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PANEL ANALYSIS OF RELATIONSHIP BETWEEN SALES AND PROFITABILITY OF CROP PRODUCTION COMPANIES IN THE REPUBLIC OF SERBIA

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OPEN ACCESS

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SUMMARY

This paper presents the research on factors influencing profitability of crop production companies in the Republic of Serbia. The research is based on 416 observations of financial statements of crop production companies during the period 2008–2023. The analysis was conducted using panel data models. Profitability was measured by return on assets, while the independent factors examined included: size, leverage, sales growth and current ratio. The findings reveal that although crop production companies in the Republic of Serbia have an average positive profitability rate, the level remains low. Furthermore, the results indicate that sales growth has a positive and significant impact on profitability, while the current ratio and size have a negative and significant effect. The results of the study are significant for a wide range of stakeholders, including managers, owners and regulatory bodies, as the results indicate the profile of crop production companies that can be used for improving profitability and fostering sustainable growth and development.

Key words:
crop production companies, panel analysis, profitability, sales

INTRODUCTION

Agriculture (agriculture, forestry and fisheries combined) continues to play a significant role in the global economy, contributing an average of 4% annually to global GDP since 2000. In 2021, its estimated global value added reached 3.7 trillion US dollars, which is an 84% increase compared to 2000 (FAO, 2023). According to the International Labor Organization (2024), approximately one billion people, or 28% of the total world`s workforce, are employed in agriculture. The relative importance of the agricultural sector in a national economy primarily depends on its level of economic development. In developing countries, the agricultural sector accounts for a larger share of the gross domestic product. In high-income countries, lower levels reflect lower labor productivity in agriculture in comparison to industry and services (Cheong et al., 2013). Similarly, the proportion of labor force employed in agriculture and the share of agricultural product exports in the total exports are lower in high-income countries. The development of agriculture in a country or region is shaped by various factors, including climate and weather conditions, soil quality, water availability, access to capital, socio-economic conditions, agricultural policies, infrastructure, technological innovations, market dynamics for agricultural products, and labor force (Milić et al., 2024).

Although various forms of production generate total agricultural production value and agricultural gross value added, they can be divided into two main groups: crop production and livestock production. Crop production includes crop farming, fruit growing and viticulture, while livestock production comprises cattle, sheep, pig and poultry breeding. Crops can be further divided into annual and perennial. The characteristic of annual crops is that "they do not last more than two growing seasons and typically only one, while perennial or permanent crops last for more than two

growing seasons, either dying back after each season or growing continuously" (Eurostat, 2023). Annual crops include wheat, maize, barley, sugar beet, potatoes, soybeans, rapeseed, rice, etc. Perennial crops include fruit trees and vines.

Crop production strongly impacts overall agriculture growth and development, on both national and global economy levels. In 2021, global production of primary crops reached 9.5 billion tons, valued at 2.8 trillion US dollars (FAO, 2023). Cereals accounted for nearly 30% of global production by both quantity and value. While the primary function of crop production is to meet human nutritional needs, it also provides inputs for the processing industry and livestock production. With the expansion of international trade and the development of global food chains, crop production also needs to provide surpluses for exports which, as a source of income, directly affect living standards.

Agriculture, particularly crop production, is of great importance for the economy of the Republic of Serbia. Although the country has abundant natural resources, they are insufficiently used. According to the World Bank (2024), Serbia, classified as a middle-income country, achieved a GDP of 75.5 billion US dollars in 2023, equivalent to a GDP per capita of 11,270.8 US dollars. A GDP growth of 2.5% in 2023, compared to the previous year, was achieved by improvements in agriculture, construction, and the energy sector. In 2022, the participation of agricultural sector in the GDP of this national economy was 6.46% (Statista, 2024). Despite the low share of agriculture in the GDP, it has a significant impact on the country`s economic development due to its high average annual growth rate (Vučkovski et al., 2022). Crop production generates the largest portion of the agricultural gross value added in the Republic of Serbia. In 2022, crop production and food industry accounted for 11.0% of the country`s total gross value added (Chamber of Commerce and Industry of Serbia, 2024).

