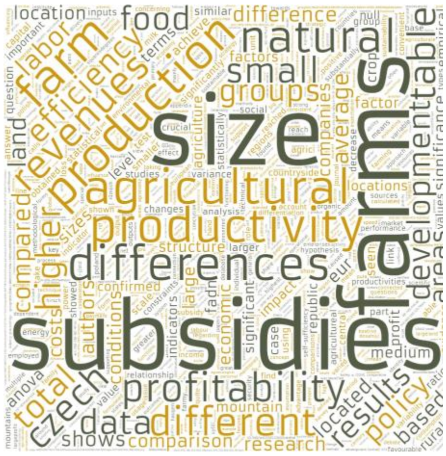
European Countryside	volume 15	No. 4	p. 508-524	DOI: 10.2478/euco-2023-0027



LINKS BETWEEN FARM SIZE, LOCATION AND PRODUCTIVITY OF FARMS IN THE CZECH REPUBLIC

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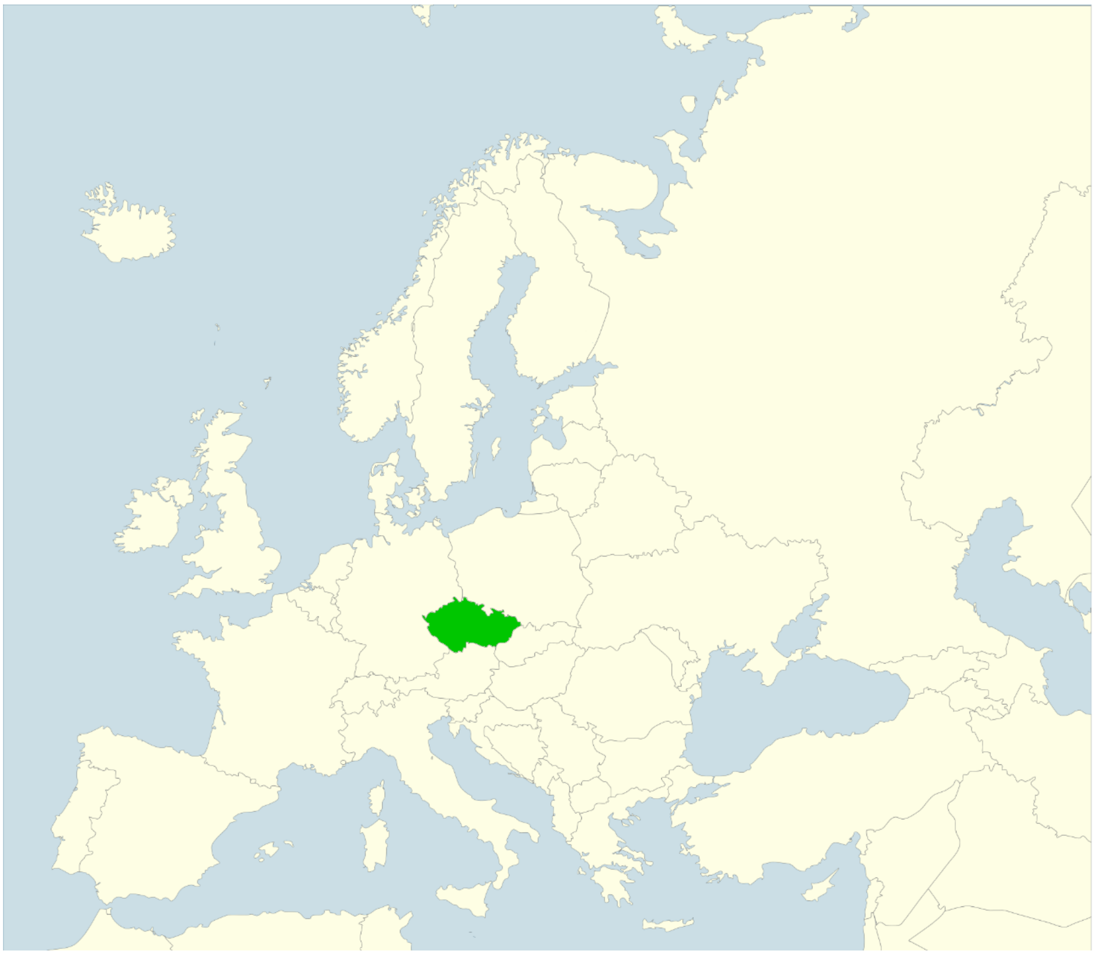

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Received 18 April 2023, Revised 22 August 2023, Accepted 27 August 2023

Abstract: This paper aims to examine the productivity of Czech farms with dependence on their size and natural conditions. The methodological approach is based on the analysis of variance (ANOVA), which enables to assess whether there are significant differences between groups of farms with different size and from different locations in terms of their productivity and profitability. We use data from the FADN CZ database for the period 2015–2020 and show that very large and large farms reach substantially higher productivity in all regions, whatever the natural conditions are. Results confirmed that farms in areas without natural constrains achieve statistically significantly higher levels of all productivity indicators in comparison with farms located in areas with natural constraints. The results also showed that the agricultural policy is decisive for functioning of small farms. The subsidies have a greater effect on smaller farms than on their larger counterparts.

