# Economies of scale as a source of cost advantage: example from the agricultural companies in the Czech Republic

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**Josef Krause**
Ing. et Ing., Ph.D.
Faculty of Business Administration
Department of Strategy
University of Economics, Prague
W. Churchill Sq. 1938/4
130 67 Praha 3 – Žizkov
E-mail: **krausej@vse.cz**

## Abstract

The presented paper deals with the effect of economies of scale in agricultural sector in the Czech Republic. An overview of potential benefits depending on a company size are given in the article. The agricultural sector is divided into five sub-sectors: crop production, animal production, mixed production, permanent crop production and support activities. 3524 companies were involved to the research. The impact of a size of companies on index of profitability and cost ratio indicator is analyzed. The regression and correlation analysis is used for evaluation. Concretely Spearman`s ran correlation coefficient and linear regression is used. The relationship between a size of companies and cost ratio indicator according to Spearman`s ran correlation coefficient is confirmed. The greater companies achieve a better value of cost ratio indicator. The results according to the linear regression indicate a positive dependence between the size of companies and profitability indicator. However, the results are not statistically significant.

**Key words**: economies of scale; financial performance; strategic orientation.

## 1. Introduction

Johnson et al. (2011, 2012) state that important strategic capability is to achieving and continually improving cost efficiency. This issue is very important for various stakeholders. For example customers can benefit from lower prices or from better products sold by same prices. And considering of various stakeholders in strategic management is very important issue for very actual concept which is corporate social responsibility (Freeman et al. (1983), Freeman et al. (2010)).

There are discussed many sources of cost advantage in a literature. Johnson et al. (2011) formulate four following sources of cost efficiency: economies of scale, supply costs, experience and product/process design. According to Grant (2010), it is possible to find following drivers of cost advantage: economies of scale, economies of learning, production techniques, product design, input costs, capacity utilization and residual efficiency. These drivers have further many partial influencers: technical input-output relationship, indivisibilities, specialization, increased individual skills, improved organizational routines, process innovation, re-engineering of business processes, standardization of designs and components, design for manufacture, location advantages, ownership of low-cost inputs, non-union labour, bargaining power, ratio of fixed to variable costs, fast and flexible capacity adjustment, motivation and organizational culture, managerial effectiveness.

Leadership in total costs is also one of the Porter`s generic strategies (Porter, 1998). Economies of scale, experience curve and other cost benefits are an important barriers of entry for companies entering to the industry (Porter, 2004). Cost efficiency is formulated as one of the key success factors in phase of maturity of the life cycle of industry (Grant et al., 2012). According to Yip et al. (2012), the cost drivers are one group of the general globalization drivers. The costs monitoring is one important issue for the blue ocean strategy. This concept emphasizes the current costs reduction and customer's value increasing (Kim et al., 2005).

Some of the most important cost drivers are connected with the size of the companies and the range of production. These factors are primarily economies of scale, economies of learning and capacity utilization.

The aim of the paper is to verify the dependence between the size of companies and cost effectiveness and the size of companies and profitability.

## 2. Aspect of Cost Advantage

How is mentioned above, there are various aspects for cost advantage. The main aspects are presented in this part. Operating leverage considers the relationship between fixed and variable costs. Fixed costs are defined according to Samuelson and Nordhaus (1992) as "the amount that must be paid regardless of the level of output". Examples of these items are contractual payments for building, interest payments on debts etc. Variable costs are defined by Samuelson and Nordhaus (1992) as "costs that change with the level of output". Examples are material costs, costs on production workers etc. Brigham et al. (2005) state: "in business terminology, a high degree of operating leverage, other factors held constant, implies that a relatively small change in sales results in a large change in EBIT". Higher fixed costs are caused especially by automation. In case of demand fall, high percentage of fixed costs presents a relatively high business risk (Brigham, 1989).