In 2023, the utilized agricultural area (UAA) in the Republic of Serbia totaled 3,2396,373 ha, of which 77.7% were arable land and kitchen gardens. These were followed by permanent grassland and pastures (14.5%), fruit plantations/orchards (6.0%) and vineyards (0.6%). Within the arable land and kitchen gardens, cereals accounted for 67% of the cultivated area, industrial crops 19%, fodder crops 9%, and other crops 4% (Statistical Office of the Republic of Serbia, 2024). The northern regions of the country are oriented towards cultivation of cereals and industrial crops, while the southern regions are focused on vegetables, fodder crops and perennial crops (Grujić et al., 2018).

The economic indicators of crop production in the Republic of Serbia recorded growth in 2023, primarily owing to the poor results in 2022. Increased areas under cereals and more favorable weather conditions in 2023 compared to 2022 contributed to 34.9% increase in the country's cereal production. In comparison to the five-year average, it was a rise of 6.7%. Sugar beet production in 2023 was 22.4% higher than in 2022, but 1.5% lower in relation to the five-year average. In the same year, oilseeds production recorded a growth of 25.6% compared to the previous year, and 3.7% rise compared to the five-year average. Country`s tobacco production increased by 12.1% compared to 2022, but was 9.3% below the five-year average. In 2023, vegetable production reached an increase of 11.96% compared to the previous year, but declined by 3.03% in comparison to the five-year average. Fruit production dropped by 16.5% in 2023 compared to 2022, despite larger areas under fruit in 2023. During 2023, grape production fell by 19% and wine production by 7.7% in relation to 2022. In comparison to the five-year average, grape and wine production decreased by 16.9% and 19.4%, respectively (Ministry of Agriculture, Forestry and Water Management, 2024a).

Agricultural and food product trade is dominant in the total foreign trade exchange of the Republic of Serbia. In fact, this is the only sector of the country`s economy consistently achieving a surplus. Primary agricultural products account for the highest proportion of export and import values. In 2023, their export value was approximately 2.9 billion EUR, representing 60.7% of the value of agricultural and food product exports, while their import value was around 2.1 billion EUR or 61.5% of the value of agricultural and food product imports (Ministry of Agriculture, Forestry and Water Management, 2024b). Leading export primary agricultural products include frozen raspberries, mercantile corn, food for dogs and cats and mercantile wheat, while imports are dominated by frozen boneless pork, raw coffee, bananas, seed corn, mercantile soy, etc.

Profitability is a crucial factor for survival and growth of any business. It represents the company's ability to generate income that exceeds its expenses and it is a key indicator of financial health. Profitability ensures sustainability, facilitates growth, attracts investment, and enhances competitive advantage (Toshniwal, 2016; Dakić & Mijić, 2020). Without profitability, a business faces challenges in surviving, let alone thriving in a competitive market. Management plays a key role in ensuring a company's success. Therefore, management need to continuously monitor business performance, with a particular focus on profitability. Factors influencing profitability include production-related factors, financial, economic, social and natural factors. Profitability growth can not only improve the position of companies in the market, but also contribute to the development of the whole agricultural sector (Vukoje et al., 2022). Continuous analysis of performance indicates the potentials for growth and development as well as disruptions of business continuity (Kušter, 2023).

Numerous studies have identified a variety of factors that influence profitability, with growth being consistently identified as a crucial one. Growth can be defined as the change in sales growth. Sales revenue growth is a key driver of profitability, as it enables companies to leverage economies of scale, improve profit margins, strengthen their competitive position, and invest in future growth. In this way, revenue growth becomes a catalyst for sustainable success and long-term profitability for businesses (Vuković et al., 2022).

