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DuPont profitability analysis of different types of agricultural farms in Croatia

Analiza profitabilnosti različitih tipova poljoprivrednih gospodarstava u Hrvatskoj primjenom DuPont analize

Vesna OČIĆ, Zoran GRGIĆ, Branka ŠAKIĆ BOBIĆ (✉), Kristina BATELJA LODETA, Tihana KOVAČIĆEK

University of Zagreb Faculty of Agriculture, Svetošimunska cesta 25, Zagreb, Croatia

✉ Corresponding author: bsakic@agr.hr

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ABSTRACT

The DuPont analysis is a useful and simple tool for measuring the financial performance of agricultural farms and assessing the company's profit potential. The research objective of this paper is to analyse eight different types of farms and two regions of the Republic of Croatia in the period from Croatia's accession to the European Union in 2013 until 2021. The data from the Standard results, which represent the weighted averages of agricultural farms in the FADN sample, were used. The Farm Accountancy Data Network (FADN) is a European data collection system with the aim of annual determination of the farm income and business analysis of the agricultural farm. It can be concluded that the profitability of agricultural farms in Croatia increased in the observed period, but with significant deviations. Return on equity (ROE) shows the earning potential of invested own capital and is the top indicator of the DuPont analysis. In both regions of the Republic of Croatia (Adriatic and Continental), a positive change can be observed after 2017, with better indicators in Continental Croatia. The lowest ROE was recorded for the mixed type in 2014, when the return on equity was -10.52%. The highest ROE (12.44%) was recorded for the milk type in 2020. For all types, as well as all regions, there are large fluctuations in return on equity caused primarily by changes in gross and net farm income.

Keywords: DuPont analysis, Farm Accountancy Data Network, farm types, return on equity

SAŽETAK

DuPont analiza je koristan i jednostavan alat za mjerenje financijskog učinka poljoprivrednih poduzeća i procjenu potencijala poduzeća za ostvarivanje profita. Cilj istraživanja ovog rada je analizirati osam različitih tipova poljoprivrednih gospodarstava i dvije regije Republike Hrvatske u razdoblju od pristupanja Hrvatske Europskoj uniji 2013. godine pa do 2021. godine. Korišteni su podaci iz Standardnih rezultata koji predstavljaju ponderirane prosjeke poljoprivrednih gospodarstava u FADN uzorku. Sustav poljoprivrednih knjigovodstvenih podataka (Farm Accountancy Data Network – FADN) je europski sustav prikupljanja podataka s ciljem godišnjeg određivanja prihoda poljoprivrednih gospodarstava te poslovne analize poljoprivrednog gospodarstva. Može se zaključiti da se profitabilnost poljoprivrednih gospodarstava u Hrvatskoj u promatranom razdoblju povećavala ali uz značajna odstupanja. Povrat na kapital pokazuje potencijal zarade od uloženog vlastitog kapitala i vršni je pokazatelj DuPont analize. U obje regije RH (Jadranska i Kontinentalna) se primjećuje pozitivna promjena nakon 2017. godine s boljim pokazateljima u Kontinentalnoj Hrvatskoj. Najniži povrat na kapital zabilježen je kod tipa mješovito gospodarstvo 2014. godine kada je povrat na kapital bio -10,52%. Najviši povrat je zabilježen kod mljekarskog tipa 2020. godine od 12,44%. Kod svih tipova, kao i kod regija postoje velike fluktuacije povrata na kapital uzrokovane prvenstveno promjenama bruto i neto prihoda farme.

Ključne riječi: DuPont analiza, Sustav poljoprivrednih knjigovodstvenih podataka, tipovi gospodarstava, povrat na kapital

