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PRODUCTION FUNCTION IN AGRICULTURE IN THE CZECH REPUBLIC

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Abstract. Correct setting of value drivers of agricultural companies plays an important role, as every company strives for maximizing its profit. The goal of the paper was to determine the dependence of profit on production factors and to identify important production factors. Variables verified as value drivers were land, material, personnel costs, and depreciation of fixed tangible and intangible assets. The selected method of data processing is multiple regression analysis. The data were represented using a normal probability plot of residuals and a distribution histogram. The results show that 51.44 % of significant variables are material, personnel costs and depreciation of fixed tangible and intangible assets. The findings also imply that multiple regression analysis is a suitable statistical method. In conclusion, it can be stated that material, personnel costs, and depreciation of fixed tangible and intangible assets are important value drivers.

Keywords: agricultural companies; value drivers; profit; multiple regression analysis; production function

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JEL Classifications: D24, Q12

1. Introduction

According to Wicki (2018), the global population is constantly growing, as is the demand for food. Agriculture thus plays a key role. An increase in agricultural production can be achieved mainly by the proper use of production factors. Production factors include land, labor, and capital. Agricultural land is a finite natural resource with a growing economic value (Takac et al., 2020). Soil fertility is paramount in determining the type of plant production (El-Ramady et al., 2019). Correct setting of production factors increases labor productivity and thus leads to capital return (Vochozka et al., 2021; Potapov 2020; Holmen, 2022). Technical development and sufficient human capital enable achieving higher profitability and improving the competitiveness of agricultural products (Vochozka et al., 2020, Anand, Husain& Prakash, 2022; Ganush & Tsetsiarynets, 2022).

Earnings are not determined by production factors only. According to Parolini (2022), agricultural production is also influenced by weather and climatic factors. Agricultural companies are thus at risk of being unprofitable under adverse climatic conditions (Priyanka et al., 2019; Gavurova et al. 2017a). There are soil erosion and

nutrient losses. Extreme weather is a result of climate changes caused by increasingly intensive human activity (Qiao et al., 2018). Climatic changes thus become a global problem (Nyangena, Kinyuru & Imathiu, 2021). Low yields of crops gradually lead to growing food prices (Lambert et al., 2021). By selecting the proper types of crops, agriculture can contribute to soil protection and mitigate climatic changes (Parolini, 2022).

Production inputs and their combination influence the result of agricultural production. The relationship between production inputs and the final product is determined by the production function (Simtion, 2020, Vochozka et al., 2020). Production function remains a current method in economy. Based on the results, it is possible to examine the economic growth (Bartoš et al., 2021, Cheng & Liu, 2021). Production function is an important tool for the analysis, evaluation and prediction of production processes (Kučera et al., 2021, Gadzhieva et al., 2019). The issue of production functions in general and in the industrial sector is also addressed by Straková et al. (2020, 2021).

Agricultural companies differ from each other in the volume of their production considering their size, different yields, technologies, or weather conditions (Gavurova et al. 2017b, 2020; Tkacova et al. 2017). Therefore, it is necessary to determine a suitable model for using the production function that would consider this heterogeneity and find the main determinants of agricultural production (Pechrová Simpachová & Simpach, 2019; Belas et al. 2020).

2. Literature review

As already mentioned, the correct setting of production factors may positively influence the earnings of agricultural companies. This issue has been addressed by several authors.

Vasyl'yeva (2021) used a modified Cobb-Douglas production function describing the effect of human capital on gross added value and gross output. The parameters of production function were determined and verified using correlation and regression analysis; equations of balance and construction of isoquants were used to predict the optimal combinations of production function factors (Kocisova et al. 2018). Chabatul et al. (2019) evaluated the effect of production factors on the revenues from agricultural product sales on the basis of regression analysis. The results were used for scheduling of production and selection of production factors.

Nasir, Ribij and Al-Wassity (2020) estimated the Cobb-Douglas production function using the regression method to determine the functional relationship between the volume of wheat production and the quantity of seed, fertilizers, pesticides, and the number of hours worked using human labor without any mechanization and using mechanization. The results suggest that mechanization significantly increases the return to scale. Muhajan et al. (2018) proposed a quantile regression model using the Cobb-Douglas production function for the analysis of data on the production of foodgrain with respect to net area sown, net cultivated area, and net irrigated area, consumption of fertilizers, pesticides, and electricity. They concluded that net sown and cultivated area plays an important role in increasing the production volume.

The study by Elita et al. (2019) analyses the relationship of the selected inputs in the form of the production area and the quantity of labor, seed, and fertilizers and the output in the form of rice and corn production using the Cobb-Douglas production function. The authors also compared the minimum costs, where the costs of rice growing were lower than the costs of corn growing, but corn profit was higher than rice profit. Shkuratov et al. (2020) used correlation and regression analysis to estimate the volume of gross agricultural production in relation to the area of agricultural land used. Kukushina & Okomina (2019) evaluated the impact of used production factors on the agricultural activity outputs on the basis of regression equation. As stated by Mengthen et al. (2018), capital is the most important factor in the agricultural sector, despite the high dependence of agriculture on land. This finding was achieved using time series regression analysis, whose results indicate that capital

contributes about 76.86 % to the growth of agricultural economy, while the contribution of land, energy, water, and technological progress is lower. By using the Cobb-Douglas production function, Tiammee et al. (2019) found that the size of inputs (agricultural land, labor, and capital) influences the return to scale. Pechrová Simpachová & Simpach (2020) argue that production approximated by sales is directly dependent on the consumption of material, energy, fixed assets, the number of employees, and the acreage of agricultural land, which resulted from the results of the Cobb-Douglas production function.