Economies of scale are defined by Prager (1993) as situation when “equiproportionale increases in all inputs lead to more than proportionate increments in output”. In parallel, term diseconomies of scale are defined by this author as situation when “proportional increases in all inputs lead to less than proportional increments in output”. The existence of economies of scale causes that average costs decrease. Prager (1993) formulates several reasons for this effect. There reasons are specialization, technology, physical relationships and input integration. In case of specialization, a larger factory allows better utilization of workers and machinery. Recurrence of some operations by workers allows reduction of costs on the operations. The specialized machinery also allows cheaper execution of specific operations. In case of technology, the use of high-speed machinery is only profitable for large production. The existence of some laws of physics argues for the large production. For example a storage tank twice larger than smaller storage tank costs less than double of the smaller tank. Input integration means that the company can use a greater variability of inputs in case of a larger production. The effect of economies of scale is not obvious. The growth of the companies can be also connected with the effect of decreasing returns to scale which is defined above. McEachern (1988) argues that the amount and variety of resources growths it is more and more difficult to manage these inputs. It is difficult to manage a communication in a company, bureaucracy, and monitor production.

Another effect for the cost savings is learning curve. According to Samuelson and Marks (1995) “learning curve embodies the inverse relationship between average cost and cumulative production”. It means the decrease of average costs with the increase of outputs. There are many sources for this effects. Workers can perform working operation faster with the increasing number of performed operations. The managers can better manage the production processes in the company. The employees in quality control need some time for identifying of the potential areas of errors. This effect is also called as experience curve effect and is considered to be a basis for cost advantage of a concrete company with the comparison with the competitors (Hedley, 1977).

The globalization of markets is another reason for the growth of companies and costs savings. Levitt (1983) argues that the existence of global markets and standardized customer products enables to benefit from “enormous economies of scale in production, distribution, marketing and management". These effects should enable to decrease the world prices and defeat the competitors.

Further aspect influencing competitiveness of companies is productivity. The productivity is ratio between input and output (Vochozka et al., 2015). The productivity means the effectiveness of use of production factors. One of the ways for increasing of productivity is lean management which leads to reduction of overproduction, waiting, overproduction, correction (Klečka, 2008).

## 3. Material and Methods

The agricultural companies in the Czech Republic are analyzed in this article. The data are obtained from the database Albertina which is available in the University of Economics, Prague. This database contains the financial details from financial statements.

Section Plant and Animal Production were selected. Five subsections of this section were further analyzed. These subsections are: crop production, animal production, mixed production, permanent crop and support activities. The companies with revenues less than 1 million Czech crowns were eliminated. After cleaning and assembling, data sample contains 3524 companies. The structure of the sample according to type of production is following:

- Crop production – 400 companies;
- Animal production – 388 companies;
- Mixed production – 1603 companies;
- Permanent crop production – 97 companies;
- Support activities – 1036 companies.

The size of companies were measured by issue "Sales of own products and services". This variable is presented in "thousands". The indicators of "cost ratio" and "return on assets" were chosen.

The indicator "cost ration" is constructed as:

$$Cost\ Ratio = \frac{\text{total costs}}{\text{total earnings}}$$

The indicator "return on assets" is constructed as:

$$Return\ on\ assets = \frac{\text{total costs}}{\text{total earnings}} * 100$$

Spearman's rank correlation coefficient were chosen for the evaluation.

The formula for Spearman`s rank correlation coefficient is (Meloun et al., 2012):

$$r_s = 1 - \frac{6}{n(n^2-1)} \sum_{i=1}^{n} (x_{1si} - x_{2si}))^2 \ ,$$

n – is number of observation

$x_{1si}$ – order of selection elements relative to the variable $\xi_{1,}$

$x_{2si}$ – order of selection elements relative to the variable $\xi_{2.}$

If the elements have the same rank, the average of rank is assigned to all elements. The modified formula is (Meloun et al., 2012):

$$r_s = \frac{\frac{n(n^2-1)}{6} - \sum_{i=1}^{n} (x_{1si} - x_{2si})^2 - a - b}{\sqrt{\left(\frac{n(n^2-1)}{6} - 2*a\right)*\left(\frac{n(n^2-1)}{6} - 2*b\right)}} \ ,$$

where a and b are repaired coefficients for rank.

$$a = \frac{1}{12} \sum_{(j)} (a_j^3 - a_j),$$

$$b = \sum_{(k)} (b_j^3 - b_j),$$

where „j“ are numbers of clusters fir same ranks for $x_i$ and $a_j$ is number of values with the same rank in “j” cluster. The calculation for “k” and $b_k$ is analogical.

Spearman's rank correlation coefficient captures not only linear relationship but generally decreasing or increasing relationships and this coefficient is robust against remote values (Hendl, 2015). The coefficient is insensitive to deviations from the normal distribution (Meloun et al., 2012).