INTRODUCTION

Financial management is important as a management function of any business, including farm businesses. Successful farm business managers must understand the determinants of profitability and have an overall long-term or strategic management focus (Melvin et al., 2004). The DuPont analysis is a common and useful tool for assessing and understanding the drivers of profitability (Barry et al., 2000). Profitability indicators show the company's profit potential, i.e. the total effect of liquidity, asset and debt management on the profit potential. Profitability is measurable in relation to the amount of realized sales, which includes the gross and net profit margin, and in relation to investments, which includes the profitability of assets and the profitability of own capital. They are expressed in percentages, and a low percentage of profitability leads to the failure of the company in the future (Vidučić, 2012). The adoption of financial management practices, such as using investment analysis techniques, significantly impacts farm financial performance (Gloy and LaDue, 2003). Shadbolt (2012) examine the financial performance of five grazing dairy farming systems through the use of financial ratio analysis in the form of the DuPont analysis. Examining the returns on assets or equity is useful in assessing how well a company uses its capital stock (Prager et al., 2018). DuPont is a useful and simple tool used to measure the financial performance of agricultural businesses. The low net profit margin negatively affected the percentage of return on investment (Büyükarıkan and Eryılmaz, 2020). The DuPont analysis was used to determine the main drivers of return on equity at dairy farms from the five EU countries. The lowest return on equity in the years 2004–2020 was calculated for farms from the Netherlands, while the highest return on equity was calculated for farms from France (Parzonko et al., 2023). Ladvenicová et al. (2019) analyzed the factors that influence the changes in return on equity for farms from Slovakia, Poland, Hungary and the Czech Republic. The source of data was the Farm Accountancy Data Network (FADN). Baležentis and Novickytė (2018) have explored the profitability of Lithuanian family farms using data from the FADN system in the period 2005-2015 and applying DuPont analysis and ROE indicators. The average ROE ratio for the entire period was 0.103. Specialist cereal, oilseeds and protein crops family farms showed higher returns than all family farms. The difference between ROE and ROA reflects the effect of the financial leverage on the company profitability. The advantage of this method consists in the simultaneous analysis of more rates, offering an overview of the company's performances that allows the identification of potential issues that need to be solved (Ilea and Armanca, 2018). Mishra et al. (2012) find that key drivers of net profit margins are farmers' education, farm size and typology, specialization, and level of government payments. Beyer and Hinke (2020) in their study shows that for the European agricultural companies in terms of profitability present a complex and differentiated picture. Kusz et al. (2023) in their paper try to determine the endogenous factors that determine ROE, the direction of the impact of these factors, as well as the strategy of biogas plants in shaping the ROE level. The DuPont was used in the analysis of ROE changes. Góral and Soliwoda (2021) found that subsidies had a negative effect on the profitability of large farms. They did not detect a significant impact of variables related to the farm manager. The financial surplus to liabilities had a positive impact on ROA. Pastusiak et al. (2021) investigate the difference between less-favored area (LFA) farms and non-LFA households using DuPont analysis and the Sustainable Growth Challenge (SGC) model. Differences between values of DuPont expansion indicators for LFA and non-LFA farms were statistically significant, with some exceptions. Asset turnover was higher at non-LFA farms. The higher rate of ROE for LFA farms may be attributed mainly to higher profit margins and asset turnover. The ROA of an average farm in the EU in 2018 was 1.3 % (1.9 % in 2017). Farms in Bulgaria (8.7 % ROA), Hungary (7.4 % ROA) and Portugal (7.1 % ROA) had the highest ROA indicators, while 13 Member States registered a negative ROA, with the lowest value recorded in Sweden (−3.5 %). The average ROA in Croatia was around -0,9% (EC, 2021). DuPont analysis was performed on the data to examine the profitability of agricultural farms and determine the impact of the profit margin, assets turnover and leverage on ROE (return on equity).

MATERIALS AND METHODS

This paper analyzed the data of Croatian agricultural farms in the period from Croatia's accession to the EU (2013) until the last available year (2021). Data from the Standard Results were used, which represent weighted averages of agricultural farms in the FADN sample. The Farm Accountancy Data Network (FADN) is a European data collection system with the aim of annual determination of the farm income and business analysis of the agricultural farms. FADN data are also important for the development and monitoring of the impact of the Common Agricultural Policy (CAP) (Council Regulation (EC), No. 1217/2009). The FADN system includes only commercial farms that exceed the minimum threshold, and participation in the system is voluntary. The analysis included 8 basic types of farms (Fieldcrops, Horticulture, Wine, Other permanent crops, Dairy, Other grazing livestock, Granivores and Mixed) and two regions of the Republic of Croatia (Adriatic and Continental).