According to Suseela & Chandrasekaran (2018), the use of technology increases the yield of agricultural crops and profit, as indicated by the results of the Cobb-Douglas production function. On the basis of Stochastic frontier production function fitted by Cobb-Douglas function, Ahmed et al. (2018) confirmed that maize production depends on the acreage, fertilizers used, and the quantity of seed. Pechrová Simpachová & Simpach (2019) used the Cobb-Douglas production function to analyze agricultural output in the form of sales depending on the consumption of material, capital, the number of employees, and acreage of agricultural land. They concluded that the consumption of material had the highest impact, while the effect of the number of employees and acreage of agricultural land was lower. Using the Cobb-Douglas function, Zhang, Chen and Li (2021) found that the yield of agricultural crops grows with the acreage of agricultural land.

Onofri et al. (2019) used the production function to estimate the marginal product of key production inputs (labor and land) and to determine the future performance of the agricultural sector with regard to climatic changes (Onofri et al., 2019). The basis for setting up effective production functions can be, for example, a strategic situational analysis, including an analysis of value streams or corporate production processes (Vochozka et al., 2016; Straková et al., 2018). In the current turbulent to chaotic corporate environment, one of the pro-growth production parameters is targeted investments in other production processes, especially in infrastructure (Straková et al., 2016; Bilan et al. 2017; Gavurova et al. 2019).

The goal of the paper is to determine the production function of production factors of companies operating in the agricultural sector of the CR.

Agricultural activities cannot be carried out without agricultural land. Land (A) is used for plant production – food and feed for animal production. Land is thus the basic production factor in this sector. Other production factors include labor (L), i.e. a human activity appraised with a wage. Another equally important production factor is capital (K), which can be divided into two categories by its nature – tangible (agricultural machinery, buildings, structures, livestock) and monetary.

The profitability of agricultural companies depends on the quantity of the production factors used. A larger area of agricultural land enables the production of a higher volume of agricultural products. The proper setting of production factors (the number of employees, use of agricultural technology) results in higher earnings and generation of profit. The relationship between value drivers and profit generators is expressed by the production function. Production function determines the relationship between the production factors – inputs (labor, land, capital) and outputs.

3. Data and methods

Based on the analysis of the main goal of the paper, two research questions were formulated:

RQ1: What are the value drivers in agricultural companies?

RQ2: What is the relationship of value drivers and profit generators in agricultural companies?

Within the first research questions, value drivers of agricultural companies will be determined. Within the second research question, multiple regression analysis will be used to determine the relationship of these value drivers to the value of profit (earnings).

The data source will be the dataset Extrakt_VSCB_NACE_A_2022_Agriculture, which contains 42,641 rows. The data from the profit and loss account will be processed in Excel, Microsoft. From this dataset, only the columns Company identification number, Tax identification number, Name, Active, Land (p1220), Material (p1243), Earnings for current accounting period (+/-) (p1331), Personnel costs (p1518), Depreciation of fixed intangible assets and fixed tangible asset (p1525).

From these columns, only the rows that will contain the required values will be used. The data will be processed using the Statistica software by TIBCO Software Inc. This software will be used for determining the multiple regression analysis.

A given dataset is opened in the Statistica software, the selected list is imported into the table. Next, the option “1st row as the names of variables is selected, since the dataset contains names in the first row. In the basic menu, in the “Statistics” tab, multiple regression is selected. Furthermore, we will select variables, entering the dependent variable on the left side, which is *Earnings for current accounting period (+/-) (p1331)* in this case. On the right side, there will be a list of independent variables, i.e. *Land (p1220)*, *Material (p1243)*, *Personel Costs (p1518)*, *Depreciation of fixed intangible assets and fixed tangible assets (p1525)*. Then we will continue with calculating the results of the regression; in the tab, we will select “adding to the log”. In the log, a table with given values will be created. The mathematical model of multiple regression expressed as a formula is as follows:

$$y = ax_1 + bx_2 + cx_3 + dx_4$$

where y is profit,
 x_1 land,
 x_2 material,
 x_3 personnel costs,
 x_4 depreciation.

Next, a simplified model of regression analysis without the independent variable Land (p1220) will be created. The process is the same but when choosing variables for multiple regression, Land (p1220) is not included in the list of independent variables. Other items will be the same as above. The process is then the same until the calculation of the regression results and the creation of a log with a table containing the necessary values.

For overall testing of the model (F test), the following hypotheses were formulated:

H0: the model as a whole is insignificant, and H1: the model as a whole is significant.

When testing the significance of the explanatory variable x_1 = Land, the formulated hypotheses are as follows:

H0: the explanatory variable “Land” is insignificant, and H1: the explanatory variable “Land” is significant.

For the variable x_2 = material, the following hypotheses were tested: H0: the explanatory variable “Material” is insignificant, and H2: the explanatory variable “Material” is significant.

For the variable x_3 = personnel costs, the hypotheses tested were as follows: H0: the explanatory variable “personnel costs” is insignificant, and H3: the explanatory variable “personnel costs” is statistically significant

When testing the significance of the explanatory variable x_4 = depreciation, the following hypotheses were formulated:

H0: the explanatory variable “depreciation” is insignificant, and H4: the explanatory variable “depreciation” is significant.