A simple linear regression is chosen from the methods of regression analysis. The basic formula of linear line is (Marek et al. 2007):

$$y = \beta_0 + \beta_1 + \varepsilon$$

Where:

y is explained variable,

$\beta_0$ and $\beta_1$ are parameters of regression line,

$\varepsilon$ is random component.

## 4. Results

### 4.1. Crop production

The summary statistics of crop production and the information about averages of ROA and cost ration indicators in crop production according to chosen size group are given in tables in Appendix 1. Table 1 presents values of Spearman correlations coefficient.

**Table 1: Spearman Rank Correlations – Crop Production**

| | SALES | ROA | COST RATIO |
|---|---|---|---|
| SALES | 1 | 0,1818 | -0,1450 |
| -P-Value | 0,0000 | 0,0003 | 0,0038 |
| ROA | | 1 | -0,8618 |
| -P-Value | | 0,0000 | 0,0000 |
| COST RATIO | | | 1 |
| -P-Value | | | 0,0000 |

The results show a weak positive dependence between sales and ROA indicator and weak negative dependence between sales and cost ration. Both results are statistically significant.

The table 2 presents results of regression analysis, concretely the analysis of dependence ROA on sales.

**Table 2: Regression analysis – dependence ROA indicator on sales**

| Parameter | Least Squares Estimate | Standard Error | | T Statistic | P-Value |
|---|---|---|---|---|---|
| Intercept | 9,01327 | 0,935394 | | 9,6358 | 0,0000 |
| Slope | 0,00000359589 | 0,0000202608 | | 0,177481 | 0,8592 |

Note: Dependent variable: ROA; Independent variable: sales; Total P-Value of model is 0,8592.

The equation of the fitted model is ROA = 9,01327 + 0,00000359589*sales. The slope of linear line is positive. It indicates a positive dependence ROA indicator on sales, however a value of this indicator is not statistically significant (p-value = 0,8592).

The table 3 presents the results of regression analysis, in this place the dependence of cost ratio on sales.

**Table 3: Regressions analysis – dependence cost ratio indicator on sales**

| Parameter | Least Squares Estimate | Standard Error | T Statistic | P-Value |
|---|---|---|---|---|
| Intercept | 0,91567 | 0,0125826 | 72,7727 | 0,0000 |
| Slope | -3,17057E-7 | 2,72541E-7 | -1,16334 | 0,2454 |

Note: Dependent variable: cost ratio; Independent variable: sales; Total P-Value of model is 0,2454.

The equation of the fitted model is COST RATIO = 0,91567 + -3,17057E-7*sales. The slope of linear line is negative. It indicates a decrease of cost ratio with an increase of sales. Value of this indicator is not also statistically significant (p-value=0,2454).

## 4.2. Animal production

The summary statistics of animal production and the information about averages of ROA and cost ration indicators in animal production according to chosen size group are given in tables in Appendix 2.

Table 4 presents values of Spearman correlations coefficient.

**Table 4: Spearman Rank Correlations – Animal Production**

| | SALES | ROA | COST RATIO |
|---|---|---|---|
| SALES | 1 | 0,3032 | -0,2495 |
| -P-value | 0,0000 | 0,0000 | 0,0000 |
| ROA | | 1 | -0,8682 |
| -P-value | | 0,0000 | 0,0000 |
| COST RATIO | | | 1 |
| -P-value | | | 0,0000 |

Spearman correlation coefficient show a weak positive dependence between sales and ROA indicator and weak negative dependence between sales and cost ration. Both correlation coefficients are statistically significant.

Table 5 presents results of regression analysis. The results of dependence of ROA indicator on sales are given in this table.

**Table 5: Regressions analysis – dependence ROA indicator on sales**

| Parameter | Least Squares Estimate | Standard Error | T Statistic | P-Value |
|---|---|---|---|---|
| Intercept | -13,6683 | 6,76327 | -2,02096 | 0,0440 |
| Slope | 0,0000506886 | 0,0000526889 | 0,962035 | 0,3366 |

Note: Dependent variable: ROA; Independent variable: sales; Total P-Value of model is 0,3366.

The equation of the fitted model is ROA= -13,6683 + 0,0000506886*sales. The slope of linear line is positive. In indicates a increase ROA indicator with a increase of sales. This indicator is also not statistically significant (p-value = 0,3366).

The table 6 presents results the analysis of dependence of cost ratio on sales with the use of regression analysis.