Key words: countryside development, farms, farm size, financial sources, agricultural subsidies, productivity, agricultural policy, regional disparities

Souhrn: Cílem tohoto článku je zkoumat produktivitu českých zemědělských podniků v závislosti na jejich velikosti a přírodních podmínkách. Metodický přístup je založen na analýze rozptylu (ANOVA), která umožňuje posoudit, zda existují významné rozdíly mezi skupinami farem s různou velikostí a z různých lokalit z hlediska jejich produktivity a rentability. Využíváme údaje z databáze FADN CZ za období 2015–2020 a ukazujeme, že velmi velké a velké farmy dosahují podstatně vyšší produktivity ve všech regionech, ať už jsou přírodní podmínky jakékoliv. Výsledky potvrdily, že zemědělské podniky v oblastech bez přírodních omezení dosahují statisticky významně vyšších hodnot všech ukazatelů produktivity ve srovnání s podniky nacházejícími se v oblastech s přírodními omezeními. Výsledky také ukázaly, že pro fungování malých farem je rozhodující zemědělská politika. Dotace mají větší vliv na menší farmy než na jejich větší protějšky.

Klíčová slova: rozvoj venkova, farmy, finanční zdroje, zemědělské dotace, produktivita, zemědělská politika, regionální rozdíly

Highlights

- Larger farms achieve higher productivity than smaller farms.
- Different natural conditions are connected with differences in farm productivity.
- Subsidies have a greater effect on the profitability of small farms than large ones.

1. Introduction

Agriculture has been an important part of European countryside for centuries, shaping its landscapes, economy, and culture. All these aspects of rural development are influenced by the size structure of farms. Meyfroidt (2017) claims that farm size has become a key variable of interest in discussions surrounding food security, environment and community. From the environmental point of view, Ricciardi (2021) finds that smaller farms often use more traditional farming methods that are less harmful to the environment, such as crop rotation and organic farming. Larger farms, by contrast, may rely more heavily on pesticides and other chemicals. On the other hand, economy of scale leads to lower energy consumption and GHG emissions by larger farms (Redlichová et al., 2021). The size of farms can also impact the social structure of the countryside. Smaller farms are often family-owned and operated, which can create a strong sense of community. In contrast, larger farms may be owned by corporations or absentee landlords, which can lead to a more disconnected community. The preservation of traditional farming practices and local food production is important for maintaining cultural identity and promoting rural tourism (Brandth and

Haugen, 2011). While societal and environmental aspects of the farm size role in the rural development are being left for further research, this article aims to make key contribution by examining the relationship between farm size and its food security function.

One of the crucial agricultural issues is to ensure a sufficient amount of good quality food for an appropriate price (Tesla, 2021; Godenau et al. 2020; MacDonald et al. 2015). In view of today's global changes (climate change, pandemics, wars), food self-sufficiency is frequently advocated. According to FAO (1999), "The concept of food self-sufficiency is generally taken to mean the extent to which a country can satisfy its food needs from its own domestic production" rather than importing it from abroad. This idea should lead to protecting the inhabitants from dependency on a global market and the impacts of its volatility in terms of price changes, poor food quality, or shortage, as mentioned also by Minot and Nidup (2010). Godenau et al. (2020) pointed out that food self-sufficiency can also be discussed on the sub-national scale. On the other hand, the economic approach implies the most effective usage of the resources at disposal, which could lead to maximal quality and quantity at minimal production costs and consumer prices (Čechura et al. 2022). One of the important conditions, in this case, is economy of scales reached through specialization and absolute and comparative advantages, which implies active participation in foreign trade and integration into the globalization process (Macak et al. 2019).

As mentioned by Minot and Nidup (2010), there is a long-standing debate between the call for assurance of enough food and independency on other countries on one side, and the economic concept of efficiency, which requires the most efficient usage of resources at disposal. Economic efficiency is a wider term that integrates productivity and other aspects. In this respect, productivity means how many outputs can be produced by using one unit of resource. Other factors related to efficiency are bargaining power, the length of the market chain, price strategy, and others. Adopting pure food sufficiency or specialization is probably not possible nor strategic as mentioned by Clapp (2017), even if the specialization increases the total factor productivity (Žáková Kroupová et al., 2020). To balance these two approaches is the question of economics and politics. A more practical application of the concept of food self-sufficiency is defined as a country producing a proportion of its own food needs that approaches or exceeds 100 percent of its food consumption (FAO, 1999). This does not mean the exclusion of foreign trade at all, but generating a sufficient amount of production that, in case it is needed, would be able to meet the entire requirements for food for the whole country´s population. As soon as agriculture is naturally located in the countryside areas, this problem is closely connected to the development and future of the countryside, its form, and its functioning. As mentioned above, taking the global changes into account, the countries tend to be food self-sufficient as much as possible, which is connected to the productivity of farms ensuring food (Chocholouše et al. 2021). Therefore, it is relevant to investigate the appropriate size structure of farms for increasing productivity in order to achieve food self-sufficiency.