3. Results

Value drivers

Based on the content analysis (research) of the available materials, the selected value drivers are:

x_1 land, x_2 material, x_3 personnel costs, and x_4 depreciation of fixed tangible and intangible assets. Earnings are marked as y .

Relationship of value drivers and profit generators of agricultural companies

The existence of these relationships was verified by multiple regression analysis.

Table 1 suggests that the correlation coefficient R indicating the intensity (tightness) of dependence equals 0.718. This indicates a stronger dependence of earnings on the acreage of land and at the same time, on material, personnel costs, and depreciation. The determination coefficient R^2 equals 0.515, the value of the modified determination coefficient (modified R^2), which is used for comparing models with a different number of variables (here, specifically, 4 explanatory variables) is 0.468. The model with the higher modified R^2 appears to be better. The column b^* (sometimes also referred to as beta coefficient) is used to determine the relative strength of the impact of individual variables on the dependent variable. This way it is possible to determine which variables have the biggest and the smallest impact on the variance of the dependent variable. Since x_1 (land), x_2 (material), x_3 (personnel costs), and x_4 (depreciation) have different units, their impact on y is difficult to compare but possible using b^* . Here, the highest absolute value of b^* is recorded in the case of depreciation. This implies that depreciation has the biggest effect on revenues (earnings). As can be seen, the value of depreciation is -1.318, which means an inverse ratio – depreciation decreases with the growing revenues. The column Standard deviation of b is a standard error of the estimate of the b parameter. The column t is the test criterion for the individual test of parameters, or test of significance of individual variables calculated as follows:

$$t = \frac{b}{st. error}$$

This should be compared with the critical value of the Student's t -distribution, but in this case, the comparison of p -value and α was used. Column b is used for the compilation of the model's equation. This means that the following expression of the model can be found in this column:

$$y' = -494084.871367 - 0.015124x_1 + 1.335417x_2 + 1.003646x_3 - 1.468423x_4$$

The value of F is 10.889. This is the value of the test criterion, which can be compared with the critical value, that is, the quantile of F -distribution. However, in this case, the p -value and α were compared.

Using the overall model test (F test), the following hypothesis was tested:

H0: the model as a whole is insignificant

Since $p < 0.05$ (α), H0 is rejected, which means that the model as a whole is statistically significant. To determine the quality of the model, determination coefficient R^2 was used, whose value is 0.515. The changes in

earnings are 51.51% explained by the change in land, and at the same time, the change in material, personnel costs, and depreciation.

Furthermore, a test of significance of individual explanatory variables (x_1 : land, x_2 : material, x_3 : personnel costs, x_4 : depreciation).

For land x_1 , the following hypothesis was tested:

H_0 : the explanatory variable "land" is insignificant

H_1 : the explanatory variable "land" is significant

Since the p-value 0.811 > 0.05, H_0 is not rejected, which means that land is a statistically insignificant explanatory variable and the conclusion is that it needs to be removed from the model.

For material x_2 , the following hypothesis was tested:

H_0 : the explanatory variable "material" is insignificant

H_2 : the explanatory variable "material" is statistically significant

Since the p-value 0.026 < 0.05, H_0 is rejected, which means that material is a statistically significant explanatory variable and needs to be included in the model.

For personnel costs x_3 , the following hypothesis was tested:

H_0 : the explanatory variable "personnel costs" is insignificant

H_3 : the explanatory variable "personnel costs" is significant

Since the p-value 0.000 < 0.05, H_0 is rejected, which means that "personnel costs" is a significant variable and needs to be included in the model.

For depreciation x_4 , the following hypothesis was tested:

H_0 : the explanatory variable "depreciation" is insignificant

H_4 : the explanatory variable "depreciation" is significant

Since the p-value 0.000 < 0.05, H_0 is rejected, which means that depreciation is a significant explanatory variable and needs to be included in the model (for more details, see Table 1).

Table 1. Regression Summary for dependent variable (Model 1)

N= 46	Regression Summary for dependent variable: Profit/(loss) for the current accounting period					
	R=,71770834 R2= ,51510526, adjusted R2= ,46779845					
	F(4,41)=10,889 p<,00000 Standard error of estimate: 4630E3					
	b*	Standard error of b*	b	Standard error of b	t(41)	p-value
intersection			-494084,871367	940753,6	-0,52520	0,602272
land	-0,04265	0,177499	-0,015124	0,1	-0,24029	0,811304
materials	0,34572	0,149666	1,335417	0,6	2,30994	0,026002
personnel costs	1,25404	0,205800	1,003646	0,2	6,09351	0,000000
depreciation of tangible fixed assets and intangible fixed assets	-1,31796	0,219700	-1,468423	0,2	-5,99891	0,000000

Source: Authors

Figure 1 shows a normal probability plot of residuals, which is used to check whether the distribution of residuals is normal.