**Table 6: Regressions analysis – dependence cost ratio on sales**

| Parameter | Least Squares Estimate | Standard Error | T Statistic | P-Value |
|---|---|---|---|---|
| Intercept | 1,22318 | 0,0591248 | 20,6881 | 0,0000 |
| Slope | -6,86736E-7 | 4,60609E-7 | -1,49093 | 0,1368 |

Note: Dependent variable: cost ratio; Independent variable: sales; Total P-Value of model is 0,1368.

The equation of the fitted model is: COST RATIO = 1,22318 - 6,86736E-7*SALES. The positive slope of linear line indicates a negative dependence of cost ration on sales. The level of significance also exceeds a standard level of significance 0,05.

### 4.3. Mixed production

The summary statistics of animal production and the information about averages of ROA and cost ration indicators in animal production according to chosen size group are given in tables in Appendix 3. The results for correlation analysis are given in table 7.

**Table 7: Spearman Rank Correlations – Animal Production**

| | SALES | ROA | COST RATIO |
|---|---|---|---|
| SALES | 1 | 0,278 | -0,1811 |
| -p-value | 0,0000 | 0,0000 | 0,0000 |
| ROA | | 1 | -0,7894 |
| -p-value | | 0,0000 | 0,0000 |
| COST RATIO | | | 1 |
| -p-value | | | 0,0000 |

The values of Spearman coefficient indicate a weak positive dependence between sales and ROA indicator and a weak negative dependence between cost ratio and sales. The values of coefficients are statistically significant.

Table 8 shows results of regression analysis. In this table, dependence of cost ration on sales is analysed.

**Table 8: Regressions analysis – dependence cost ratio on sales**

| Parameter | Least Squares Estimate | Standard Error | T Statistic | P-Value |
|---|---|---|---|---|
| Intercept | 1,13108 | 0,0468556 | 24,1397 | 0,0000 |
| Slope | -0,00000195823 | 6,36819E-7 | -3,07501 | 0,0021 |

Note: Dependent variable: cost ratio; Independent variable: sales; Total P-Value of model is 0,0021.

The equation of the fitted model is cost ration = 1,13108 - 0,00000195823*sales. Slope of linear line is negative and this indicator is statistically significant (p-value=0,0021). This means that the cost ratio indicator decreases that the cost ration indicator decrease with the increase of sales.

Table 9 shows results of regression. The analysis of dependence of ROA ratio on sales is given there.

**Table 9: Regressions analysis – dependence ROA ratio on sales**

| Parameter | Least Squares Estimate | Standard Error | T Statistic | P-Value |
|---|---|---|---|---|
| Intercept | 4,43476 | 0,581335 | 7,62859 | 0,0000 |
| Slope | 0,0000281521 | 0,00000790098 | 3,56312 | 0,0004 |

Note: Dependent variable: ROA; Independent variable: sales; Total P-Value of model is 0,0004.

The equation of the fitted model is ROA = 4,43476 + 0,0000281521*SALES. The slope of linear line is positive and statistically significant (p-value=0,0004). This result indicates a growth of ROA indicator with a grow of sales.

### 4.4. Permanent crops

The summary statistics of permanent crops production and the information about averages of ROA and cost ration indicators in permanent crop production according to chosen size group are given in tables in Appendix 4.

The results of correlation analysis presents table 10.

**Table 10: Spearman Rank Correlations – Permanent Crop Production**

| | SALES | ROA | COST RATIO |
|---|---|---|---|
| SALES | 1 | 0,2498 | -0,2533 |
| -p-value | 0,0000 | 0,0144 | 0,0131 |
| ROA | | 1 | -0,9533 |
| -p-value | | 0,0000 | 0,0000 |
| COST RATIO | | | 1 |
| p-value | | | 0,0000 |

The values of Spearman coefficient indicates a weak positive dependence between sales and ROA indicator and a weak negative dependence between sales and cost ration. As by previous analysis, results are statistically significant.

Table 11 presents results of correlation analysis.

**Table 11: Regression analysis – dependence COST ratio on sales**

| Parameter | Least Squares Estimate | Standard Error | T Statistic | P-Value |
|---|---|---|---|---|
| Intercept | 1,07139 | 0,0296692 | 36,1111 | 0,0000 |
| Slope | -8,10151E-7 | 7,20621E-7 | -1,12424 | 0,2637 |

Note: Dependent variable: cost ratio; Independent variable: sales; Total P-Value of model is 0,2637.

