicator of profitability ratio). Simultaneously we maximize the value of profitability ratio (the profit per 1 CZK of assets, equity or sales) and labour productivity (value added per 1 CZK of labour costs) and minimize the value of operating ratio indicator (operating costs per 1 CZK of sales). During the analysis of the firm data we identify two firms having negative equity. These firms report also the lost (negative profit) in examined year. The value of ROE was positive despite the lost. To eliminate the distortion caused by negative equity we assign the worst rating in this criterion to these two firms.

To roughly assess the situation in the industry of raising swine in terms of profitability we compare ROE with opportunity costs of equity. Opportunity cost of equity represents the return on equity which could be achieved if we invest in the same risk investment opportunities. The opportunity cost of equity ( $r_e$ ) is the sum of the risk-free rate and the risk margin which consists of risk premiums for entrepreneurial risk, financial structure, financial stability and company size. These risk premiums are firm specific and they depend on the characteristics of company (the ratio of equity and debt, the size of the equity and interest-bearing debt, enterprise liquidity and production strength) (Ministry of industry and trade, 2015).

To assess the relationship between firm size and economic performance of the firm we use linear regression model.

$$c_i = \beta_1 \text{firm size}_i + \beta_2 \text{firm age}_i + \beta_3 \text{initial capital}_i + u_i \quad (6)$$

Where  $i$  denotes firm,  $c_i$  is economic performance of the  $i$ -th firm,  $\text{firm size}_i$  is the size of the  $i$ -th firm,  $\text{firm age}_i$  is the age of  $i$ -th firm,  $\text{initial capital}_i$  denotes the amount of initial capital of  $i$ -th firm and  $u_i$  is the disturbance term.

As dependent variable we use the results from multi-criteria evaluation method (TOPSIS) which represent economic performance of the firm. As explanatory variable we use firm size, firm age and initial capital.

- Firm size. We use natural logarithm of sales and total assets (both in thousands of CZK) as the indicator of firm size. Sales, total

assets and number of employees belong to the most frequently used criterion of firm size in empirical studies (Nassar, Almsafir and Al-Mahrouq, 2014). We do not use the number of employees firstly because of the database Albertina (from which we take the data) does not contain the accurate data, number of employees is present in the form of interval. Secondly sales and total assets appear to be better indicators of firm size due to relative rigidity of number of employees. The changes in real output of the company could be reflected in this indicator with a considerable delay (Fiala and Hedija, 2015). As we noted in the part titled Review of literature, from economic theory point of view the relationship between firm performance and a firm size is uncertain. The large firms could realize the economies of scale and scope and reach lower expenses due to formalization of procedures and more effective implementation of operations. They could also benefit from higher competitive power. On the other hand smaller and younger firms could be more flexible and to better adapt to market changes. Boudný and Špička (2012) concluded that in the Czech enterprises specializing in breeding pigs the economies of scale are realized. Due to this fact we can expect that bigger firms would achieve better economic performance as compared with smaller ones in raising of swine sector.

- Firm age. This indicator was being measured as the number of years since the founding of the company until 2013. From the theoretical point of view the age of firm could affect the economic performance of the firm but final effect is not clear. The older firm could benefit from experience, reputation and built business relationships and networks. These factors might be the reason for higher economic performance in comparison with smaller firm. On the other hand

the younger firms are more flexible, they suffer less bureaucracy and they are more active in seeking of market opportunities. Due to the characteristics of the raising swine sector and the type of product we expect that reputation, experience and network should play an important role. So we expect mostly positive relationship between firm age and firm performance.

- Initial capital. The initial capital is measured as the natural logarithm of registered capital of the company at the time of its founding (in thousands of CZK). We expected positive effect of initial capital on firm performance. At the stage of establishing a company it is difficult to obtain loans and equity (initial capital) is an important source for firm development and growth.

Descriptive statistics for linear regression are shown in Table 1. We use program Stata to estimate the coefficients of regression model by the Ordinary Least Square (OLS) with heteroskedastic-consistent standard errors (command “regress” and option “robust” in Stata). We detect the multicollinearity using the variance inflation factor (“vif” command in Stata). There is not a problem of multicollinearity in the presented models.