Profitability of farms in the European Union during the period 2007-2018 was investigated by Kryszak et al. (2021) using panel data models. The research results indicate that growth plays a crucial role in achieving high profitability rates. Additionally, the study revealed that the level of debt has a significant negative impact on profitability rate. In Serbia, the profitability of meat processing companies was analyzed over the period 2007-2016 (Dakić & Mijić, 2020). Using panel data models, the authors investigated factors that have significant impact on return on assets, as a main profitability indicator. Research results show that variables such as age, debt ratio and capital turnover ratio are significant at the level of 1%, sales growth is significant at the level of 5%, while the quick ratio is significant at the level of 10%. The findings indicate that, among all the factors, a higher rate of sales growth can improve the profitability ratio. The research on profitability of manufacturing companies listed in Tehran Stock Exchange between 2014 and 2022 was conducted by Asadifard et al. (2023). The study, which involved 171 companies and used multiple regression models, indicated that sales growth had a significant and positive impact on the company's profitability, while inventory turnover had inverse and significant impact on profitability ratio. The role of investment, growth rate of sales, company size on company performance was investigated for 194 manufacturing companies listed on the Indonesia Stock Exchange over the period 2010-2016 (Ghozali et al., 2018). The results showed a positive relationship between investments and the company's performance. Companies that strongly focus on boosting sales are likely to generate future profits, which significantly increases the appeal for investments.

Contemporary research on profitability factors of agricultural companies has expanded to incorporate additional dimensions, such as impact of implementing new technologies, such as drones, sensors and artificial intelligence (Karunathilake et al., 2023). Regardless of the groups of factors investigated, continuous monitoring and analysis of profitability are necessary to ensure a company's sustainability, growth and development.

MATERIAL AND METHODS

The analysis of a company's profitability is a key indicator of its business success. Over the past 20 years, numerous studies have been dedicated to researching this topic to understand the factors influencing company performance. The aim of this study was to examine the influence of certain internal factors, such as sales growth, on company profitability, attempting to answer why certain companies are more profitable than others. Measuring factors affecting company performance is of great importance, as reliable and informed decisions cannot be made without such analyses.

The study used panel regression analysis, with the accounting indicator of profitability ROA (return on assets) serving as the dependent variable, and internal company factors such as sales growth, company size, overall liquidity, and indebtedness, serving as the independent variables (Tab. 1).

The sample consisted of 26 companies from the crop production sector, as a part of the agricultural sector in the Republic of Serbia. The companies were observed over a period from 2008 to 2023 (16 years), resulting in a total number of 416 observations. The data obtained from the financial statements for the observed companies were sourced from the Scoring database (Scoring, 2024). The given data set is strictly balanced, meaning that complete time series are available for each year (time series with data for each year, i.e. no missing data).

Table 1. Overview of variables included in the panel regression analysis
(source: Authors' illustration based on Rodić et al. (2017))

Variables	Symbol	Type of variables	Indicator	Explanation	Expected impact on dependent variable
Return On Assets	ROA	Dependent	ROA is a financial metric that measures how efficiently a company is generating profits from its assets	Net Income / Total Assets	/
Sales Growth	SG	Explanatory	Indicates increase or decrease in	(Current Period Sales – Previous	Positive

Variables	Symbol	Type of variables	Indicator	Explanation	Expected impact on dependent variable
			sales between two time periods.	Period Sales) / Previous Period Sales	
Current Ration	CR	Explanatory	Current ratio is a financial indicator that measures a company's ability to meet its short-term obligations using its current assets	Current assets/ current liabilities of the company	Positive
Leverage Ratio	LR	Explanatory	Indicates the structure of source of funding	Total debts/ Total Assets	Negative
Size of company	Size	Explanatory	Indicates the size of company	Natural log of Total Assets	Positive or negative

In accordance with the stated research objective, the following hypotheses were formulated:

H_0: The profitability of a company, measured by Return on Assets (ROA), does not depend on internal company-specific factors such as company size, current ratio, leverage ratio and sales growth.
H_1: The profitability of a company, measured by Return on Assets (ROA), depends on internal company-specific factors such as company size, current ratio, leverage ratio and sales growth.