Existing research shows that the diversity of the EU farm size structure is a result of environmental conditions and historical development (Kostov et al. 2019; Nowak et al. 2016; Ciutacu et al. 2015, Swinnen et al. 1997). The Czech Republic is among the countries in which large and strongly concentrated farms prevail (Harvey et al. 2017; Zdráhal et al. 2016, Fenyves et al., 2020; Glowinkel et al. 2021). Čechura et al. (2022) claimed that large farms are more competitive because of higher productivity. On the other hand, Koppenberg and Hirsch (2021) indicated that the appropriate strategy for small farms aiming for market niches enables them to reach higher margins and profitability. As economies of scale are linked to the amount of production, the size of companies plays a crucial role as larger companies are in general more likely to be able to adopt new technologies and invest in research and development and/or its outcomes as showed by Novotna et al. (2020). In this context, the aim of our paper is to identify the differences across farm size when evaluating their productivity.

For this, our first research question is as follows:

RQ1: What are the differences in the productivity of agricultural companies of different sizes?

Given that natural conditions are one decisive factor of farm efficiency, as reported by Lososová et al. (2017) and Klíma et al. (2020) for example, we consider them in our research. The second research question is, therefore, as follows:

RQ2: How significant is the difference in farm productivity reached under different agricultural conditions?

In addition to size and natural conditions, agricultural policy is an important factor influencing farm economic situation as it brings additional financial sources and therefore has an impact on profitability (Svobodová et al., 2022).

The third research question in this respect is:

RQ3: What is the influence of agricultural policy on the profitability of companies of different sizes?

Based on the questions above, we will be able to discuss what the future of the countryside could be in terms of the size and business strategy of agricultural companies?

2. Methods and Data

The data was obtained from the FADN CZ database. The primary source of data utilized for the analysis was the FADN CZ database, which stands for Farm Accountancy Data Network of the Czech Republic. This database is an integral component of the larger FADN EU database. Functioning as a distinctive information system, it furnishes data concerning the economic status of agricultural enterprises. A pivotal tenet of the FADN system is the uniform approach to selecting survey participants; this means that uniform accounting principles are employed across all EU nations. This ensures the reliability and representativeness of the survey's outcomes across each EU member state. Consequently, the production and economic data employed in our analysis stem from the standardized indicator methodology implemented within the broader framework of the FADN EU. The research focuses on conventional farms (by opposition to organic farms) with production specialisation on field crop, milk and mixed productions, and cattle breeding. The classification of farms regarding the natural conditions, economic size, and production specialisation is based on the FADN methodology. The natural conditions are divided into three groups: the Areas with Natural Constraints that are located in the mountains (ANC M), the Areas with Natural Constraints that are located in other locations (not in the mountains) (ANC O), and the Areas without Natural Constraints (N ANC). These locations represent the differences in the rural regions of the Czech Republic of different natural conditions. The size structure is defined by the average annual value of the agricultural output at farm-gate price in euro: Small (less than 50 k€), Medium (50–500 k€), Large (500–1000 k€), Very large (more than 1000 k€). Our dataset consists of a dataset spinning time period 2015–2020 and covers 992 farms on average. The exact number of enterprises according to their size and location in particular observing years are presented in Tables 1 and 2.

Tab 1. Number of farms in the sample according to their size. Source: authors (data: FADN CZ, 2022)

	2015	2016	2017	2018	2019	2020
small	60	64	53	58	62	25
medium	237	247	205	234	218	210
large	263	260	263		259	235
very large	422	437	485	483	465	443

Tab 2. Number of farms in the sample according to their location. Source: authors (data: FADN CZ, 2022)

	2015	2016	2017	2018	2019	2020
non ANC	541	556	550	491	486	422
ANC M	95	94	96	103	97	91
ANC O	346	358	360	441	421	400

Our empirical strategy to answer our research questions RQ1, RQ2 and RQ3 is based on an analysis of variance (ANOVA). This statistical tool enables to assess whether there are any significant differences between groups of farms with different size and from different locations in terms of their productivity and profitability (Hocking, 2013). To measure productivity, we used three indicators: land productivity (LP), labor productivity (LabP), and total factors productivity (TFP). To measure profitability, we deployed indicator return on sales (ROS). All variables, including the description of the measures used and their descriptive statistics, are summarized in Table 3.

Tab 3. The indicators and variables used in the analysis. Source: own elaboration

land productivity	= agricultural revenues / agriculture land (ha)
total factors productivity	= total revenues / total costs
labor productivity	= total revenues / total AWU
agriculture subsidies to production ratio	= agriculture subsidies / agriculture production
profitability	= profit / agriculture land (ha)
profitability ratio	= profit / total revenues
total revenues	= total production revenues + operational subsidies
agriculture revenues	= crop production + animal production revenues
total costs	= production consumption + depreciation + costs for external factors (wages, rents, interests, taxes and fees) + unpaid labor[*]
agriculture subsidies	= operational subsidies – renewable resources subsidies
agriculture production	= crop production + animal production
profit	= total revenues – total costs

[*] The unpaid labor is evaluated by the 13.1 k€ of total personal costs for one worker annually (AWU) in the period under observation, which equals the monthly wage of 800 €.

