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Are the Agricultural Subsidies Based on the Farm Size Justified? Empirical Evidence from the Czech Republic

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Abstract: The paper aims to explore the relationship between size, production orientation, and performance in the Czech agriculture and to answer the research question as to what extent a farm size and a product orientation of farm do matter in relation to its productivity and profitability. We use data from FADN CZ database (Farm Accountancy Data Network—Czech Republic) of conventional farms oriented on fieldcrops production, milk production, other grazing livestock and mixed production, and we cover the period from 2015–2020. Pursuing an econometric approach (ANOVA and multivariate regression analysis), we test productivity and profitability differentiation among the different-sized and different production orientation companies. Finally, subsidies and their effects on different groups of companies are assessed. The findings from testing our empirical model indicate that very large farms have statistically significantly higher total factor productivity than large farms, which perform better than medium and small farms. Average productivity of large-size farms compared to small and medium farms is 1.4 times higher in terms of total factor productivity, more than two times higher in terms of agricultural land productivity, and 3.2 times higher in terms of labour productivity. The findings show that farms with field production statistically significantly outperform farms with orientation on other grazing livestock and mixed production. Different levels of productivity are translated into differentiation in the profitability. The highest profitability ratios are achieved by large farms followed by very large, medium, and small ones. The assessment of ratio of subsidies to agricultural production shows that small farms received 2.3 times higher agricultural subsidies per unit of agricultural production compared to very large farms.

Keywords: farm size; productivity; subsidy; agricultural policy; the Czech Republic

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1. Introduction

Currently, the support of small farms is an essential issue on the agenda of discussion about agricultural policy in the Czech Republic and the whole European Union. The year 2022 brought to the Czech Republic an intense political debate over the rules of subsidies for farms dependent on their size. The new EU programming period 2023–2027 meant a change in subsidy rules for all Member States. However, the preference for small companies over large ones proved to be more pronounced in the Czech Republic than in other countries. In the Czech Republic, 23 percent of the total amount for direct payments is to go to redistributive payments favouring small farms, while in neighbouring countries, the proportion is 10 to 12 percent. According to The Agrarian Chamber of the Czech Republic and the Agricultural Union of the Czech Republic, there is a risk of deteriorating food quality, rising prices, and higher food imports from neighbouring countries, notably Poland. On the other hand, the Private Agriculture Association representing small farmers sees the changes as a step in the right direction. Financial support favouring small farms in the Czech Republic is driven by the need to diversify agricultural activities in the landscape. Ref. [1] claims that smaller fields have more edges that provide habitat, and independently managed smaller farms may create a more heterogeneous landscape. This idea supports today's subsidy system in the Czech Republic. However, the remaining goals of the common agricultural policy, such as continuous increase in productivity in European agriculture, ensuring the long-term security of supply for consumers, stabilizing the agricultural market, providing farmers with a decent income and ensuring a fair income for farmers [2] seems to be left behind". To mitigate this dichotomy, we aim to identify farm performance by size and to lay an empirical foundation for policy recommendations regarding building a farming system with the ability to ensure the long-term security of food and continuously increasing the productivity of farms.

2. Theoretical Background

The relationship between farm size and productivity has become an intensive academic debate among agricultural experts over the decades. The most often examined principle became known as the inverse farm size productivity relationship (hereafter referred to as IR) that was first mentioned by [3] or later by [4]. Inverse farm size productivity relationship states that resource productivity decreases as the size of the farm increases. The debate around the nature and causes of this relationship continues despite a mountain of empirical analysis that in the majority confirms that diseconomies of scale characterise the agricultural systems. Needless to stress that the empirical research focuses mostly on developing countries (e.g., [5–10]), where agricultural production constitutes a high share on GDP and any improvement in inefficient factor allocation would have immerse implication for poverty treatment. The general studies confirm the inverse relationship between farm size and farm productivity, which has become a stylized fact of rural development in developing countries. However, the empirical evidence of this relationship in the conditions of the developed world is ambiguous. While Refs. [11,12] find a positive relationship between efficiency and size of farms in Spain, Ref. [13] shows the opposite result. Based on the data from Slovak farms, they confirmed the inverse relationship between farm size and productivity.