## Results and discussion

Firstly we evaluate the economic performance of the firms using TOPSIS. We present the value of all criterions which are used in multi-criteria evaluation model. Table 2 shows the median, average value, the best and the worst values for all three profitability ratios and also for labour productivity and the operating ratio. We remind that profitability ratios and labour productivity are MAX-indicators, the operating ratio is MIN-indicator.

As regards the profitability ratios the average value of ROA is 5.82 percent and 54.8 percent of all firms reach the value above average. 11 from 42 examined firms reached negative ROA and ROS which was

	Sales (in thousands CZK)	Total assets (in thousands CZK)	Age	Start-up capital (in thousands CZK)
Minimum value	424	6724	9	100
Maximum value	1381851	1104142	22	290590
Mean	206662	195945	19	77065
Standard deviation	289440	220551	3	81308

Source: own processing

Table 1.: Descriptive statistics for linear regression.

caused by negative EBITDA. As regards ROE the average value was negative and reached -0.1. The negative value of ROE reported 16 firms which is approximately 38 percent of firms. However, the negative EAT was observed in 18 firms. Two firms report negative equity and negative EAT and ROE were positive in this case.

To assess the situation of companies in the sector we compare ROE with opportunity cost of equity ( $r_e$ ). Aside from individual factors in any case ROE should be greater than the sum of risk-free rate increased by minimum risk premium for the sector. According to data from Ministry of industry and trade (2015) risk-free rate was (determined as profitability of 10year government bonds) 2.26 percent and minimum penalty for the business risk in agriculture reached 3 percent in 2013. The sum of both rates amounted to 5.26 percent. The ROE of firms from the sector raising of swine should be above this rate in 2013 so that we can assess its situation as satisfactory. Nevertheless, ROE higher than 0.0526 reached only 16 companies that represents only 14 percent of firms in raising of swine industry (excluding two companies that have achieved positive ROE due to the negative EAT and equity). Business in this industry does not appear to be highly profitable.

We used method TOPSIS to assess the economic performance of firms belonging to the raising of swine sector according to selected criteria. The aim is to minimize the distance from the ideal solution. In our case the best values (see Table 2) are taken as the ideal hypothetical company. The results for the best and the worst three companies are presented in Table 3. The values called "Relative distance" describe the closeness to the ideal solution that is why the higher value is the better and in our case it is the indicator

of economic performance. The winner company is Agro Vyšehořovice zemědělská a obchodní, a.s that has the minimal distance to ideal solution because of the best ROA (37 percent) and very good values in other criteria. The return on equity is more than 42 percent and return on sales amounts 48 percent. This firm produces almost 3 CZK added value per 1 CZK labour cost and operating costs without depreciation amounts for 85 percent of revenues from sold goods and production. On the other hand the worst company is Velkovýkrmny Zákupy, a.s. that reaches the smallest value of relative distance. This firm had the worst value in three criteria in comparison with other firms (operating ratio, labour productivity and ROE) and surprisingly also the best value of ROS. Very high value of ROS was reached due to very high value of depreciation that caused that EBITDA was positive (despite negative EAT) and high relative to sales. It confirms the fact that ratings firms using only one criterion may be highly misleading.

In second step we examine the relationship between economic performance and firm size using linear regression model (equation 6). As dependent variable the relative distance from TOPSIS is used. Due to higher objectivity we use two variants of firm size indicator: sales and total assets. As other explanatory variables we use initial capital and age of the firm.

The results are shown in Table 4 and Table 5. There are used sales as the measurement of firm size in Table 4 and total assets in Table 5. Firstly we use only firm size as independent variable to find out the explanatory power of these variable respective to economic performance (model (1)). The regression coefficients are positive in both cases that imply the directly proportional relationship between firm size and firm performance. Using

	Profitability ratios			Labour productivity	Operating ratio
	ROA	ROE	ROS		
Best value	0.3713	0.7283	1.0024	3.7458	0.7464
Worst value	-0.1366	-2991 / -4.6204 <sup>1</sup>	-0.6673	-2.6723	7.6816
Mean	0.0582	-71.3 / -0.10	0.0827	1.2469	1.2492
Standard deviation	0.0954	455.98 / 0.804	0.2147	1.0553	1.0580
Median	0.0613	0.0254	0.0576	1.1428	1.0179
Number (%) of comp. with negative value	11 (26.2%)	16 (38.1%)	11 (26.2%)	3 (7.1%)	0 (0%)
Number (%) of comp. with values above average	23 (54.8%)	41 / 32 (97.6 / 76.2)	16 (38.1%)	17 (40.5%)	6 (14.3%)

Note: <sup>1</sup> ROE for 1 company was extremely different (-2991) and so we have calculated first with this value and the second numbers are without this outlier as it influences the average and standard deviation.