To compare the size groups of farms in terms of their average productivity (RQ1), a one-way ANOVA was used, where the productivity indicator (i.e., LP, LabP, resp. TFP) was the dependent variable and the four size groups of farms were used as a factor. In order to find out the differences in productivity of farms operating in different natural conditions (RQ2), a one-way ANOVA was again used, where the productivity indicator (i.e., LaP, TFP, resp. LP) was the dependent variable and the three types of natural conditions were used as a factor. To answer the RQ3, we calculated the difference between ROS when subsidies were included and ROS if subsidies were not provided (i.e., the decrease in ROS caused by the non-participation of agricultural policy, ROS_dif). Using one-way ANOVA, we determined whether there are any statistically significant differences among four size groups of farms in terms of the means of this decrease in ROS, i.e., the ROS_dif was the dependent variable and the four size groups of farms were used as a factor. For each ANOVA test, the null hypothesis (H0) and the alternative hypothesis (H1) were formulated – the null hypothesis says that means are equal (H0: $\mu 1 = \mu 2 = \mu 3 = \mu 4$) and the alternative hypothesis says that not all means are equal, i.e., at least one of the mean values is different from others. The null hypothesis was rejected or accepted on the basis of statistical significance (the significance level $\alpha = 0.05$). Due to the violation of the assumption of homoscedasticity, i.e., the assumption of equality of variances in groups is not met (Levene's test is statistically significant), the Brown-Forsyth test was used, which is robust to violations of the assumption of equality of variances (Field, 2013). The Games-Howell post-hoc test was applied to find out between which specific groups there is a difference in average profitability. The statistical data and graphs were processed with the use of the software IBM SPSS Statistics 20.

3. Results

Based on the formulated research questions, we have structured the results into three sections, each answering one of the research questions.

Differences in the productivity of agricultural companies of different sizes

The differences in productivity in the particular size groups of farms are presented in Table 4. In addition, farms are grouped according to their location – i.e., farms situated in regions without natural constraints (N ANC), in mountain regions (ANC M) and in other regions with natural constraints (ANC O).

Tab 4. The productivity of farms based on their size and location (2015–2020). Source: authors (data: FADN CZ, 2022)

type of region	economic size			
	small	medium	large	very large
land productivity (EUR/ha)				
ANC M	621	671	1 930	1 847
ANC O	761	868	1 093	1 858
N ANC	1 378	1 113	1 236	2 378
labor productivity (EUR/AWU)				
ANC M	15 171	27 632	44 147	58 260
ANC O	15 436	31 730	61 755	71 491
N ANC	20 329	37 850	76 701	98 747
total factor productivity				
ANC M	0.44	0.54	0.72	0.78
ANC O	0.50	0.65	0.83	0.82
N ANC	0.62	0.78	0.93	0.99

The differences in productivity indicators of farms of different sizes are evident from Table 4 and also from Table 5 showing their relative comparison. In a nutshell, the productivity indicators of very large farms are almost doubled in the comparison to their small and medium counterparts.

Tab 5. The productivities´ comparisons (based on size). Source: authors (data: FADN CZ, 2022)

comparison of	productivity of		
	land	labor	TFP
small / very large	0.44	0.23	0.60
medium / very large	0.43	0.43	0.76
large / very large	0.72	0.80	0.96

The variability of productivity within individual size groups of farms in 2015–2020 is shown in the graph in Figure 1a–c. As it can be seen in Figure 1a–c, smaller farms achieved lower productivity on average, while the greatest variability within groups was found in very large farms, which also achieved the highest values in all the productivity indicators.

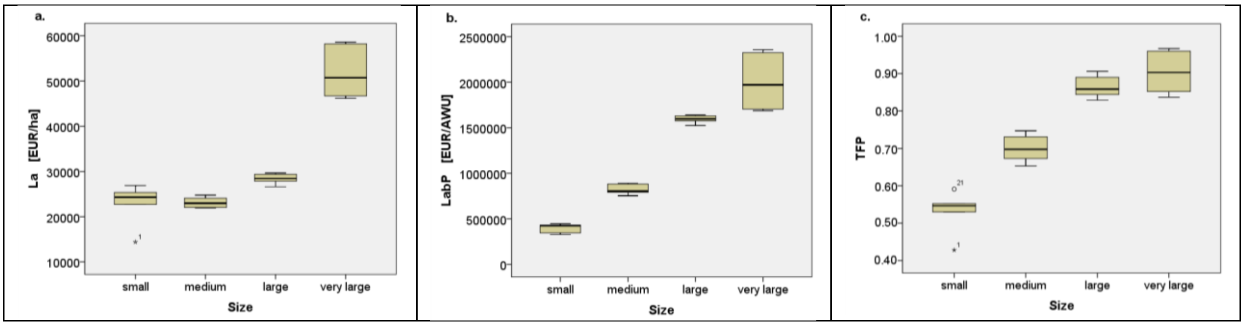

Fig 1a–c. The variability of productivity based on size groups. Source: authors (data: FADN CZ, 2022)

The land productivity is quite similar in groups of small and medium farms, while the land productivity of larger farms is substantially higher, which is in line with previous research by Desiere and Lolliffe (2018). In terms of labor productivity (LabP), comparison of LabP among farms of varied sizes shows the highest differences between smaller and very large farms if we take into account other productivity indicators (i.e., LP and TFP). Taking the very large companies as a base, the small ones are at the level of 23% and the medium ones at 43%. It can be assumed that these differences are a consequence of higher substitution of labor by capital (technique) and higher innovation activity of large farms, as also confirmed by Novotná and Volek (2016).