The DuPont analysis was developed by managers at the DuPont Chemical Corporation for the purpose of internally pinpointing strengths and weaknesses within the company's management hierarchy. The DuPont formula provides upper management with a top-down look into the company's performance culminating with ROE which, again, is of the most interest to company shareholders (Bigel, 2022). The key factor for the competitiveness of an enterprise element can be the implementation of the DuPont formula. One of the most important and meaningful coefficients is ROE (return on equity). It shows the effectiveness of the use of shareholders' funds (Kishibayeva and Jaxybekova, 2023). Mishra et al. (2008) use DuPont analysis to examine the significance of specialization and vertical integration on domestic agriculture. The hypothesis was that agricultural specialization directly affects the asset efficiency and gross margin of the farm. Hines (2014) uses DuPont to identify key profitability drivers of farmer cooperatives of different sizes throughout time. Mishra et al. (2012) use a financial approach based on the Du Pont expansion to investigate the impact of demographics, specialization, tenure, vertical integration, farm type, and regional location on the three levers of performance: ROE, net profit margins, asset turnover ratio, and asset-to-equity ratio. Balezentis and Novickyte (2018) use DuPont for analysing the profitability of Lithuanian family farms.

Based on the DuPont analysis, ROE decomposes as (Mishra et al., 2009; Mishra et al., 2012; Balezentis and Novickyte, 2018):

$$\frac{R_t}{E_t} = \frac{R_t}{A_t}\frac{A_t}{E_t}$$

R_t is profit (returns), E_t is equity, and A_t stands for assets at period t.

The decomposition of ROE can be further refined by considering the sales variable in the analysis. In this case, ROE decomposes into the relative profitability of each unit of sales through the gross margin ratio, the efficiency of asset uses through the asset turnover ratio, and a leverage effect through the inverse of the solvency ratio. Thus, the DuPont model decomposes the ROE ratio into multipliers of the net profit margin, asset turnover, and financial leverage (or assets to equity ratio). The multiplicative relationship among the discussed variables takes the following form:

$$\frac{R_t}{E_t} = \frac{S_t - C_t}{S_t}\frac{S_t}{A_t}\frac{A_t}{E_t} = P_t N_t L_t$$

S_t is sales and C_t is production costs for period t, and P_t, N_t and L_t denote profit margin, asset turnover, and leverage for period t, respectively.

To adapt the DuPont to FADN data, it is necessary to choose the appropriate variables of the FADN system.

The profit margin indicator is calculated as the quotient of the difference between the net income of the farm (FNI) and the opportunity costs of labor and the gross income of the farm. FADN variable SE420 (Farm Net Income) was used as an indicator of the net income of the farm; opportunity labor costs were calculated as a product of FADN variable SE016 (unpaid labor input in hours) and the average cost of an hour of work in agriculture. FADN variable Se410 (Gross Farm Income) was used for the farm's gross income. Turnover of total assets is calculated

as the quotient of Gross Farm Income and Total Assets, as shown by the FADN variables SE410 (Gross Farm Income) and SE436 (Total Assets). The Leverage indicator was obtained by dividing Total Assets and Net worth, that is, the FADN variable SE436 (Total Assets) and SE501 (Net Worth). All the variables are expressed in euros.

The paper additionally calculated the trend value in 2022 and presented the degree of change of the last observed year (2021) compared to the first year (2013).

RESULTS

The analysis was done on two levels, according to the regions of the Republic of Croatia and according to the basic types of agricultural farms.

Tables 1 and 2 show the trend of return on assets within individual regions and individual types of farms in the Republic of Croatia. In the first five observed years, both the Continental and Adriatic regions of Croatia recorded negative returns on assets, with a stronger negative trend in the Adriatic region. In Adriatic Croatia, the negative returns remained until 2018 with a slightly increasing trend, and from 2019 the returns became positive. Continental Croatia recorded positive returns a year earlier, in 2018. Interestingly, the highest return on assets in both Adriatic and Continental Croatia was recorded in 2020, the year of the global COVID-19 pandemic. Compared to the year of Croatia's accession to the European Union, the return on assets has more than doubled in both regions, and has gone from negative to positive, which is certainly satisfactory and is a consequence of the use of European funds. However, returns are still relatively low (except Continental Croatia in 2020). According to the European Commission (EC) (2021), the average return on assets of European farms is 1.3%, i.e. returns on assets in agriculture are relatively low, as Croatian data show, except for Continental Croatia in 2020.