The ambiguity of studies that empirically analyse the IR principle on a sample of developed countries is mainly due to the incorporation of countries with transition process history, i.e., countries from the former Soviet Union and Central and Eastern Europe. Over the last thirty years, the countries in question have transformed from a centrally planned economy to a market economy. This milestone was triggered by a change in the political system in 1989 and later, in several countries, strengthened by the process of integration into the European Union. Ref. [14] claims that IR as a "stylised fact" of rural development became the guiding principle of the major land reform in the former Soviet Union and the Eastern European countries. This impacted the increase in the numbers of farms in countries at an early stage of the transformation, thus reducing their average farm sizes. Agriculture of the Eastern bloc at the end of the 1980s was characterised by high crop and livestock productivity. The high level of agricultural production was achieved by an agricultural policy aimed at achieving self-sufficiency of individual countries; or rather the predominance of agricultural commodity exports over imported volumes. Due to the relatively low level of agricultural land per capita, these outputs were achieved by high productivity per hectare of agricultural land and a high share of arable land in the total area of the agricultural land fund. During the transformation process, the agricultural land was largely returned to their descendants or to the original owners who farmed it before 1948. Agricultural cooperatives have thus been transformed into landowners' cooperatives, who leased their land for farming to cooperatives or companies. The restitution process increased the number of farms and, at the same time, reduced their average size. Figure 1 shows the changing structure of the agricultural sector in the Czech Republic over the last three decades when several milestones (indicated by red doted lines) of the agrarian subsidy system took place.

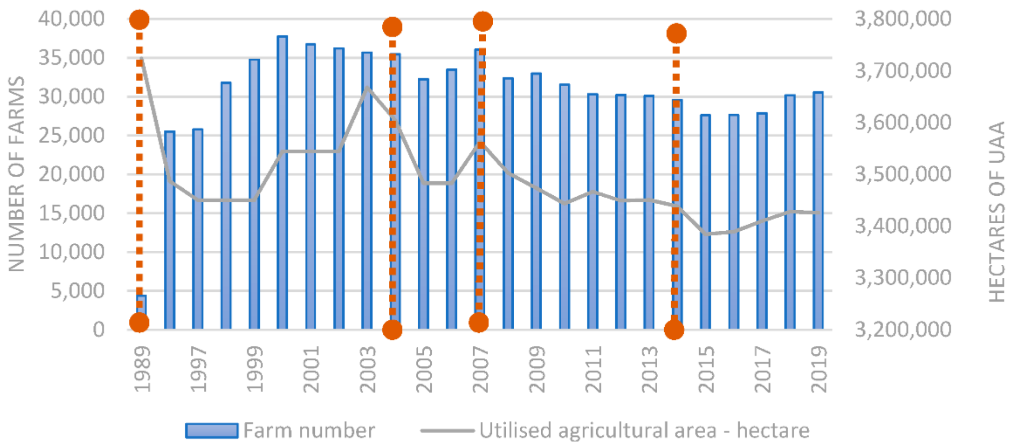

Figure 1. Farms number and utilised agriculture area in hectares in the Czech Republic after changes of agricultural subsidy rules (milestones are indicated by red doted lines). Source [15,16].