The results show that in general, all productivity indicators are higher in larger agricultural companies compared to their smaller counterparts. Using analysis of variance (ANOVA), it was subsequently verified that there were statistically significant differences in all the researched productivities (LP, LabP, and TFP) between individual size groups of farms during the monitored period – results for all productivity indicators are shown in the Table 6. At the 5% level of statistical significance, the null hypothesis was rejected and statistically significant differences among the average values of productivities (for LP, LabP and TFP), according to the farm size groups, were confirmed. This finding is consistent with results of previous empirical studies, conducted in similar geopolitical conditions, which dealt with the relationship between farms´ size and their productivity. Bokusheva and Čechura (2017) proved the positive link between the size of agricultural operations and the overall efficiency of crop farms in the Czech Republic. They demonstrated that larger farms possess an advantage in capitalizing on economies of scale due to their capacity to leverage technological advancements, which served as a primary catalyst for increased productivity. In a subsequent study, Čechura et al. (2022) examined the determinants of overall efficiency in Czech farms, focusing on cereals, milk, and beef production. Through statistical modeling, they reaffirmed their earlier findings, highlighting that smaller producers significantly trail behind their larger counterparts, affirming the influence of size on overall efficiency. However, Kostlivý and Fuchsová (2017) offered a mixed conclusion concerning the connection between size and technical effectiveness of organic farms. Their analysis revealed findings that the economic magnitude of farms does not notably impact the economic outcomes of organic farming.

Tab 6. Results of analysis of variance (ANOVA) for productivity in terms of farm size groups. Source: authors (data: FADN CZ, 2022)

Dependent Variable	Source of Variability	Sum of Squares	Degrees of Freedom	Mean Square	Brown-Forsythe test	Sig.
LP	Between Groups	3.401e+009	3	266.590	79.659	0.000
	Within Groups	0.284e+009	13.663	95.240		
	Total	3.685e+009	1.666			
LabP	Between Groups	9489.679e+009	3	3163.226e+009	125.776	0.000
	Within Groups	502.994e+009	20	25.149e+009		
	Total	9992.674e+009	23			
TFP	Between Groups	0.519	3	0.173	76.151	0.000
	Within Groups	0.045	20	0.002		
	Total	0.565	23			

Mutual differences between group mean values, i.e., between the average level of productivity (for LP, LabP, and TFP) of individual farm size groups, and their statistical significance were assessed by post-hoc multiple comparison using the Games-Howell test (see Table A in the Appendix). The analysis confirmed the above conclusions about significant differences in the productivity of very large farms compared to small and medium farms. Very large farms achieve statistically significant differences in the level of land productivity (LP) compared to all other size groups of enterprises, and statistically significant differences in the level of labor productivity (LabP) and total factor productivity (TFP) compared to small and medium farms.

These productivity differences may be caused by the development in the last century. This development is specific to the increasing scientific and technical progress and the changes in the social forms of agriculture towards the larger companies. The crucial factors having an impact on the differentiation of companies' productivity are the speed of innovations, the labor division and cooperation development, and the position of farms on the inputs and outputs markets (Svobodová et al., 2022; Redlichová et al., 2021). Another important factor influencing the relationship between size and productivity of Czech farms is the transition process history of the Czech Republic, resulting in a farm size structure dominated by large farms benefiting from principle of economy of scale (Blažková and Chmelíková, 2015). Hughes (2000) found a positive relationship between size and performance in the Czech Republic. He examined the economic efficiency of Czech farms and identified a strong positive relationship between productivity and the farm size. He based his explanation on the improved bargaining power of big farms and on greater opportunity for diversification, and hence better ability to react on supply shocks.

Difference in farm productivity under different agricultural conditions

To answer RQ2, we also used the data presented in Table 4, and we focused on the differences between rows that present varied location based on agroecological conditions. Comparison of the data of farms located in different regions (regardless of their sizes) (see Table 7) showed that farms located in less convenient agricultural conditions (i.e., ANC M and ANC O) reached around 80% of the productivity of farms operating in agriculturally favorable regions (i.e., N ANC). This finding is consistent with previous studies (e.g., Redlichová, 2022 or Klima et al., 2020). Klima et al. (2020) showed on the case of Polish farms that the average value of productivity indicators gained by farms located in favorable conditions was twice as high as in the mountainous conditions.