Source: own processing

Table 2: Descriptive statistics for selected criterions of firm performance.

Rank		Relative distance	Profitability ratios			Labour productivity	Operating ratio
			ROA	ROE	ROS		
1	Agro Vyšehořovice zemědělská a obchodní, a.s.	0.8696	0.3713	0.4243	0.4824	2.960	0.7464
2	Granero Vlasatice, s.r.o.	0.7859	0.1015	0.0895	0.1701	3.6504	0.8161
3	AG - Horní Rybníky, s.r.o.	0.7717	0.0955	0.0606	0.0749	3.7458	0.9316
40	Vysoká, a.s.	0.4977	-0.0326	-0.2860	-0.0222	-0.1004	1.6868
41	Zemědělsko obchodní společnost Brodek u Prostějova, a.s.	0.4443	-0.1366	-0.1904	-0.6673	0.3652	2.8038
42	Velkovýkrmny Zákupy, a.s.	0.2707	0.0222	-2991 <sup>1</sup>	1.0024	-2.6723	7.6816

Note: <sup>1</sup> Because of negative EAT and negative equity, ROE was positive and reaches 0.5699. In calculation, the worst value from the industry was assigned.

Source: own processing

Table 3: Results and criteria values for the best and worst companies - Multi-criteria evaluation model.

Model	(1)	(2)	(3)
Firm size ( $\beta_1$ )	0.027* (0.015)	0.043*** (0.009)	0.043*** (0.009)
Initial capital ( $\beta_2$ )	-	-0.019*** (0.006)	-0.020*** (0.006)
Firm age ( $\beta_3$ )	-	-	0.002 (0.005)
Constant	0.320* (0.173)	0.313*** (0.096)	0.288** (0.115)
R <sup>2</sup>	0.1527	0.3572	0.3594
F-test	0.0735	0.0001	0.0001
N	42	42	42

Note: \*\*\*significant at the 1 percent level, \*\*significant at the 5 percent level, \*significant at the 10 percent level, robust standard errors in brackets.

Source: own processing

Table 4: Results - Linear regression model (SALES).

Model	(1)	(2)	(3)
Firm size ( $\beta_1$ )	0.018 (0.014)	0.047** (0.019)	0.047** (0.019)
Initial capital ( $\beta_2$ )	-	-0.020** (0.008)	-0.022** (0.008)
Firm age ( $\beta_3$ )	-	-	0.002 (0.005)
Constant	-	0.274 (0.168)	0.249 (0.168)
R <sup>2</sup>	0.0481	0.2441	0.2468
F-test	0.1779	0.0407	0.0641
N	42	42	42

Note: \*\*\*significant at the 1 percent level, \*\*significant at the 5 percent level, \*significant at the 10 percent level, robust standard errors in brackets.

Source: own processing

Table 5: Results - Linear regression model (TOTAL ASSETS).

the sales as the measurement of firm size firm size explained 15 percent of variability in economic performance of firms. In the case of total assets

the effect on economic performance was not statistically significant and the firm size explained only 5 percent of variability in economic

performance. These results point to the fact that the relationship between sales and firm performance was tighter than between economic performance and the sum of total assets in the Czech raising swine sector.

The regression coefficients are positive in both cases that imply the directly proportional relationship between firm size and firm performance. Using the sales as the measurement of firm size firm size explained 15 percent of variability in economic performance of firms. In the case of total assets the effect on economic performance was not statistically significant and the firm size explained only 5 percent of variability in economic performance. These results point to the fact that the relationship between sales and firm performance was tighter than between economic performance and the sum of total assets in the Czech raising swine sector.