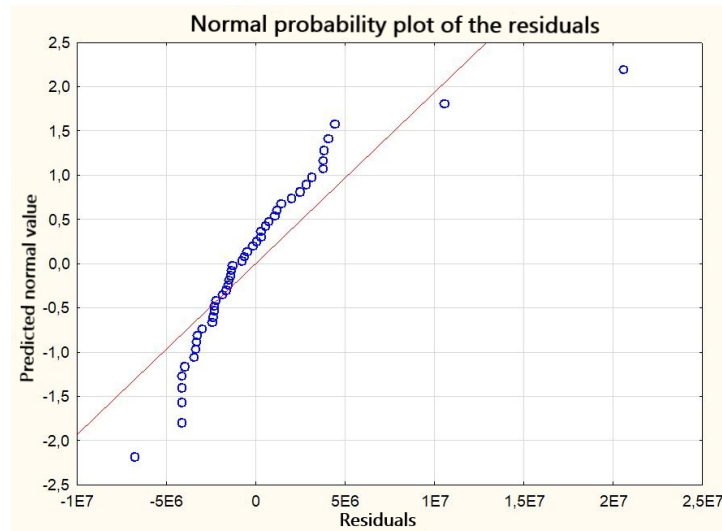


Figure 1. Normal probability plot of the residuals (Model 1)

Source: Authors

The points should be located as close to the red line as possible, which was achieved in this case.

Figure 2 shows the distribution histogram. The shape of the histogram should be similar to the Gaussian curve as much as possible (red curve = normal distribution).

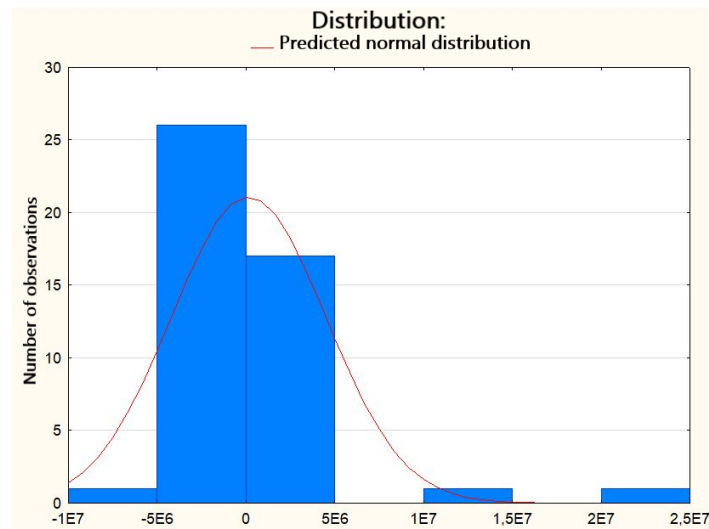


Figure 2. Normal distribution histogram (Model 1)

Source: Authors

Simplified model

It can be seen from Table 2 that the value of the correlation coefficient R is 0.717. In this case, it again indicates a stronger dependence of earnings on material, and at the same time, on personnel costs and depreciation. The value of the R^2 determination coefficient is 0.514, the value of the modified determination coefficient (modified R^2) is 0.479. In this case, there are 3 explanatory variables. The model with a higher modified R^2 appears to be better; now it can be seen that the simplification of the model was suitable, as this model shows a higher modified R^2 . In the b^* column, it can be seen that the highest absolute value of beta is achieved in the case of depreciation, which means that depreciation has the biggest effect on revenues. It is a negative value (-1.326), that is, the inverse ratio, which means that the revenues (earnings) grow with decreasing depreciation. Column b shows the shape of the model:

$$y' = -452401.263612 + 1.268884x_2 + 0.992108x_3 - 1.477922x_4$$

Using the overall model test (F test), the following hypothesis was tested:

H0: the model as a whole is insignificant

Since $p < 0.0 < 0.05$ (alpha), H_0 is rejected, which means that the model as a whole is statistically significant. To determine the quality of the model, the determination coefficient R^2 was used, whose value is 0.514. The changes in earnings are 51.44 % determined by the change in the material, and at the same time by the change in personnel costs and depreciation.

Furthermore, the tests of significance of individual explanatory variables (x_2 : material, x_3 : personnel costs, x_4 : depreciation) were performed.

For material x_2 , the following hypothesis was tested:

H0: the explanatory variable "material" is insignificant

H1: the explanatory variable "material" is significant

Since the p-value $0.015 < 0.05$, H_0 is rejected, which means that material is a significant explanatory variable and needs to be included in the model.

For personnel costs x_3 , the following hypothesis was tested:

H0: the explanatory variable "personnel costs" is insignificant

H2: the explanatory variable "personnel costs" is significant

Since the p-value $0.000 < 0.05$, H_0 is rejected, which means that "personnel costs" is a significant variable and shall be included in the model.

For depreciation x_4 , the following hypothesis was tested:

H0: the explanatory variable "depreciation" is insignificant

H3: the explanatory variable "depreciation" is significant

Since the p-value $0.000 < 0.05$, H_0 is rejected, which means that depreciation is a statistically significant explanatory variable and needs to be included in the model (see Table 2).

Table 2. Regression Summary for dependent variable (Model 2)

N= 46	Regression Summary for dependent variable: Profit/(loss) for the current accounting period					
	R=,71723246 R ² = ,51442240, adjusted R ² = ,47973829					
	F(3,42)=14,832 p<,00000 Standard error of estimate: 4578E3					
	b*	Standard error of b*	b	Standard error of b	t(41)	p-value
intersection			-452401,2636	914190	-0,4948	0,62327
materials	0,3285	0,12990	1,26888	0,5	2,5288	0,01529
personnel costs	1,2396	0,19463	0,99210	0,2	6,3688	0,00000
depreciation of tangible fixed assets and intangible fixed assets	-1,3264	0,21437	-1,47792	0,2	-6,1878	0,00000

Source: Authors

Figure 3 shows the normal probability plot of residuals. This graph serves to verify whether the residuals show normal distribution.