Tab 7. The productivities´ comparisons (based on location). Source: authors (data: FADN CZ, 2022)

comparison of	**productivity of**		
	land	labor	TFP
ANC M / N ANC	0.85	0.66	0.74
ANC O / N ANC	0.75	0.78	0.84

Differences in the productivity indicators based on location (see Table 7) are smaller compared to the differences of productivity indicators based on sizes (see Table 5). The variability of the farms´ productivities according to their location is shown in Figure 2a–c. As observed, farms located in the areas without natural constraints (N ANC) achieved the highest productivity (measured by LP, LabP, and TFP). On the other hand, it is obvious that productivity (LP, LabP, and TFP) in these natural conditions fluctuates considerably, i.e., it has great variability within the monitored period.

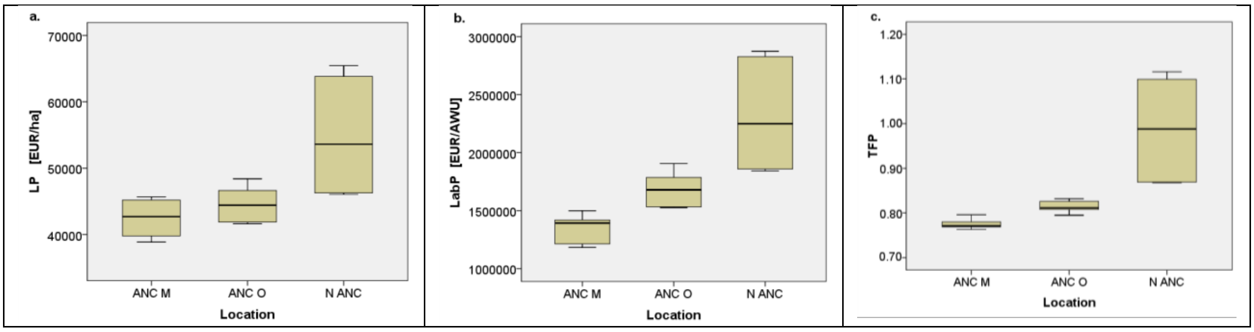

Fig 2a–c. The variability of productivity based on location. Source: authors (data: FADN CZ, 2022)

Based on ANOVA (see Table 8), differences in productivity of farms (LP, LabP and TFP) grouped according to the natural conditions where they operate, were confirmed to be statistically significant.

Tab 8. Results of analysis of variance (ANOVA) for productivity in terms of natural conditions. Source: authors (data: FADN CZ, 2022)

Dependent Variable	Source of Variability	Sum of Squares	Degrees of Freedom	Mean Square	Brown-Forsythe test	Sig.
LP	Between Groups	0.521e+009	2	260.894e+006	7.786	0.005
	Within Groups	0.502e+009	15	33.506e+006		
	Total	1.024e+009	17			
LabP	Between Groups	2891.773e+009	2	1445.886e+009	15.337	0.000
	Within Groups	1414.140e+009	15	94.276e+009		
	Total	4305.914e+009	17			
TFP	Between Groups	0.154	2	0.077	14.610	0.000
	Within Groups	0.079	15	0.005		
	Total	0.234	17			

Based on the post-hoc multiple comparison using the Games-Howell test (see Table B in Appendix), it was confirmed that farms in areas without natural constrains achieved statistically significant differences in the level of productivity (LP, LabP, and TFP) in comparison with farms located in areas with natural constraints (both in the mountains and other locations). Statistically significant differences were also confirmed between farms located in areas with natural constraints in mountain areas (ANC M) and in other locations (ANC O) from the viewpoint of the means of land productivity (LP) and labor productivity (LabP). This finding is supporting the general expectation of lower productivity of farms located in less favored areas (inter alia Pittelkow, 2015) and calls for the support of other functions of farms with worsened natural conditions.

Influence of agricultural policy on the profitability of companies of different sizes

Given that the third research question (RQ3) examines the effect of agricultural policy on the profitability of farms of different sizes, the crucial characteristic is the level of subsidy compared to the level of production. Therefore, Table 9 shows the subsidies received per 1 € of production (calculated as the amount of subsidies divided by total production).

Tab 9. The subsidies per 1 EUR of production. Source: authors (data: FADN CZ, 2022)

type of region	economic size			
	small	medium	large	very large
ANC M	0.85	0.80	0.50	0.34
ANC O	0.59	0.46	0.37	0.30
N ANC	0.28	0.27	0.34	0.21

The farms in ANC M location have obtained 2.3 times higher subsidies for one EUR of production (average of all sizes) compared to the farms in N ANC location. The small farms have obtained 2.5 times higher subsidies (average of all locations) compared to the very large farms. The highest value of this indicator (0.85 €) was reached by the farms with the lowest productivity (see Table 4). The lowest subsidies for one EUR of production (0.21 €) were obtained by the farms with the highest productivity (see Table 4).

The extent to which subsidies are important for profit and farm profitability is shown in Table 10, which presents the average economic results of farms (namely profit per hectare, and ROS) in 2015–2020 in the case when we take the subsidies into account and in the case when subsidies are excluded from the revenues of farms. In addition to these two indicators calculated including and excluding subsidies, Table 10 also shows the difference in profitability (ROS) that farms achieved without subsidies and with subsidies, namely the decrease in ROS due to the absence of subsidies (ROS_dif).