The equation of the fitted model is cost ratio = 1,07139 - 8,10151E-7*sales. A negative slope of linear line indicates a decrease of cost ratio with a increase of sales. According to a presented model, this indicator is not statistically significant (p-value 0,2637).

Table 12 presents results of regression analysis. The analysis of dependence ROA ratio on sales is given here.

**Table 12: Regression analysis – dependence ROA indicator on sales**

| Parameter | Least Squares Estimate | Standard Error | T Statistic | P-Value |
|---|---|---|---|---|
| Intercept | 0,585323 | 1,39737 | 0,418875 | 0,6763 |
| Slope | 0,0000376164 | 0,00003394 | 1,10832 | 0,2705 |

Note: Dependent variable: ROA; Independent variable: sales; Total P-Value of model is 0,2705.

The equation of the fitted model is ROA = 0,585323 + 0,0000376164*SALES. The positive value of the slope of linear line indicate the increase of ROA indicator with the increase of sales. The value of this indicator is also not statistically significant (p-value = 0,2705).

## 4.5. Support activities

The summary statistics of support activities and the information about averages of ROA and cost ration indicators in permanent crop production according to chosen size group are given in tables in Appendix 5.

The table 13 presents the results of correlation analysis.

**Table 13: Spearman Rank Correlations – Support Activities**

| | SALES | ROA | COST RATIO |
|---|---|---|---|
| SALES | 1 | 0,2839 | -0,1827 |
| p-value | 0,0000 | 0,0000 | 0,0000 |
| ROA | | 1 | -0,8322 |
| p-value | | 0,0000 | 0,0000 |
| COST RATIO | | | 1 |
| p-value | | | 0,0000 |

The values of Spearman correlation indicates statistically significant a weak positive correlation between sales and ROA indicator and a weak negative correlation between sales and cost ratio by support activities.

The results of regression analysis (dependence cost ration on sales) are given in table 14.

**Table 14: Regression analysis – dependence COST ratio on sales**

| Parameter | Least Squares Estimate | Standard Error | T Statistic | P-Value |
|---|---|---|---|---|
| Intercept | 1,32756 | 0,091645 | 14,4859 | 0,0000 |
| Slope | -0,00000355578 | 0,00000337492 | -1,05359 | 0,2921 |

Note: Dependent variable: cost ratio; Independent variable: sales; Total P-Value of model is 0,2921.

The equation of the fitted model is cost ratio = 1,32756 - 0,00000355578*sales. A negative slope of linear line indicates a negative dependence of cost ratio on sales. This indicator is not statistically significant (p-value = 0,2921).

Table 15 presents results of regression analysis. Values of linear regression model of dependence of ROA indicator on sales are given here.

**Table 15: Regression analysis – dependence ROA ratio on sales**

| Parameter | Least Squares Estimate | Standard Error | T Statistic | P-Value |
|---|---|---|---|---|
| Intercept | 0,457509 | 2,15657 | 0,212146 | 0,8320 |
| Slope | 0,000106071 | 0,0000794178 | 1,3356 | 0,1817 |

Note: Dependent variable: ROA; Independent variable: sales; Total P-Value of model is 0,1817.

The equation of the fitted model is ROA = 0,457509 + 0,000106071*SALES. Also these results show not statistically significant positive dependence of ROA indicator on sales.

## 5. Discussion

The summary of results of the regression and correlation analysis presents appendix 6. The results show that the cost ratio is lower by greater companies. The index of profitability is generally greater by greater companies in generally. The results of research of other authors are not consistent. Valero et al. (2013) examined business profitability in wine industry in Spain in Castilla-La Mancha region. They observed three main factors which influence the profitability of companies.

These factors are company structure, size of companies and financial structure. The larger companies have according these authors better performance because they take advantage of scale economies. Kasman et al. (2009) investigated the cost efficiency and scale economic in insurance industry in Turkey. They state that large companies are less cost efficient than small companies. Wijesiri et al. (2017) investigated the effect of size and age on financial efficiency of microfinance instutions.

They observed that greater microfinance instructions tended to higher financial efficiency. Nehring et al. (2009) researched small and large dairy farms. Generally, large conventional farms had better technical efficiency and various financial indicators than small farms. Duvaleix-Treguer et al. (2016) assesse the importance of farm size on cost of production. Hog farms were explored. Authors observed that cost economies of large farms emerge mainly from the possibility to achieve a lower prices of feed.