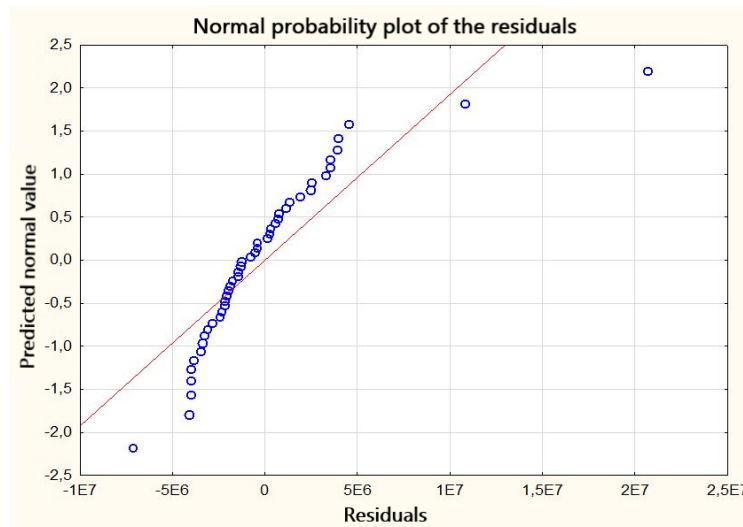


Figure 3. Normal probability plot of the residuals (Model 2)

Source: Authors

The points should be located as close to the red line as possible, which is achieved in this case.

Figure 4 shows a distribution histogram. The shape of the histogram should be similar to the Gaussian curve (red curve = normal distribution).

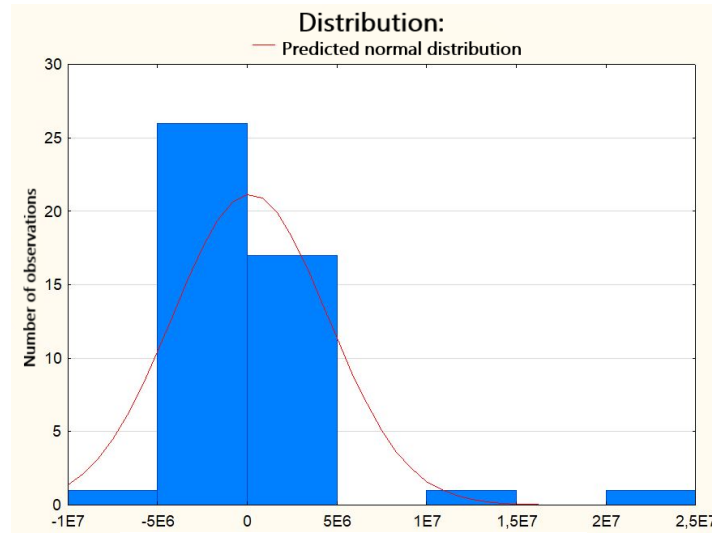


Figure 4. Normal distribution histogram (Model 2)

Source: Authors

Discussion – Evaluation, research questions

RQ1: What are the value drivers of agricultural companies?

Within the first research question, the selected value drivers of agricultural companies were *land*, *material*, *personnel costs* and *depreciation of fixed tangible and intangible assets*. These value drivers were verified on the basis of multiple regression analysis. It was concluded that *land* should be removed (for more details, see RQ2).

When using the Cobb-Douglas production function, Elita et al. (2019) selected the acreage of agricultural land, the quantity of work, seed and fertilizers as value drivers. They determined the relationship between these inputs and outputs in the form of rice and corn production. Shkuratov et al (2020) used correlation and regression analysis and selected the acreage of used agricultural land as a value driver, estimating the volume of gross agricultural output in relation to this value driver. Tiamme et al. (2019) selected agricultural land, labor, and capital as value drivers. They were used for the Cobb-Douglas production function, where the authors found that the size of these inputs influences the return to scale. Pechrová Simpachová and Simpach (2019) selected material, capital, number of employees and acreage of agricultural land as value drivers when using the Cobb-Douglas production function. The authors concluded that sales are directly dependent on these value drivers. According to Pechrová Simpachová & Simpacha (2020), value drivers include material, energy, fixed asset, the number of employees, and the acreage of agricultural land. Land and labor were selected as value drivers by Onofri et al. (2019).

RQ2: What is the relationship of value drivers and profit generators in agricultural companies?

When dealing with the second research question, value drivers (*land*, *material*, *personnel costs* and *depreciation of fixed tangible and intangible asset*) were compared and their relation to *profit – earnings* were analyzed using multiple regression analysis. In the first model, it was found that the changes in *earnings* are 51.51 % influenced by *land*, *material*, *personnel costs* and *depreciation*. However, further analysis showed that *land* is an insignificant variable and needs to be removed from the model due to the zero values of *land* of companies listed in Annex 5. In the second model, the *land* variable was not considered. It was concluded that the changes in *earnings* are 51.44 % determined by *material*, *personnel costs* and *depreciation*.

For comparison, it can be stated that Pechrová Simpachová & Simpach (2019) monitored the agricultural production in the form of sales in dependence on the consumption of material, capital, the number of employees, and the acreage of agricultural land. Instead of regression analysis, the authors used the Cobb-Douglas function and concluded that sales were most influenced by the consumption of material; the number of employees and the acreage of agricultural land had a smaller effect. Vasylyeva (2021) used a modified Cobb-Douglas production function describing how human capital acts on gross value added and gross production. The parameters of the production function were verified by means of correlation and regression analysis. The author concluded that by using higher labor potential and higher capital investments, it is possible to achieve better, yet unspecified agricultural outputs. Therefore, our data cannot be compared with the findings of this author.