Tab 10. The profitability differentiation based on the subsidies. Source: authors (data: FADN CZ, 2022)

type of region	**economic size**			
	small	medium	large	very large
profit (EUR / ha)				
ANC M	-346	-33	122	110
ANC O	-411	-74	171	116
N ANC	-480	-18	324	473
ROS (%)				
ANC M	-31%	-3%	7%	4%
ANC O	-33%	-6%	11%	5%
N ANC	-31%	-1%	18%	16%
profit excluding subsidies (EUR / ha)				
ANC M	-864	-569	-423	-519
ANC O	-836	-469	-230	-436
N ANC	-789	-318	-101	-47
ROS excluding subsidies (%)				
ANC M	-75%	-47%	-26%	-21%
ANC O	-67%	-37%	-15%	-18%
N ANC	-51%	-23%	-7%	-16%
ROS_dif (pp)				
ANC M	-44	-43	-33	-25
ANC O	-34	-31	-26	-23
N ANC	-20	-22	-25	-32

When including subsidies as a part of revenues, the average profitability (ROS) of all farms was -4%. Excluding subsidies from the revenues, the profit decreased, and the average ROS was -34%, with minimum value of -75% and maximum value of -7% (i.e., 68 pp difference). To see if the decrease in profitability due to the exclusion of subsidies (ROS_dif) was significantly different among individual farm size groups, i.e., whether agricultural policy affects farm profitability significantly (RQ3), the one-way ANOVA was employed. The results for the ROS_dif indicator are shown in Table 11. At the 5% level of statistical significance, the null hypothesis was rejected and statistically significant differences between the average value of ROS_dif according to farm size groups were confirmed.

Tab 11. Results of analysis of variance (ANOVA) for ROS_dif in terms of farm size groups. Source: authors (data: FADN CZ, 2022)

Dependent Variable	Source of Variability	Sum of Squares	Degrees of Freedom	Mean Square	Brown-Forsythe test	Sig.
ROS_dif	Between Groups	0.142	3	0.047	7.204	0.002
	Within Groups	0.132	20	0.007		
	Total	0.274	23			

As for the post-hoc Games-Howell test, it showed that there were statistically significant differences between small and medium farms compared to very large farms (see Table C in the Appendix). The results confirmed that subsidies have a greater effect on smaller farms than on their larger counterparts. If the agricultural policy did not intervene in the form of subsidies, it would have a significantly greater impact on smaller farms in terms of profitability. This finding supports conclusion of Stanieszewski and Borychowski (2020), who found statistically significant difference between impacts of the common agricultural policy on the performance of different size groups of farms. They showed that stimulating effect of subsidies was identified only in the group of the largest farms and, hence, small ones are becoming less efficient and profitable without financial support. Similarly, Bojnec and Latruffe (2013) showed on the example of Slovenian farms that functioning of small farms is associated with the provision of subsidies, which are negatively related to farms' technical efficiency but positively related to their profitability.

4. Conclusion

The aim of this paper was to identify the differences in farm productivity according to the farm size and natural conditions, where these farms operate. The paper also aimed to evaluation the impact of agricultural policy on the farms' profitability across different size groups. To answer our set of research questions, we deployed the statistical tool ANOVA. This enabled to evaluate whether noteworthy variations exist among groups of farms with varying sizes and originating from diverse locations concerning their levels of productivity and profitability. We found that very large and large farms reach substantially higher productivity in all regions, whatever are the natural conditions were. This finding is consistent with previous empirical studies (e.g., Svobodová, 2020; or Čechura, 2022). When it comes to investigating the difference in farm productivity under different natural conditions, it was confirmed that farms in areas without natural constrains achieve statistically significantly higher levels of all productivity indicators in comparison with farms located in areas with natural constraints (both in the mountains and other locations). This finding supports the general expectation of lower productivity of farms located in less favored areas and calls for the support of other functions of farms, that are operating under worsened natural conditions. Farming in the less favourable areas contributes to the countryside development (Zieliński et al., 2022; Papić, 2022) mainly in the regions suffering from peripheral symptoms (Chmelíková and Redlichová, 2020). This helps to prevent the lagging of the rural areas, minimizing regional disparities and leading to better life quality of their inhabitants. The results also showed that the agricultural policy is decisive for functioning of small farms. The subsidies have a greater effect on profitability of smaller farms than on profitability of their larger counterparts. If the agricultural policy did not intervene in the form of subsidies, it would have a significantly greater impact on smaller farms in terms of profitability. A possible direction could be the focus on specialized production in the less favorable regions, respecting the possibilities of agroecological condition. The projects of this character should also be supported by the agricultural policy, and operational and investment subsidies. In this conception, small and medium companies can be a stable part of the agricultural structure. Lower economic income could be acceptable for two types of farms: small farms of senior farmers and so-called "healthy lifestyle" farms, where financial income is the additional source of finance.