It is clear from Figure 1 that the change in the political and economic system in 1989 brought a significant change in the structure of the agricultural sector of the Czech Republic. IR became the guiding principle of land reform in the Eastern European countries ([17] or [14]), which led to a significant decrease in the average farm size in the Czech Republic after 1989. After 1989, when large-scale restitution processes took place, a large proportion of agricultural land was transferred to households, who temporarily used it for personal consumption or kept it idle. During forthcoming decade, the land was partially returned to utilised agricultural area (UAA) as it was again used for business purposes. Due to the shift in policy course from state-wide support for agricultural production to supporting the non-productive functions of agriculture, a big area of agricultural land was also transferred to non-productive functions (e.g., protection of watercourses, maintenance of the landscape, roads, afforestation, protection of greenery, etc.). For this reason, at the beginning of the 1990s, there was a significant drop in registered utilised agricultural area. Another important milestone in developing the agricultural sector structure in the Czech Republic was its accession to the European Union in 2004 and the introduction of direct payments for a cultivated agricultural area. This has led to an increase in the number of businesses in the primary sector. The year 2007 represents a change in the structure of subsidy titles within the new EU programming period 2007–2013. Subsidy titles of this period were characterised by support of farming in less favourable areas and did not directly aim to support the genesis of new farms, which led to the stagnation of the farm population. With the next programming period, 2014–2020, the change came in the form of emphasis on the diversity of agricultural activities concerning the sustainability of this sector and the pressure to reduce the size of agricultural businesses. This has led to an increase in the number of farms in the Czech Republic. The development of the agricultural business demography in the Czech Republic clearly shows that farm size is sensitive to state interventions and hence puts great demands on the quality of policy incentives.

In general, economies of scale mean that the average cost per unit of production decreases as the farm size increases due to the possibility of spreading more production over the same fixed costs level. This principle is powered by synergies from better management systems, a higher rate of innovations and better positions in the agribusiness vertical systems that increase with the growing size of the farm. On the other hand, diseconomies of scale mean that the average cost of the product goes up with the ever-increasing size of the farms and are in agricultural systems explained by several possible reasons such as the failure of land and labour markets (e.g., [9] or [7]) or measurement errors (among other things [18]). Several empirical analyses derive different conclusions with a strong dependence on the economic level of the region (e.g., [19]). While farms from developing countries usually suffer from diseconomies of scale, farms from high-income countries use the opportunities for their growth. However, the empirical evidence for countries undergoing the transition process is ambiguous.

One of the first empirical studies on data from transforming economies of the Central European area was conducted by [20], who found a positive relationship between farm size and performance. He examined the economic efficiency of farms and identified a strong positive relationship between total factor productivity and the size of the farms in the Czech Republic and Slovakia. He argues that economies of scale are caused by bargaining power in the agricultural vertical integration, better access to credits, greater opportunity for diversification and better ability to respond to supply incentives. The opposite results were confirmed by [21], who brought evidence from Polish agriculture. They used two different methods—total factor productivity comparisons between farm size categories and non-parametric Data Envelope Analysis—to show that large farms are not more efficient than smaller farms and that smaller farms are more labour-intensive than larger farms. Based on these results, they called for removing policies and distortions favouring larger farms over smaller farms and creating markets to service small farmers in areas where they are missing. Similar results were delivered by the authors [22], who showed on the data from Slovenian farms that the size of the farms matters and negatively influences their technical efficiency. Their quantile regression analysis confirmed the positive impact of farm size and the negative impact of government subsidies on the technical efficiency of farms. Ref. [23] also focused their research interest on this topic and compared Slovenian and Hungarian farms. They explored the relationship between farm size and the growth of farms using tests of the validity of Gibrat's Law stating that the proportional rate of growth of a firm is independent of its absolute size. Besides rejecting the fact of Gibrat's Law, they showed that smaller farms in Hungary grew faster than their bigger counterparts. The role of size in Slovenian farms was less obvious. Ref. [24] claims that Slovenian smaller farms are not growing faster than larger ones, thus increasing the average farm size. Empirical evidence from Slovakia was brought by [13]. They examined the relationship between farm size and productivity in a chosen sample of companies in Slovakia. They concluded that the impact of farm size on production is inverse. Using the regression models (ordinary least square and fixed effect model applied to the farms' data) they confirmed the presence of diseconomies of scale.