Conclusions

The goal of the paper was to derive the production function of production factors of companies operating in the agricultural sector of the CR, to determine the value drivers and their relationship to the profit generators. The selected method was multiple regression analysis, while the determined variables were land, material, personnel costs, depreciation of fixed intangible and tangible asset, and earnings for the current accounting period.

The authors used multiple regression analysis to assess the relationship of the variables and profit. In the first model, it was concluded that earnings are 51.52 % determined by land, material, personnel costs and depreciation of fixed tangible and intangible assets. Since 17 companies out of 46 showed zero values of land, it was considered an insignificant variable and was removed from the model. In the simplified model, it was found that the changes in earnings are 51.44 % determined by material, personnel costs and depreciation. The results indicate that correct setting of production factors positively affects the profit of agricultural companies. In our case, material, personnel costs, and depreciation of fixed tangible and intangible assets contribute 51.44 % to the generation of profit.

Agricultural companies are thus recommended to focus their attention primarily on three out of the four production factors when striving for streamlining their activities. The main benefit of this study is the finding that land as such has probably the same value when held by any company. This can be explained by the fact that agricultural companies quite correctly choose suitable types of plans for all types of soil and soil quality. Therefore, this production factor practically does not play any role in a possible success or failure of an agricultural company. In contrast, the other three assessed production factors play an important role in corporate decision-making. Specifically, these are material, labor, and fixed assets. This is confirmed by the results of regression analysis. However, the truth is that simply increasing the volume of these production factors is not sufficient. What is essential is to maintain an effective ratio of these three production factors' combination. This combination is determined by the parameters (weights) of the regression curve of the second model. Agricultural companies should thus continue to care for land but at the same time, they must be aware of the fact that success depends on the aforementioned combination of material, human labor, and fixed assets. This will allow agricultural companies to set the ratio of these production factors so that they could succeed in the market and generate profit, which will then be used to achieve the main goal of the company – the growth of the value for the owners.

The goal of the paper was thus achieved. However, potential limitations of the research shall be pointed out. The limitation is definitely the dataset. The research was conducted on a limited number of agricultural companies. Furthermore, it can be stated that the ratio of controlled production factors will be different for a micro-enterprise or a large enterprise. The question also is whether the research included all production factors decisively participating in profit generation. The research considered properly the countable value drivers; however, there is a question of whether unquantifiable value generators should have been considered as well. This of course suggests a possible future direction of the research. It is not necessary to examine the level of the influence but

just the existence and the nature of the value driver should be dealt with. This is naturally given by the fact that agriculture is a very specific sector. On the one hand, it is a strategic industry of each state and as such, it receives great support. On the other hand, it is highly dependent on exogenous factors, such as the weather.