Observing the return on assets by types of agricultural farms, it is evident that in the first year of EU accession, all types show a negative return on assets. Types of dairy cattle (milk) and field crops show the highest returns on assets, which become positive in crop farming already in 2014, and in dairy cattle from the following year, 2015. In 2020, the dairy cattle type achieved an extremely high return of 12.01%, and that year the other grazing livestock types also recorded a high return (7.56%). This may be a consequence of increased direct payments to livestock farms during the pandemic. Particularly large sums were given to dairy cattle through the Producer Support Program for the restoration of damaged production potential in the cattle breeding sector for the period 2018 – 2020, especially given in the year 2020 (NN 44/2019). The only type that shows a negative return on assets in the entire observed period is the mixed type, even though its loss compared to the initial year decreased by more than 50%. In the EU, horticulture (vegetables and flowers) with an average of 6.8% and viticulture and winemaking with 5.4% stand out as the types with the highest return on assets, which is the most efficient in generating income from its assets. The negative ROA have other grazing livestock and mixed type (EC, 2021). If we compare the Republic of Croatia with the EU, it can be seen that the types that are the most successful are dairy and arable farming while in the EU are below the average return, which is 1.3%, while in the EU the most successful type (horticulture) shows a negative return, with the exception of 2021.

Table 1. Trend of return on assets (ROA) of Croatian agricultural farms (%), by region

Regions	2013	2014	2015	2016	2017	2018	2019	2020	2021	% trend	% change
Adriatic Croatia	-2.94	-3.29	-2.53	-1.71	-1.65	-1.16	0.01	1.24	0.51	0.58	117.3469
Continental Croatia	-4.47	-3.03	-1.59	-0.92	-0.10	0.26	0.27	4.78	1.47	1.47	132.8859

Source: author's calculation

Table 2. Trend of return on assets (ROA) by types of agricultural farms (%)

Regions	2013	2014	2015	2016	2017	2018	2019	2020	2021	% trend	% change
Fieldcrops	-2.75	0.09	0.58	1.02	2.94	1.60	1.64	5.69	4.60	5.79	267.2727
Horticulture	-5.34	-0.85	-3.13	-4.96	-0.84	-5.17	-3.75	-1.14	8.60	2.61	261.0487
Wine	-2.07	-3.40	-0.72	0.05	1.41	1.09	2.75	2.29	1.89	3.77	191.3043
Other permanent crops	-2.73	-3.04	-1.70	-1.54	-1.11	-1.50	-1.03	0.25	-1.51	-0.20	44.6886
Dairy	-1.76	-1.11	0.14	0.32	2.58	3.63	3.89	12.01	0.30	7.09	117.0455
Other grazing livestock	-4.20	-2.85	-2.88	-0.11	-0.50	1.91	4.09	7.56	2.13	6.61	150.7143
Granivores	-0.66	3.77	2.01	5.47	-1.57	-0.63	-3.59	-2.63	-2.35	-3.62	-256.0606
Mixed	-8.54	-10.38	-8.00	-6.83	-6.21	-4.34	-4.64	-0.71	-3.60	-1.09	57.8454

Source: author's calculation

Fruit and olive growing also generates negative returns, except in 2020, when it generated a minimal return of 0.25%. In Croatia, as well as in the whole EU, the mixed type is the least successful in generating income from invested assets (EC, 2021) (Table 2).

The next step of the profitability analysis using the DuPont is the analysis of the return on equity (ROE) (Tables 3 and 4). Return on equity shows the earning potential of invested own capital and is the top indicator of the DuPont analysis.