The research employs panel series of data, necessitating the application of methodologies from the field of panel series data analysis. Panel data models provide information about the behavior of individual units (i.e. specific subjects) through the characteristics of the subject itself and over time. Panel data and the models related to them contain comparative data, characteristics, and time intervals within which they are observed. In these models, we have the same cross-sectional unit observed over time.
When examining the dependent variable Y, which is explained by the independent variables K as well as random variation representing the stochastic part of the model, the general regression model that describes panel data can be represented by the following equation:

$$Y_{it} = \beta_{1it} \cdot xX_{1it} + \beta_{2it} \cdot X_{2it} + \cdots + \beta_{Kit} \cdot X_{Kit} + u_{it}, \quad (1)$$

where parameter: Y_{it} represents the value of the dependent variable for the *i*th unit of observation in period t; X_{Kit} represents the value of the kth independent variable for that unit observations in the period t; β_{kit} represents the value of unknown regression parameters that are variable by the *ith* observation unit and period *t*; and u_{it} represents the random error, with an expected value of zero ($E(u_{it}) = 0$), i.e. that its arithmetic mean is equal to zero, and that its variance is constant $D(u_{it}) = \sigma^2$, for each *i* and *t*.

The general regression model for panel data represents the most general form of linear models. There are several different panel models, the choice of which depends on the degree of variability of the regression parameters. In the broadest sense, panel models can be divided into the following:

- Pooled OLS Regression Model: Assumes constant coefficients and error variances across time and individuals.
- Fixed Effects Model: Assumes individual-specific intercepts to capture individual characteristics that do not change over time.
- Random Effects Model: Assumes that individual-specific effects are random and uncorrelated with the independent variables.
- Dynamic Panel Model: Includes lagged dependent variables as predictors to account for dynamics over time.

Models are used to assess the influence of independent variables on the dependent variable linear regression, most commonly the fixed effects model and the stochastic effects model. The fixed effects model considers the internal dimension of the data (difference within the same company), while the stochastic effects model considers both internal differences and differences between individual subjects (Verbeek, 2008).

RESULTS AND DISCUSSION

Table 2 shows the basic indicators of descriptive statistics for the variables included in the model, while Figure 1 illustrates the trend of the average value of ROA in the period from 2008 to 2023.

Table 2. Descriptive statistics of variables used in model (source: Authors' calculation)

Variable	Mean	Median	Minimum	Maximum	Std. Dev.	Missing obs.
ROA	0.032359	0.022000	-0.42090	0.43310	0.090102	0
Size	5.4583	4.7559	0.73189	16.289	3.5183	0
CR	4.2355	1.2056	0,00007	665.58	33.171	0
LR	0.49332	0.46095	0.0026000	1.3450	0.29628	0
SG	1.2344	1.1278	0.00000	9.6800	0.83315	0

Figure 1. Mean ROA trends in the period 2008-2023 in selected companies in Serbia (source: Authors' illustration)

As shown in Figure 1, the highest mean ROA was recorded in 2012, and the lowest in 2014.

For a panel regression model to be considered reliable, certain assumptions must be met. These assumptions are tested using appropriate diagnostic tests in data analysis software: a) Time Invariance; b) Error Independence; b) Homoskedasticity; c) No Perfect Collinearity; d) No Serial Correlation; e) Linearity; f) Normality of Errors.

Multicollinearity in a panel regression model occurs when independent variables are highly correlated with each other, which can pose challenges in interpreting the regression coefficients and affect the reliability of the model's results. To assess whether multicollinearity is a problem in our panel regression model, a Correlation Matrix (Tab. 3) was constructed for all independent variables included in model, providing an overview of pairwise correlations between each pair of variables. As shown in Table 3, there are no high correlation coefficients (above 0.5) indicating strong linear relationships between variables, so it can be concluded that multicollinearity is not a problem in this model.