The results of the studies mentioned above based on the data from central Europe are in contrast to the analysis of [25], who provided evidence on the positive association between farm size and total factor productivity of crop farms in the Czech Republic. They showed that large farms stay in a better position to exploit economies of scale due to the ability to use the opportunity of technical change, which was the major driver of productivity growth. Ref. [26] analysed the total factor productivity drivers in the Czech farms (namely cereals, milk and beef) and using the econometric modelling confirmed their previous findings. That is, the smallest producers lag considerably behind the largest ones, confirming that size matters in relation to the total factor productivity. An ambivalent conclusion on the relationship between size and technical efficiency was delivered by [27], who evaluated the technical efficiency of Czech organic farms using parametric stochastic frontier analysis. They found that the economic size of farms does not significantly influence the economic results of organic farming.

To contribute to the ambiguous empirical research on the relationship between size and productivity of farms in the central European area, we attempt to answer our overarching research question as to what extent a farm size matters concerning its performance. While there is a clear evidence that the population of farms in the Czech Republic is strongly influenced by the agricultural policy, namely by the system of subsidies and other governmental incentives, we approach the size/productivity topic by focusing on the role of subsidies in this relationship. To research this conjecture comprehensively, we develop a set of two research questions:

How do farms' size and product orientation influence their economic performance in the current period of Czech agricultural development?

How does the Czech subsidy system, favouring smaller entities, influence the economic performance of farms? Does agricultural production from smaller entities get higher public support?

3. Materials and Methods

Economic performance is driven by both productivity, i.e., the ability of the company to achieve maximum production using a given volume of inputs, and profitability, i.e., the company's ability to use the optimal volume of inputs at a given price and level of production technology ([28,29]). Therefore, we use the productivity and profitability indicators to assess the economic performance of farms and to analyse the differences between agricultural companies with different economic sizes. We are also aware of the fact that higher factor productivity has an impact on farm profitability through cost reductions [30].

The process of our empirical analysis reflects established research questions mentioned above and is as follows. First, the productivity differentiation among the different-sized companies is calculated. Differentiation of particular size groups of farms are statistically verified using the ANOVA test. Second, the productivity indicators are assessed according to the different production orientations of farms, while the size structure is still considered. Third, a regression model was estimated to verify the relationship between the size of farms and their performance, taking into account other factors influencing the performance of farms. Fourth, the differentiations in profitability among companies of different sizes and production orientations are evaluated. Finally, subsidies and their effects on different groups of companies are assessed.

To evaluate the total productivity of the farms, we follow the study of [30–32] and quantify the total factor productivity (*TFP*) as follows:

$$TFP = \frac{output}{sum\ of\ inputs} = \frac{output}{labour + capital + energy + material} \tag{1}$$

where output is represented by the volume of total agricultural and affiliated production, and sum of all inputs is calculated as total costs, which include intermediate consumption, depreciation, and external factors (wages + rents + interests + taxes), and are further adjusted for the value of unpaid labour.

To be able to deeply analyse the effectivity of utilisation of each production factor (land, labour, capital), the partial productivity measures were calculated as follows:

$$\text{agricultural land productivity}: \ e_{La} = \frac{agricultural\ production}{utilized\ agricultural\ area}; \tag{2}$$

$$\text{labour productivity}: \ e_L = \frac{output}{total\ labour\ input}; \tag{3}$$

$$\text{capital productivity}: \ e_c = \frac{output}{long - term\ assets}. \tag{4}$$

The regression model was estimated in the software Gretl with the use of OLS estimation technique. *TPF* represents the dependent variable. The determinants of TFP were selected taking into account the availability of data and relying on relevant theory and literature (e.g., [33–36].). Four independent variables were tested, namely company size, prevailing type of farming, environmental conditions, and the share of unpaid labour on the number of employees. The estimated model has a good explanatory power of the variability of the dependent variable in the terms of the R-Squared and was found to be statistically significant [37].