In both regions, a positive change can be observed after 2017, with better indicators in Continental Croatia. The Adriatic region has managed to achieve positive returns on equity only since 2019 (6 years after joining the EU), and the Continental region since 2018. Since the return on equity gradually increases until 2020, when the return is the highest, we can say that Croatia's accession to the EU brings positive developments in the profitability and management of farms, especially in the last three observed years, and the same trend should continue in 2022.

Return on equity follows the situation of return on assets, and dairy and arable farms stand out as the most successful types. All the time, the mixed type has negative returns, as well as fruit and olive growing with the exception of 2020 and vegetable and flower growing with the exception of 2021. This indicator increases noticeably for most groups of producers with the accession of Croatia to the EU, with growth stalling in 2021, as a result of the impact of the pandemic and the beginning of the economic crisis in the EU and the world (increase in input prices, especially mineral fertilizers, animal feed and energy).

Table 3. Trend of return on equity (ROE) by regions of the Republic of Croatia (%)

Regions	2013	2014	2015	2016	2017	2018	2019	2020	2021	% trend	% change
Adriatic Croatia	-2.97	-3.31	-2.54	-1.71	-1.65	-1.16	0.01	1.25	0.51	1.49	117.1717
Continental Croatia	-4.64	-3.17	-1.67	-0.95	-0.10	0.27	0.28	5.06	1.54	4.17	133.1897

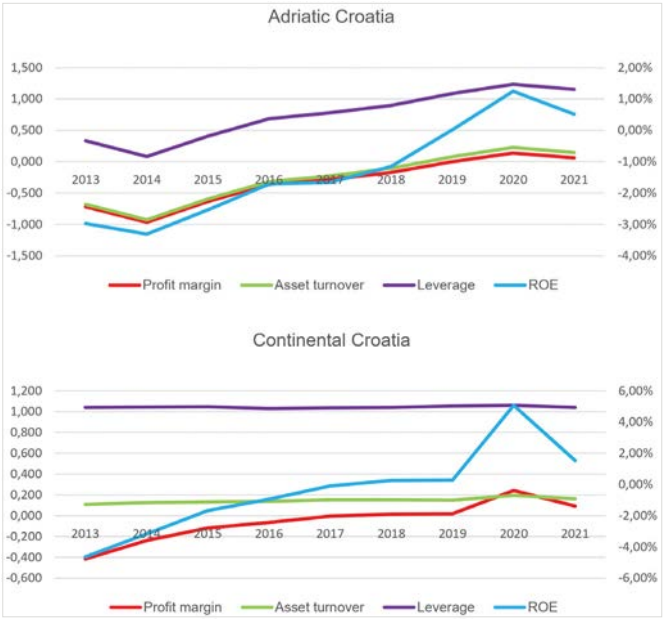
Source: author's calculation

Table 4. Trend of return on equity (ROE) by type, (%)

Regions	2013	2014	2015	2016	2017	2018	2019	2020	2021	% trend	% change
Fieldcrops	-2.83	0.09	0.60	1.04	3.02	1.65	1.75	6.06	4.79	6.07	269.258
Horticulture	-5.37	-0.86	-3.13	-4.96	-0.84	-5.39	-3.76	-1.14	8.61	2.58	260.3352
Wine	-2.11	-3.45	-0.73	0.05	1.48	1.12	2.83	2.37	1.96	3.89	192.8910
Other permanent crops	-2.81	-3.08	-1.72	-1.55	-1.12	-1.51	-1.04	0.25	-1.52	-0.19	45.9075
Dairy	-1.87	-1.17	0.14	0.33	2.66	3.73	4.07	12.44	0.31	7.36	116.5775
Other grazing livestock	-4.29	-2.92	-2.89	-0.11	-0.50	1.96	4.16	7.71	2.20	6.76	151.2821
Granivores	-0.71	4.39	2.76	6.41	-1.87	-0.70	-3.97	-3.11	-2.59	-4.15	-264.7887
Mixed	-8.66	-10.52	-8.09	-6.87	-6.28	-4.39	-4.71	-0.73	-3.63	-1.09	58.0831

Source: author's calculation

This is particularly pronounced in crop production and animal husbandry, and to a lesser extent in winemaking. The negative trend was maintained in pig farming and poultry, as well as mixed production and other permanent crops. These sectors are very sensitive to the volatility of the input and output markets, which is constant in Croatia, so until market stability is ensured, positive indicators cannot be expected.