Table 3. Pearson correlation coefficient (source: Authors' calculation)

	ROA	Size	CR	LR	SG
ROA	1.0000				
Size	-0,2042	1.0000			
CR	-0,0911	-0.0562	1.0000		
LR	-0,1179	0.0254	-0.1121	1.0000	
SG	0,2088	-0.0863	-0,0013	0,0387	1.0000

While the correlation matrix gives an overview of pairwise relationships, the Variance Inflation Factor (VIF) is a more precise measure of multicollinearity in regression models. Therefore, the VIF was calculated for each variable to quantify the extent of multicollinearity.

Table 4. Collinearity Statistics (source: Authors' calculation)

Variable	Variance impact factors of variables (VIF)
Size	1.011
CR	1.016
LR	1.015
SG	1.009

As shown in Table 4, all values are below 5, which is generally acceptable, confirming the absence of multicollinearity.

Panel data refer to data where multiple entities (in this case, companies) are observed over multiple time periods. Autocorrelation in panel data can occur when the error terms for a particular entity are correlated across time periods, violating the assumption of independence. In other words, the presence of autocorrelation means that the random error related to one observation is dependent on the random error related to another observation.

To test for autocorrelation in panel data, Wooldridge test was conducted to check for the presence of autocorrelation in the residuals of a panel data regression model. The null hypothesis assumes no first-order autocorrelation (rho = 0). The test statistic F (1, 25) = 3.64071, with p-value = P (F (1, 25) > 3.64071) = 0.0679309, provides the basis to conclude that there is no problem with autocorrelation.

In regression models, heteroscedasticity refers to a situation where the variance of the error (random deviation) of the model changes with respect to observation. This means that heteroscedasticity in panel regression models occurs when the variance of the error term differs across individuals and/or over time. This violates the assumption of homoscedasticity, where the error terms have constant variance. If the random error is heteroscedastic, the estimated coefficients obtained through regression will still be consistent, but they will not be efficient. Additionally, the standard error of the estimated values will be biased and inconsistent. Therefore, it is necessary to detect the presence of heteroscedasticity in the panel data used in the analysis.

The Breusch-Pagan and White's tests are the most commonly used to test this problem. The White's test is known as a special form of the Breusch-Pagan test. The null hypothesis in this test states that all error variances are equal, while the alternative hypothesis states that the error variances are different. White's test was conducted, and since the p-value was over 5% (p=0.06469), it was concluded that there was no heteroscedasticity in the model.

Table 5 presents all three models based on processed data from the sample, while Table 6 provides the panel diagnostics used to determine the most suitable of the three offered models.

Table 5. Panel models (source: Authors' calculation)

Explanatory variables	Coefficient		
	Model 1	**Model 2**	**Model 3**
Const.	0.0540181	0.0302959	0.0319194
	(<0.0001)***	(0.0002)***	(0.0282)**
Size	−0.00487335	−0.00201861	−0.00221294
	(<0.0001)***	(0.0226)**	(0.0122)**
CR	−0.000316688	−0.000187317	−0.000192486
	(0.0135)**	(0.0117)**	(<0.0102)**
LR	−0.0406891	0.00791465	0.00539405
	(0.0046)***	(0.3899)	(0.5609)
SG	0.0213502	0.00807681	0.00864597
	(<0.0001)***	(0.0066)***	(<0.0039)***

Legend: - Model 1: Pooled OLS; Model 2: Fix-effects model; Model 3: Random-effects; (GLS); *, **, *** indicate statistical significance at the 90% and 95% and 99% level of confidence.