The performance from the wider socio-economic point of view is most often measured by profitability indicators (e.g., [33,34,38–43]). We use the profitability revenue ratio (ROR) and the profit/loss of a company per hectare as the profitability indicators.

To assess the effects of subsidies among different size groups of companies, we calculate the share of total subsidies excluding investment on revenues and agricultural subsidies per hectare. The agricultural subsidies are calculated by deducting the subsidies on production of renewable energy (RES support) from the total subsidies excluding investment. We use the ratio of agricultural subsidies to agriculture production in assessing the allocation of agricultural subsidies per unit of production.

As we want to take into account the fact that in some farms (especially smaller ones) there is higher number of workers, who do not obtain wage (family members), we evaluate this unpaid part of labour input by average wage based on the observed dataset.

Table 1 summarises the definitions of variables used in the analysis (symbols of variables as used in FADN are in parentheses).

Table 1. List of variables.

Variables	Abbreviation	Formula	Definition/Explanation
Output (EUR)	Q	amount of total physical output × price	The sum of agricultural production and affiliated production (other output) expressed in monetary units (SE131)
Agricultural production (EUR)	AP	amount of physical agricultural output × price	The sum of the total output of crops and crop production (SE135) and the total output of livestock and livestock products (SE206) expressed in monetary units
Revenues (EUR)	–	–	The sum of output (SE131) and total subsidies excluding investment (SE605) expressed in monetary units
Adjusted costs (EUR)	AdC	total costs + (unpaid labour × average wage)	Adjusted costs are calculated as total costs, which include intermediate consumption (SE275), depreciation (SE360) and external factors (SE365) (wages + rent + interests + taxes), and are further adjusted for the value of unpaid labour (in EUR)
Profit/loss of a company (EUR)	–	Revenues—AdC	Profit, resp. loss, of a company is calculated as Revenues minus Adjusted costs
Unpaid labour	–	–	The value of unpaid labour is calculated as follows: each unpaid worker is evaluated by the average personal cost of a paid employee. We take the average annual salary in the agricultural sector during the observed period as the personal cost for one employee. In our study, these personal costs equal 12.8 thousand EUR for AWU per year.
Total labour input (SE010)	AWU	total hours worked/average annual hours worked in full-time jobs in the country	The full-time equivalent employment. Annual Working Unit (AWU).
Agricultural Subsidies (EUR)	–	Total Subsidies excluding investment minus Subsidies for Renewable Sources (RES)	Total subsidies excluding investment (SE605) lowered by subsidies for renewable sources (RES)
Total factor productivity	TFP	Q/AdC	The ratio of output (in EUR) to the amount of total costs (in EUR), including unpaid labour in monetary units
Land productivity	eLa	AP/UAA	The ratio of agricultural production (in EUR) to the utilised agriculture area (in ha)
Labour productivity	eL	Q/AWU	The ratio of output (in EUR) to total labour input (in EUR)
Capital productivity	eC	Q/C	The ratio of output (in EUR) to the amount of long-term capital (in EUR)
Profitability revenues ratio	ROR	(Profit or loss/Revenues) × 100	Profit, resp. loss, is divided by revenues (in %)