Source: author's calculation

Figure 1. DuPont analysis of return on equity by regions of the Republic of Croatia, 2013-2021

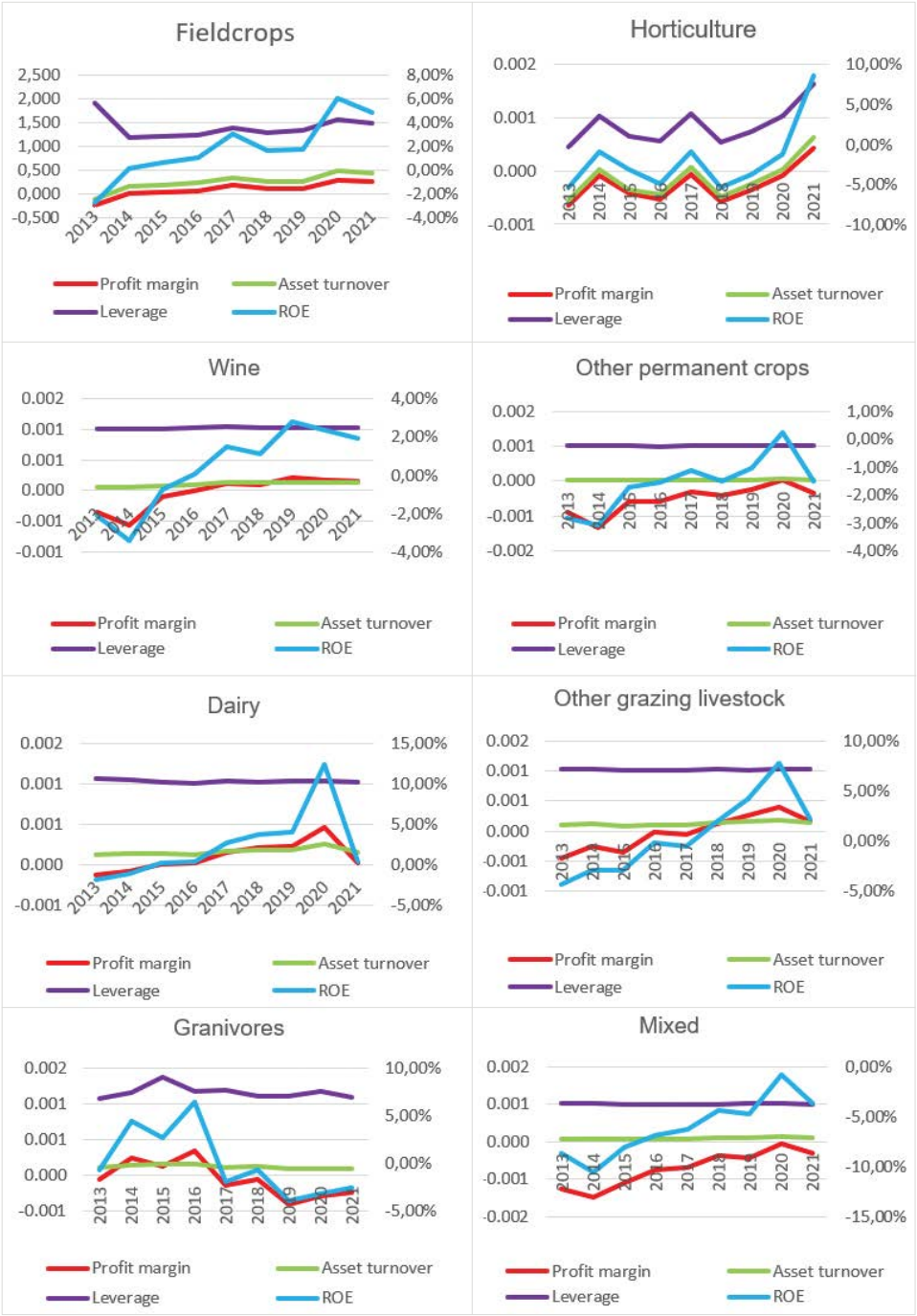
Very important factors that influence changes in ROE are profit margin, asset turnover and leverage. Therefore, a graphic presentation will be given for their changes and impact on return on equity for a particular region and type of farm.