References

- Ahmed, M. H., Tazeze, A., Mezgebo, A., & Andualem, E. (2018). Measuring maize production efficiency in the eastern Ethiopia: Stochastic frontier approach. *African Journal of Science, Technology, Innovation and Development*, 10(7), 779–786. <https://doi.org/10.1080/20421338.2018.1514757>
- Anand, P., Husain, D., & Prakash, R. (2022). Sustainable integrated system for rural development: a case study. *Insights into Regional Development*, 4(3), 96–109. [https://doi.org/10.9770/IRD.2022.4.3\(6\)](https://doi.org/10.9770/IRD.2022.4.3(6))
- Bartos, V., Vochozka, M., & Janikova, J. (2021). Fair value in squeeze-out of large mining companies. *Acta Montanistica Slovaca*, 26(4), 712–731. <https://doi.org/10.46544/AMS.v26i4.10>
- Belas, J., Gavurova, B., Cepel, M., & Kubak, M. (2020). Evaluation of economic potential of business environment development by comparing sector differences: perspective of SMEs in the Czech Republic and Slovakia. *Oeconomia Copernicana*, 11(1), 135–159. <https://doi.org/10.24136/oc.2020.006>
- Bilan, Y., Gavurova, B., Stanislaw, G., & Tkacova, A. (2017). The Composite Coincident Indicator (CCI) for Business Cycles. *Acta Polytechnica Hungarica*, 14(7), 71–90. <https://doi.org/10.12700/aph.14.7.2017.7.5>
- Chabatul, V. V., Rusakovich, A. N., & Papinava, M. V. (2019). Methodological approaches for optimization of structure of production means of agricultural companies in the Republic of Belarus. *Proceedings of the National Academy of Sciences of Belarus. Agrarian Series*, 57(1), 19–37. <https://doi.org/10.29235/1817-7204-2019-57-1-19-37>
- Cheng, M., & Liu, B. (2021). Application of an extended VES production function model based on improved PSO algorithm. *Soft Computing*, 25(12), 7937–7945. <https://doi.org/10.1007/s00500-021-05676-7>
- Elita, Y., Sentosa, S. U. & Efrizal, S. (2019). Production Analysis, Minimum Cost, and Profit in Sentra Production of Rice and Corn Farming in Padang Pariaman: *Proceedings of the third padang international conference on economics education, economics, business and management, accounting and entrepreneurship (PICEEBA)* [online].
- El-Ramady, H., Alshaal, T., Yousef, S., Elmahdy, S., Faizy, S. E.-D., Amer, M., Shams El-Din, H., El-Ghamry, A. M., Mousa, A. A., Prokisch, J., & Senesi, N. (2019). Soil Fertility and Its Security. In H. El-Ramady, T. Alshaal, N. Bakr, T. Elbana, E. Mohamed, & A.-A. Belal (Ed.), *The Soils of Egypt* (s. 137–157). Springer International Publishing. https://doi.org/10.1007/978-3-319-95516-2_8
- Gadzchiev, E., Bogacheva, O. & Arutyunyan, S. (2019). Application of production function framework for the integral assessment and forecast of industry development in a region: *Proceedings of the 2nd international scientific conference on new industrialization: global, national, regional dimension (SICNI)* [online].
- Ganush, G. I., & Tsetsyrynets, T. A. (2022). Evolution of the theory and practices of human capital management in the agricultural sector. *Proceedings of the National Academy of Sciences of Belarus. Agrarian Series*, 60(1), 35–45. <https://doi.org/10.29235/1817-7204-2022-60-1-35-45>
- Gavurova, B., Janke, F., Packova, M., & Pridavok, M. (2017). Analysis of Impact of Using the Trend Variables on Bankruptcy Prediction Models Performance. *Ekonomicky casopis*, 65(4), 370–383.
- Gavurova, B., Packova, M., Misankova, M., & Smrcka, L. (2017). Predictive Potential and Risks of Selected Bankruptcy Prediction Models in the Slovak Business Environment. *Journal of Business Economics and Management*, 18(6), 1156–1173. <https://doi.org/10.3846/16111699.2017.1400461>
- Gavurova, B., Belas, J., Bilan, Y., & Horak, J. (2020). Study of legislative and administrative obstacles to SMEs business in the Czech Republic and Slovakia. *Oeconomia Copernicana*, 11(4), 689–719. <https://doi.org/10.24136/oc.2020.028>
- Gavurova, B., Kovac, V., Drabik, P., & Gomory, M. (2019). Exploration of Disparities in Environmental Activities of European Countries from Year 2006 to Year 2016. *Acta Montanistica Slovaca*, 24(4), 376–390.
- Holmen, R. B. (2022). Agglomeration decay in rural areas. *Insights into Regional Development*, 4(3), 139–155. [https://doi.org/10.9770/IRD.2022.4.3\(9\)](https://doi.org/10.9770/IRD.2022.4.3(9))
- Kocisova, K., Gavurova, B., & Kotaskova, A. (2018). A slack-based measure of agricultural efficiency in the European Union countries. *Journal of International Studies*, 11(1), 189–200. <https://doi.org/10.14254/2071-8330.2018/11-1/14>
- Kučera, J., Vochozka, M., & Rowland, Z. (2021). The Ideal Debt Ratio of an Agricultural Enterprise. *Sustainability*, 13(9), 4613. <https://doi.org/10.3390/su13094613>
- Kukushina, O. S., & Okomina, E. A. (2019). Assessing The Impact Of Resource Potential On The Results Of Agricultural Activity. 408–415. <https://doi.org/10.15405/epsbs.2019.04.45>
- Lambert, L. H., English, B. C., Clark, C. C., Lambert, D. M., Menard, R. J., Hellwinckel, C. M., Smith, S. A., & Papanicolaou, A. (2021). Local effects of climate change on row crop production and irrigation adoption. *Climate Risk Management*, 32, 100293. <https://doi.org/10.1016/j.crm.2021.100293>