Table 6. Panel model diagnostic (source: Authors' calculation)

Diagnostics	Null hypothesis	p value	Decision
Joint significance of differing group means:	The pooled OLS model is adequate	F (25, 396) = 36.4836 with p-value 0,000	A p-value less than 5% (0.05) counts against the null hypothesis that the pooled OLS model is adequate, in favor of the fixed effects alternative.
Hausman test statistic	The random effects model is adequate	H = 16.5829 with p-value = prob (chi-square (4) > 16.5829) = 0.00232891	A p-value less than 5% (0.05) counts against the null hypothesis that the random effects model is adequate, in favor of the fixed effects alternative.

Table 6 shows that the fixed effect model is the most suitable, and its results are presented in Table 7.

Table 7. Fixed-effects model (source: Authors' calculation)

	Coefficient	Std. Error	t-ratio	p-value	
const	0.0302959	0.00800836	3.783	0.0002	***
Size	−0.00201861	0.000881758	−2.289	0.0226	**
CR	−0.000187317	7.39602e-05	−2.533	0.0117	**
LR	0.00791465	0.00919401	0.8608	0.3899	
SG	0.00807681	0.00295915	2.729	0.0066	***

Legend: -*, **, *** indicate statistical significance at the 90% and 95% and 99% level of confidence.

Findings in Table 7 indicate that three independent variables have a statistically significance impact on dependent variable (ROA), while only one variable (Leverage Ratio) is not statistically significant. The aim of this research was to test the claim that sales growth exerts a positive influence on company profitability. This goal has been achieved, as the results demonstrate that sales growth has a positive effect on company productivity. At the 1% significance level, the variable sale growth (0.00807681) shows a positive impact on ROA. On the other hand, the variables size (−0.00201861) and current ratio (−0.000187317) show negative impact on the dependent variable at the 5% significance level. The model is statistically significant (p- value (F) = 0.000), justifying the use of this model.

CONCLUSION

The Republic of Serbia has great comparative advantages for development of crop production considering the size and high quality of its arable land, climatic conditions, educated workforce, geographical, logistical and commercial position, etc. The country is considered as one of Europe's most significant crop producers, particularly in maize, soya, sunflowers and sugar beet. Additionally, it is also considered as one of the 158 world biodiversity centers, especially in medicinal herbs (Radovanović et al., 2023). It is estimated that "there are about 15,000 seed accessions and 3,500 accessions of fruit trees, while in the National Plant Gene Bank there are more than 4,000 accessions of nearly 250 plant species" (Anđelković et al., 2020). Accordingly, crop production plays a prominent role in the country`s economy as it has the largest share in the country`s total agricultural output, and thus significantly contributes to the country`s GDP, workforce and exports.

This study found an average positive profitability rate of crop production companies in the Republic of Serbia, but the profitability rate was not at the referent value. In 2023, an average rate of profitability was approximately 2%, while the referent value for sustainable development is set at a minimum of 10% (Rodić et al., 2017). Also, over the period 2008-2023, there were significant fluctuations in the average profitability. Furthermore, the results indicate that sales growth has a positive significant impact on the return on assets of crop production companies. On the other hand, the current ratio and firm size have negative significant impact on the profitability ratio. These findings confirm the hypotheses H_1, indicating that crop production companies can achieve a higher rate of profitability by increasing sales growth.

However, potentials for greater crop production in the Republic of Serbia are not fully realized, necessitating specific measures to stimulate growth. Firstly, it is recommended to revise the national agricultural policies with the aim of increasing productivity, by providing financial and educational support programs for farmers. Additionally, small and fragmented agricultural holdings with unfavorable age structure should work cooperatively to be able to meet the demands of large and dependable foreign customers (Kljajić et al., 2023). Improving the country's irrigation system

would certainly boost crop production, given the system's current low efficiency. Furthermore, it is necessary to implement modern technology, mechanization, equipment, certification, etc. A shift toward organic crop production and high value-added agricultural products is also recommended to strengthen the country's position in the global sustainable agri-food supply chains and to enhance its exports. Although the area under organic farming recorded almost a permanent growth from 2012 to 2021, it accounted for only 0.67% of the overall arable land in 2021 (Kešelj Milovanović, 2022).

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