Authors also moderated that small farms without labour had a higher price-cost margins in comparison with a larger farms. Pagliuca et al. (2017) analysed tomatoes production at Cacador region. They examined small and large scale production. Large scale tomato production enabled a reduction of fixed cost.

## 6. Conclusion

The paper examined the dependence between the size of companies and chosen index of profitability and cost ratio index. According to correlation analysis, the dependence is confirmed. The values of Spearman coefficient are statistically significant.

The results of regression analysis indicate also the dependence of chosen indicators on the size of companies, but the results are not statistically significant except the mixed production.

One of the potential reasons for it is a greater variability of indicators by a small companies. This is indicated by a greater standard deviation by this size group. Generally greater variability of evolution by ROA indicator can be caused by various strategy orientation.

The large companies can by focused on more standardized production with lower cost. The production of small companies can be more specialized and oriented on a greater value added.

These are main limitation of research. These aspect should by analysed in future research with using a questionnaire survey.

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APPENDIXES

**Appendix 1 – Crop Production**

Summary Statistics – Crop Production

| | **SALES (thous. CZK)** | **ROA (%)** | **COST RATIO** |
|---|---|---|---|
| Count | 400 | 400 | 400 |
| Average | 25452,7 | 9,1048 | 0,9076 |
| Standard deviation | 38566,1 | 15,5891 | 0,210047 |
| Coeff. of variation | 151,52% | 171,22% | 23,14% |
| Minimum | 1073 | -61,59 | 0,27 |
| Maximum | 322851 | 137,6 | 3,49 |
| Range | 321778 | 199,19 | 3,22 |
| Stnd. skewness | 31,8001 | 17,2222 | 40,6765 |

| | | | |
|---|---|---|---|
| Stnd. kurtosis | 77,967 | 66,359 | 240,332 |

Summary Statistics – Crop Production according to size group

| **Sales (mil. Czech Crowns)** | **Under 50** | **50-100** | **Over 100** |
|---|---|---|---|
| Count | 356 | 25 | 19 |
| Average-ROA (%) | 9,23 | 6,90 | 9,67 |
| St. Deviation-ROA | 16,22 | 10,43 | 6,76 |
| Average-COST RATIO | 0,91 | 0,91 | 0,88 |
| St. Deviation-COST RATIO | 0,22 | 0,09 | 0,09 |

## Appendix 2 – Anima Production

Summary Statistics – Animal Production

| | **SALES (thous. CZK)** | **ROA (%)** | **COST RATIO** |
|---|---|---|---|
| Count | 388 | 388 | 388 |
| Average | 40584,1 | -11,6111 | 1,19531 |
| Standard deviation | 121935 | 126,375 | 1,10663 |
| Coeff. of variation | 300,45% | -1088,40% | 92,58% |
| Minimum | 5 | -1939,58 | 0,13 |
| Maximum | 1,29E+06 | 281,82 | 13,6 |
| Range | 1,29E+06 | 2221,4 | 13,47 |
| Stnd. skewness | 47,4809 | -90,0269 | 52,1255 |
| Stnd. kurtosis | 175,916 | 613,154 | 219,887 |

Summary Statistics – Animal production according to size group

| **Sales (mil. Czech Crowns)** | **Under 50** | **50-100** | **Over 100** |
|---|---|---|---|
| Count | 327 | 23 | 38 |
| Average-ROA (%) | -15,02 | 7,29 | 6,29 |
| St. Deviation-ROA | 137,37 | 10,04 | 7,32 |
| Average-COST RATIO | 1,24 | 0,96 | 0,95 |
| St. Deviation-COST RATIO | 1,20 | 0,07 | 0,06 |

## Appendix 3 – Mixed Production

Summary Statistics – Mixed Production

| | **SALES (thous. CZK)** | **ROA (%)** | **COST RATIO** |
|---|---|---|---|
| Count | 1603 | 1603 | 1603 |
| Average | 45643,9 | 5,71974 | 1,0417 |

| | | | |
|---|---|---|---|
| Standard deviation | 57726,7 | 18,3218 | 1,47525 |
| Coeff. of variation | 126,47% | 320,33% | 141,62% |
| Minimum | 2 | -383,47 | 0,2 |
| Maximum | 664635 | 122 | 41,13 |
| Range | 664633 | 505,47 | 40,93 |
| Stnd. skewness | 49,2003 | -179,627 | 309,976 |
| Stnd. kurtosis | 134,263 | 1577,55 | 3564,47 |