Table 1. *Cont.*

Variables	Abbreviation	Formula	Definition/Explanation
Profit/loss per ha	–	Profit or loss/UAA	Profit, resp. loss per hectare of the area of agricultural land under cultivation (in EUR)
Company size	Company_size_small; Company size_medium; Company size_large; Company size_verylarge	Variable divides firms into four dummy categories according to their size on the output criterion, where the output criterion defines a company's total annual standard output (SO) [33]: • small farms (SO 8-25 thousand EUR), • medium farms (SO 25-100 thousand EUR), • large farms (SO 100-500 thousand EUR, • very large (SO above 500 thousand EUR).	
Prevailing type of farming	Type of farming_fieldcrops; Type of farming_milk; Type of farming_grazing livestock; Type of farming_mixed	Variable divides farms into four dummy categories based on prevailing types of production orientation using FADN CZ classification Types of Farming (TF8). This classification is based on the share of so-called Standard Output (SO) of each agricultural product (crop or livestock) in each company as follows: • field production (TF8-1) includes the prevailing production types 15, i.e., specialist cereals, oilseeds and protein crops (COP), and 16, i.e., specialist other field crops; • milk production (TF8-5) includes prevailing type 45, i.e., specialist milk; • other grazing livestock (TF8-6) includes prevailing types 46, i.e., specialist cattle such as rearing and fattening, and 47, i.e., cattle such as dairying, rearing and fattening combined; • mixed production (TF8-8) includes prevailing types 73, 74, 83 and 84, i.e., mixed crops and mixed livestock.	
Environmental conditions	ANC_dummy	A dummy variable that indicates whether the farm operates in areas with natural constraints (ANC).	
Share of unpaid labour on the number of employees	FWU_AWU	Ratio of unpaid labour (family working unit – FWU) on the total number of workers, i.e. annual working unit – AWU (paid as well as unpaid).	
Total subsidies excluding investment (EUR)	–	Subsidies on current operations linked to production (not investments) (SE605).	
Agricultural subsidies (EUR)	–	Total subsidies excluding investment (SE605) minus subsidies on the production of renewable energy	

Source(s): Own elaboration (based on [30,33,44]).

Data Description

The data for the analysis were obtained from the FADN CZ database, i.e., Farm Accountancy Data Network of the Czech Republic [45], which is a part of FADN EU database and provides data on the economic situation of agricultural companies. The economic results and production data are based on the standard indicators applied in the FADN EU using a harmonised method of selecting survey companies [33]. Therefore, the representativeness and validity of surveys are guaranteed in each EU country. For our analyses we use the data surveyed by FADN.

Our sample covers the period 2015–2020 and consists of conventional farms operating in the Czech Republic oriented on fieldcrops production, milk production, other grazing livestock and mixed production. The number of companies included in the sample in particular years under observation is shown in Table 2. Other characteristic information about the research sample are shown in the Table 3.

Table 2. Number of farms in the research sample and their acreage of agricultural land.

Year	No. of Companies	Agriculture Land Area (Ha)	Small		Medium		Large		Very Large	
			No.	Ha	No.	Ha	No.	Ha	No.	Ha
2015	983	750,093	60	1971	237	15,075	263	65,643	423	667,404
2016	1008	774,499	64	1513	247	15,994	260	65,066	437	691,926
2017	1006	804,581	53	1200	205	11,981	263	54,848	485	736,552
2018	1036	792,204	58	1251	234	15,200	260	53,929	484	721,824
2019	1005	757,625	62	1249	218	13,338	259	52,725	466	690,313
2020	914	755,958	25	609	210	13,596	235	46,768	444	694,985

Source: [45].

Table 3. Basic characteristics of farms and productivity indicators (2015–2020 average).

Indicator	The Size of the Farms				
	Small	Medium	Large	Very Large	Average
Number of farms	53	226	257	456	992
UAA (ha) per one farm (in average)	24	63	220	1536	779
AWU/UAA (100 ha)	5.73	2.82	1.78	2.60	2.55
Unpaid labour/AWU ($\times$100)	87%	86%	43%	0.5%	4.3%
AdC/UAA (EUR/ha)	1614	1321	1250	2114	2032
TFP	0.53	0.69	0.87	0.90	0.90
eLa	657	834	1000	1599	1539
eL	15,224	31,574	60,730	76,287	74,404
eC	0.24	0.38	0.53	0.80	0.77
Revenues/UAA (EUR/ha)	1249	1228	1473	2453	2358
Profit (Loss)/UAA (EUR/ha)	−387	−74	221	272	261

Source: authors' calculation; data: [45].