The development of the size structure of Czech farms after 1990 is approaching the structure of countries with developed agribusiness. Similar to the USA, large companies produce around 80% of the agricultural production of the country and are the backbone of competitiveness. The difference in the size structure compared to the EU average is not the drawback of Czech agriculture, but a factor that could be treated as a competitive advantage (Zdráhal et al., 2020). On the other hand, there are also other aspects connected to the size structure of farms. The large farms do not in such extent support the community connection as the small ones do. The positive role of smaller, family-owned farms could be seen in the more tight connection between the farmer and the land he works on. They could also be more successful in the social-relation creation in the countryside society (Kansanga et al, 2020; Smędzik-Ambroży, Sapa, 2022, Chmelíková et al., 2019). A great potential could be seen in the closer relation with the customers via shorter supplier channels. Future research may be devoted to exploring effects of tight ties among farmers and their customers on the farm's performance. Consistently with Svobodová et al. (2022), we believe that the close connection between customers and the smaller farms is the advantage, enabling to find the narrow group of customers asking for special services/products and fulfill their needs.

Acknowledgements

We thank Mendel University for partial financial support via internal grant (IGA) number FRRMS – IGA – 2023/014.

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Appendix

Table A – Results of Games-Howell test for productivity indicators between size groups of farms

	Size (I)	Size (J)	Mean Difference (I-J)	Std. Error	Sig.
LP	small	medium	-138.330	1866.782	1.000
		large	-5415.398	1865.446	0.102
		very large	-28875.889*	3012.778	0.000
	medium	small	138.330	1866.782	1.000
		large	-5277.068*	640.739	0.000
		very large	-28737.559*	2451.017	0.000
	large	small	5415.398	1865.446	0.102
		medium	5277.068*	640.739	0.000
		very large	-23460.490*	2450.000	0.001
	very large	small	28875.889*	3012.778	0.000
		medium	28737.559*	2451.017	0.000
		large	23460.490*	2450.000	0.001
LabP	small	medium	-420765.718*	30050.264	0.000
		large	-1193452.710*	26402.710	0.000
		very large	-1601906.882*	126445.605	0.000
	medium	small	420765.718*	30050.264	0.000
		large	-772686.992*	27892.544	0.000
		very large	-1181141.164*	126765.066	0.001
	large	small	1193452.710*	26402.710	0.000
		medium	772686.992*	27892.544	0.000
		very large	-408454.172	125950.255	0.076
	very large	small	1601906.882*	126445.605	0.000
		medium	1181141.164*	126765.066	0.001
		large	408454.172	125950.255	0.076
TFP	small	medium	-0.167*	0.026	0.001
		large	-0.332*	0.025	0.000
		very large	-0.371*	0.033	0.000
	medium	small	0.167*	0.026	0.001
		large	-0.164*	0.019	0.000
		very large	-0.203*	0.029	0.001
	large	small	0.332*	0.025	0.000
		medium	0.164*	0.019	0.000
		very large	-0.039	0.028	0.536
	very large	small	0.371*	0.033	0.000
		medium	0.203*	0.029	0.001
		large	0.039	0.028	0.536

* The mean difference is significant at the 0.05 level.

Table B – Results of Games-Howell test for productivity indicators between groups of farms in different locations

	Size (I)	Size (J)	Mean Difference (I-J)	Std. Error	Sig.
LP	N ACN	ACN M	12318.672*	3947.739	0.048
		ANC O	10237.934	3935.020	0.092
	ACN M	N ACN	-12318.672*	3947.739	0.048
		ANC O	-2080.738	1561.155	0.410
	ANC O	N ACN	-10237.934	3935.020	0.092
		ACN M	2080.738	1561.155	0.410
LabP	N ACN	ACN M	966659.501*	208685.187	0.010
		ANC O	632059.173	211057.775	0.056
	ACN M	N ACN	-966659.501*	208685.187	0.010
		ANC O	-334600.327*	78620.333	0.005
	ANC O	N ACN	-632059.173	211057.775	0.056
		ACN M	334600.327*	78620.333	0.005
TFP	N ACN	ACN M	0.213*	0.051	0.019
		ANC O	0.174*	0.051	0.042
	ACN M	N ACN	-0.213*	0.051	0.019
		ANC O	-0.039*	0.007	0.001
	ANC O	N ACN	-0.174*	0.051	0.042
		ACN M	0.039*	0.007	0.001

* The mean difference is significant at the 0.05 level.

Table C – Results of Games-Howell test for ROS_dif between size groups of farms

	Size (I)	Size (J)	Mean Difference (I-J)	Std. Error	Sig.
ROS_dif	small	medium	-0.045	0.047	0.768
		large	-0.105	0.062	0.375
		very large	-0.205*	0.043	0.016
	medium	small	0.045	0.047	0.768
		large	-0.060	0.049	0.642
		very large	-0.159*	0.022	0.001
	large	small	0.105	0.062	0.375
		medium	0.060	0.049	0.642
		very large	-0.099	0.046	0.249
	very large	small	0.205*	0.043	0.016
		medium	0.159*	0.022	0.001
		large	0.099	0.046	0.249

* The mean difference is significant at the 0.05 level.