Changes in the ROE indicator are affected by changes in the profit margin and turnover ratio of total assets. In Adriatic Croatia, the increase in the ROE indicator over the years was caused by a significant increase in Gross and Net farm income of the farm (Gross Farm Income was 77% higher in 2021 compared to 2013, while Net Farm Income increased by as much as 263%), while the value of total assets fluctuated over the years from EUR 245.751 in 2021 to a maximum of EUR 335.139 in 2014. In Continental Croatia, according to the FADN data, Gross Farm Income recorded an increase of 60% compared to the year of accession to the EU, while Net Farm Income grew by 113%. At the same time, the value of total assets fluctuates from EUR 96,610 in 2014 to EUR 119.580 in 2021. Financial leverage does not have such a significant impact on ROE, as agricultural farms, as a rule, operate using their own sources of funds.

As the profit margin shows the percentage of the realized profit from the business venture, we can conclude that the farms of Adriatic Croatia are in losses until 2019,

and only in the sixth year since the accession to the EU are they realizing a certain profit from the business. In Continental Croatia, that turning point happened a year earlier, five years after joining the EU. The positive coefficient of turnover of total assets shows the efficient use of assets, although the coefficients in both regions are quite low.

Analyzing Figure 2, it can be concluded that in all types of farms, the ROE is most affected by the change in the assets turnover. Positive changes in this coefficient mean higher profits and an increase in the efficiency and profitability of the farm. To a lesser extent, the change in ROE is affected by the profit margin and, least by the Equity Multiplier (Financial Leverage).



Source: author's calculation

Figure 2. DuPont analysis of return on equity by basic types in the Republic of Croatia, 2013-2021

The lowest return on equity was recorded in the mixed type in 2014, when the return on equity was -10.52%. The highest return was recorded in the type of dairying (milk) in 2020, at 12.44%. For all types, as well as for all regions, there are large fluctuations in ROE indicators caused primarily by changes in gross and net farm income.

CONCLUSIONS

By applying the DuPont analysis as a useful tool for assessing profitability, the agricultural producers of the Republic of Croatia were analyzed in the period from Croatia's accession to the European Union in 2013 until 2021. Data from the FADN system were used, and the analysis was made by regions (two) and types (eight) of agricultural farms.

In general, the profitability of agricultural farms in Croatia increased from 2013 to 2021, but there are significant deviations by farm type and analyzed years. Gross farm income increased from 12,089 euros/farm in 2013 to 20,204 euros/farm in 2021. But not all profitability indicators change equally. In the first five observed years, both Continental and Adriatic Croatia recorded negative returns on assets, with a stronger negative trend in Adriatic Croatia. The highest return on assets in both Adriatic and Continental Croatia was recorded in 2020, the year of the global COVID-19 pandemic. Compared to the year of Croatia's accession to the European Union, the return on assets has more than doubled in both regions, and has gone from negative to positive, which is certainly satisfactory, but is still relatively low. Looking by types, it is evident that in the first year of accession to the EU, all types show a negative return on assets. The types with the highest returns on assets are dairy and field crops, whose returns have already become positive since 2015 and 2014, respectively. The only type that had a negative return throughout the period observed was the mixed type.

Return on equity follows positive trends in return on assets, and it can be concluded that Croatia's accession to the EU brings positive changes in the profitability and management of Croatian agricultural producers. Looking at the type, the dairy and field crop types stand out as the most successful. The only stagnation of growth is recorded in 2021, which is a direct consequence of the pandemic and the beginning of the global economic crisis. The negative trend of return on equity in the types of pig farming and poultry farming, mixed and other permanent crops is problematic.

The value of the return on equity is most affected by the change in assets turnover, while the profit margin has a smaller influence. This means that they are determined more by the selling prices of the products than by the costs of production and purchase/sale, as well as that the total invested funds on the farms have a great influence. Financial leverage, i.e. the debt-to-equity ratio, has the least impact.

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