In models (2) and (3) (Table 4 and Table 5) we added other explanatory variables to the model: initial capital and firm age. The results show that the explanatory power of model increases significantly. As statistically significant factor is proved to be firm size and initial capital. As it could be expected in our case the age is not the significant factor explaining differences in economic performance of firms belonging to the raising swine sector. The significant effect of firm size on performance could be expected in dynamic industry with a large proportion of young firms. In Czech raising of swine sector all companies were active on the market for relative long time. The firms in this sector were on average 19 years old in 2013 and the youngest firm was 9 years old (see Table 1).

The best model explaining the variability in the performance of companies appears to be model (2) for both variant of firm size measurement (sales and total assets). The explanatory variables in this model are statistically significant and it explains almost 36 percent of variability in economic performance using sales and 24 percent using total assets.

Regarding the firm size the regression coefficients are positive for both variant of firm size indicators (sales and total assets). Using sales as the indicator of firm size, the regression coefficient reaches 0.043 and is statistically significant at 1 percent level. The increase of sales by 10 percent causes the growth of economic performance measured by relative distance by 0.0043. In the case of total assets the results are very similar. The regression coefficient amounts 0.047 and is statistically

significant at 5 percent level. The increase of total assets by 10 percent causes the growth of economic performance measured by relative distance by 0.0047. This results confirms the hypothesis that larger companies achieve higher economic performance in Czech raising of swine sector. The higher technical efficiency and realization of economies of scales could be the main causes of higher economic performance of bigger firms comparing to their smaller counterparts. The empirical studies devoted to agricultural sector mostly conclude that the bigger farms achieve better technical efficiency than smaller ones (e.g. Mugerá and Langemeier, 2011; Bojnec and Latruffe, 2013). We can expect the realization of economies of scales in bigger firms in Czech raising swine sector (Boudný and Špička, 2012).

The effect of initial capital on economic performance is statistically significant and negative. If the initial capital increases by 10 percent, the relative distance decreases by approximately 0.002. Previous empirical studies rather identify the positive relationship between initial capital and firm performance (e.g. Gottschalk and Niefert, 2011). The negative effect of initial capital in Czech raising swine sector could be explained in the history context of development of this sector. Most of the examined companies were formed after the economic reforms in 1992 and 1993 as a successor to the existing agricultural cooperatives (what indicates the amount of initial capital). Companies with higher initial capital (and therefore at the time of establishing larger) can achieve lower economic performance compared with companies with lower initial capital because they have taken over large obsolete areal which maintenance and operation is expensive.

## **Conclusion**

The sector of raising of swine in the Czech Republic has faced various problems, particularly the decline in pork prices on the market in recent years. Our analysis aimed at 42 companies from this sector and the year 2013. The aim of the paper was to examine the relationship between the firm size and the economic performance using linear regression model.

To evaluate the economic performance of the firms we used the multiple-criteria evaluation of alternatives method, specifically TOPSIS. As the measurement of economic performance we used selected indicators of profitability, indicator of productivity and operating ratio. According these selected criteria we estimate the relative distance

of every company from hypothetical optimal solution. The best company was Agro Vyšehořovice zemědělská a obchodní, a.s. It reported the best value of ROA (37 percent) and also very good results in other criteria. The worst company was Velkovýkrmny Zákupy, a.s. that reported the worst value of labour productivity, operating ratio and ROE and on the other hand the best value of ROS.

Then we used linear regression model to examine the relationship between economic performance of the company and its size. As the measurement of economic performance we used relative distance of the firm from ideal solution (results from TOPSIS), as the indicator of firm size, sales and total assets. We added to a model the other two explanatory variables that are closely related

to economic performance: initial capital and age of the firm.

We found that the firm size is the statistically significant factor explaining the differences in economic performance among firms in the sector of raising swine in the Czech Republic. The firm size together with the amount of initial capital explained approximately 36 percent of variability in economic performance of the firms. The age of the firm was not statistically significant. The findings were very similar for both indicators of firm size: sales and total assets. The results showed that the larger firms reached higher economic performance compared with smaller ones. These findings indicate that economies of scale are likely to play an important role in this sector.

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