- Muhajan, S., Sharma, M., Rizvi, S. E. H. & Kumar, B. (2018). Quantile regression approach for the analysis of production function of foodgrain in India: *international journal of agricultural and statistical sciences* [online].
- Nasir, S., Ribij, M. and Al-Wassity, R. Determine the Optimal Behavior of Wheat Producers in Reclaimed Irrigated Lands in Iraq for the Season 2018: *International journal of agricultural and statistical sciences* [online]. 2020 [cit. 2022-04-18].
- Nyangena, D. N., Kinyuru, J., & Imathiu, S. (2021). Climate change: A natural streamliner towards entomophagy? *International Journal of Tropical Insect Science*, 41(3), 2133–2147. <https://doi.org/10.1007/s42690-020-00292-8>.
- Onofri, L., Bianchin, F., & Boatto, V. (2019). How to assess future agricultural performance under climate change? A case-study on the Veneto region. *Agricultural and Food Economics*, 7(1), 16. <https://doi.org/10.1186/s40100-019-0131-y>.
- Pechrová Simpachová, M. & Simpach, O. (2019). Analysis of Production Function of Agricultural Holdings: *37th international conference on mathematical methods in economics 2019* [online].
- Pechrová Simpachová, M. & Simpach, O. (2020). Cobb-Douglas or Translog Production Function in Efficiency Analysis? *38th international conference on mathematical methods in economics (MME 2020)* [online].
- Parolini, G. (2022). Weather, climate, and agriculture: Historical contributions and perspectives from agricultural meteorology. *WIREs Climate Change*, 13(3). <https://doi.org/10.1002/wcc.766>.
- Potapov, A. (2020). Modeling the Impact of Resource Factors on Agricultural Output. *Economic and Social Changes: Facts, Trends, Forecast/Экономические и социальные перемены: факты, тенденции, прогноз*, 4 (70). <https://doi.org/10.15838/esc.2020.4.70.9>.
- Priyanka, P. A., Muraligopal, S., & Kumar, E. N. (2019). The Genesis of Pradhan Mantri Fasal Bima Yojana-A Review. *Indian Journal of Economics and Development*, 15(3), 483. <https://doi.org/10.5958/2322-0430.2019.00063.5>.
- Qiao, J., Yu, D., & Wu, J. (2018). How do climatic and management factors affect agricultural ecosystem services? A case study in the agro-pastoral transitional zone of northern China. *Science of the Total Environment*, 613–614, 314–323. <https://doi.org/10.1016/j.scitotenv.2017.08.264>.
- Shkuratov, O., Dorosh, O., Gorodyska, O. & Patiyuk, O. (2020). Assessment of influence of spatial organization of the territory on economic efficiency of agrarian enterprises: *scientific papers-series management economic engineering in agriculture and rural development* [online].
- Simtion, D. (2020). How to use production functions characteristics of economic processes in agriculture. *Physical (technical) functions: scientific papers-series management economic engineering in agriculture and rural development* [online].
- Straková, J., Koraus, A., Váchal, J., Pollák, F., Cernak, F., Talíř, M., & Kollmann, J. (2021). Sustainable Development Economics of Enterprises in the Services Sector Based on Effective Management of Value Streams. *Sustainability*, 13(16). <https://doi.org/10.3390/su13168978>
- Straková, J., Kucharčíková, A., Pártlová, P., & Váchal, J. (2016). Foreign Direct Investment and Transport Serviceability - a Prerequisite for the Development and Stability of National and Regional Economies. *Nase More*, 63(3), 204-210. <https://doi.org/10.17818/NM/2016/SI24>.
- Strakova, J., Partlova, P., Dobrovic, J., & Vachal, J. (2018). Situational analysis and its role in the process of strategic business management. *Polish journal of management studies*, 18(1), 353-364. <https://doi.org/10.17512/pjms.2018.18.1.26>
- Straková, J., Rajiani, I., Pártlová, P., Váchal, J., & Dobrovič, J. (2020). Use of the Value Chain in the Process of Generating a Sustainable Business Strategy on the Example of Manufacturing and Industrial Enterprises in the Czech Republic. *Sustainability*, 12(4), 1520. <https://doi.org/10.3390/su12041520>
- Suseela, K. & Chandrasekaran, M. (2018). Influence of technology adoption on yield and income of farmers in dryland agriculture of andhra pradesh. *International journal of agricultural and statistical sciences* [online].
- Takáč, I., Lazíková, J., Rumanovská, L., Bandlerová, A., & Lazíková, Z. (2020). The Factors Affecting Farmland Rental Prices in Slovakia. *Land*, 9(3), 96. <https://doi.org/10.3390/land9030096>.
- Tkacova, A., Gavurova, B., Danko, J., & Cepel, M. (2017). The importance of evaluation of economic determinants in public procurement processes in Slovakia in 2010-2016. *Oeconomia Copernicana*, 8(3), 367-382. <https://doi.org/10.24136/oc.v8i3.23>
- Vasyl'yeva, O. (2021). Assessment of factors of sustainable development of the agricultural sector using the Cobb-Douglas production function. *Baltic Journal of Economic Studies*, 7(2), 37–49. <https://doi.org/10.30525/2256-0742/2021-7-2-37-49>.
- Vochozka, M., Horak, J., Krulicky, T., & Pardal, P. (2020). Predicting future Brent oil price on global markets. *Acta Montanistica Slovaca*, 25(3), 375–392. <https://doi.org/10.46544/AMS.v25i3.10>.
- Vochozka, M., Kalinova, E., Gao, P., & Smolikova, L. (2021). Development of copper price from July 1959 and predicted development till the end of year 2022. *Acta Montanistica Slovaca*, 26(2), 262–280. <https://doi.org/10.46544/AMS.v26i2.07>.
- Vochozka, M., Maroušková, A., Váchal, J., & Straková, J. (2016). Appraisal of changes in sewage sludge management. *International Journal of Environmental Science and Technology*, 13(6), 1607–1614. <https://doi.org/10.1007/s13762-016-0991-6>.
- Vochozka, M., Maroušková, A., Straková, J., & Váchal, J. (2016). Techno-economic analysis of waste paper energy utilization. *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects*. Philadelphia: Taylor & Francis Inc, 38(23), 3459-3463. ISSN 1556-7036.
- Wicki, L. (2018). *The role of productivity growth in agricultural production development in Central and Eastern Europe countries after 1991*. 514–523. <https://doi.org/10.22616/ESRD.2018.060>.
- Wongyai, J., Tiammee, S., Wongyai, J., Udomwong, P., Phaphuangwittayakul, A. & Chanaim, S. Smart Farming in Thailand: *2019 13th international conference on software, knowledge, information management and applications (SKIMA)* [online]. 2019 [cit. 2022-04-19].

Zhang, Q., Chen, Z., & Li, F. (2021). Appropriate Management Scale of Farmland and Regional Differences under Different Objectives in Shaanxi Province, China. *Land*, 10(3), 314. <https://doi.org/10.3390/land10030314>.

Zhao, M., Chen, Z., Zhang, H., & Xue, J. (2018). Impact Assessment of Growth Drag and Its Contribution Factors: Evidence from China's Agricultural Economy. *Sustainability*, 10(9), 3262. <https://doi.org/10.3390/su10093262>.

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