Summary Statistics – Mixed production according to size group

| **Sales (mil. Czech Crowns)** | **Under 50** | **50-100** | **Over 100** |
|---|---|---|---|
| Count | 1069 | 322 | 212 |
| Average-ROA | 4,76 | 7,53 | 7,78 |
| St. Deviation-ROA | 22,10 | 5,57 | 3,81 |
| Average-COST RATIO | 1,11 | 0,91 | 0,89 |
| St. Deviation-COST RATIO | 1,80 | 0,07 | 0,06 |

## Appendix 4 – Permanent Crops Production

Summary Statistics – Permanent Crops Production

| | **SALES (thous. CZK)** | **ROA (%)** | **COST RATIO** |
|---|---|---|---|
| Count | 97 | 97 | 97 |
| Average | 13550,7 | 1,09505 | 1,06041 |
| Standard deviation | 39079,9 | 13,0112 | 0,276307 |
| Coeff. of variation | 288,40% | 1188,18% | 26,06% |
| Minimum | 4 | -49,54 | 0,62 |
| Maximum | 340573 | 35,07 | 2,1 |
| Range | 340569 | 84,61 | 1,48 |
| Stnd. skewness | 27,2828 | -2,95239 | 6,19914 |
| Stnd. kurtosis | 106,767 | 5,3311 | 4,49512 |

Summary Statistics – Permanent crops production according to size group

| **Sales (mil. Czech Crowns)** | **Under 50** | **50-100** | **Over 100** |
|---|---|---|---|
| Count | 92 | 3 | 2 |
| Average-ROA (%) | 0,64 | 10,84 | 7,34 |
| St. Deviation-ROA | 13,07 | 12,65 | 3,32 |

| | | | |
|---|---|---|---|
| Average-COST RATIO | 1,07 | 0,91 | 0,96 |
| St. Deviation-COST RATIO | 0,28 | 0,08 | 0,06 |

## Appendix 5 – Support Activities

Summary Statistics – Support Activities

| | SALES (thous. CZK) | ROA (%) | COST RATIO |
|---|---|---|---|
| Count | 1036 | 1036 | 1036 |
| Average | 6974,12 | 1,19726 | 1,30276 |
| Standard deviation | 26256,6 | 67,1105 | 2,85098 |
| Coeff. of variation | 376,49% | 5605,35% | 218,84% |
| Minimum | 2 | -803,64 | 0,01 |
| Maximum | 666993 | 1140,74 | 65,72 |
| Range | 666991 | 1944,38 | 65,71 |
| Stnd. skewness | 233,591 | 12,0821 | 209,897 |
| Stnd. kurtosis | 2699,76 | 790,387 | 2038,56 |

Summary Statistics – Permanent crops production according to size group

| Sales (mil. Czech Crowns) | Under | 50-100 | Over 100 |
|---|---|---|---|
| Count | 1012 | 20 | 4 |
| Average-ROA (%) | 1,01 | 7,85 | 14,85 |
| St. Deviation-ROA | 67,85 | 16,63 | 14,35 |
| Average-COST RATIO | 1,31 | 0,94 | 0,95 |
| St. Deviation-COST RATIO | 2,88 | 0,13 | 0,06 |

## Appendix 5 – Summary of correlation and regression analysis

| | Correlation analysis – Spearman coeff. | | | | Regression analysis | | | |
|---|---|---|---|---|---|---|---|---|
| | ROA | | COST RATIO | | ROA | | COST RATIO | |
| | Corr. | Stat. sign. | Corr. | Stat. sign. | Slope | Stat. sign. | Slope | Stat. sign. |
| Crop production | Weak positive | Yes | Weak negative | Yes | Positive | No | Negative | No |
| Animal production | Weak positive | Yes | Weak negative | Yes | Positive | No | Negative | No |
| Mixed production | Weak positive | Yes | Weak negative | Yes | Positive | Yes | Negative | Yes |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Permanent production | Weak positive | Yes | Weak negative | Yes | Positive | No | Negative | No |
| Support activities | Weak positive | Yes | Weak negative | Yes | Positive | No | Negative | No |