4. Results

4.1. The Productivity Differentiation among the Different-Sized Companies

The findings show that the group of farms with considerable economic size reaches substantially higher productivity than small and medium farms. Table 3 shows that, in 2015–2020, the average productivity of large-size farms compared to small and medium farms is more than two times higher in terms of land productivity (eLa), 1.4 times higher in terms of total factor productivity (TFP), and 3.2 times higher in terms of labour productivity (eL). This may be caused by the fact that small firms are often below their efficient minimum scale, as documented by [46].

The amount of inputs per one hectare of utilised agriculture area (UAA) in vast farms is associated with the production structure, higher share of animal production, more intense crops and level of investment. As demonstrated by [47,48], factors shaping potential economic performance (i.e., high productivity and profitability) in agriculture include the directions of agricultural production, the intensity of management, relations between prices of individual factors and their actual availability. The higher productivity of large farms is based not only on the level of innovations of biotic as well as abiotic technic and technology but also on the economies of scale and transactional costs savings that associated with the position in the food verticals of agribusiness. Smaller farms also have lower credit availability (investment capital in general), so are not able to adopt up-to-date technology as easy as larger ones. Other point regarding the utilisation of the machinery designed for larger areas of land is also affecting the small farms' productivity.

Based on the analysis of variance (ANOVA), there were confirmed statistically significant differences between groups of farms of different sizes in terms of labour productivity levels (see Table 4), which is in line with previous research by [49].

Table 4. Scheffe's test (ANOVA).

The Farms' Sizes	Small	Medium	Large	Very Large
small		0.001678	0.000000	0.000000
medium	0.001678		0.000001	0.000000
large	0.000000	0.000001		0.002732
very large	0.000000	0.000000	0.002732	

Note: The differences between all the combinations are statistically significant at the level of $p < 0.05$; Source: [45].

Large and very large farms have total production of 60–76 thousand EUR per employee (AWU), while medium-sized and small sized recorded 31.6 thousand EUR and 15.2 thousand EUR (see Table 3), respectively. These differences may be associated with different employment. According to [50], the growth of labour productivity in the Czech Republic from 2000–2015 was mainly affected by the reduction in the number of workers rather than by production growth. In our case, small farms have 5.73 AWU per 100 hectares, while very large farms have 2.60 AWU per 100 hectares (see Table 3). However, it is necessary to take into consideration also possible methodological limitations of the collection of data on unpaid labour, since in the small and medium companies the share of unpaid labour is 87%, in the large ones the share is 43% and in the very large one it is only 0.5% share (see Table 3).

4.2. The Productivity of Different-Sized and Production-Oriented Companies

Table 5 shows the differences in the total factor productivity among companies of different production orientations. The total factor productivity of farms with varying production orientations is more differentiated in small and medium farms than in large and very large farms. In contrast, the group of very large farms is more balanced, which generally confirms the higher productivity of very large farms regardless of their production orientation. Farms focused on fieldcrops production reach higher total factor productivity, and the differences among size groups of companies are relatively small. Farms oriented on other grazing livestock have the lowest total factor productivity. There are also relatively high differences among the companies from the viewpoint of their size.

Table 5. Total factor productivity (2015–2020 average).

Production Orientation	The Size of the Farms				
	Small	Medium	Large	Very Large	Average
Fieldcrops production	0.62	0.77	0.90	0.89	0.90
Milk production	N/A	0.74	0.87	0.80	0.80
Other grazing livestock	0.44	0.50	0.64	0.75	0.67
Mixed production	0.59	0.69	0.82	0.93	0.93

Note: N/A—there are not enough farms in the sample for the result to be reliable. Source: authors' calculation. Source: [45].

Assessment of the land productivity of farms with different production orientations confirms the above-mentioned differentiation in total factor productivity among companies of various sizes in all four groups of farms of varying production orientations (i.e., fieldcrops production, milk production, other grazing livestock and mixed production), as presented in Table 6.

Table 6. Land productivity (2015–2020 average); (EUR/ha).

Production Orientation	The Size of the Farms				
	Small	Medium	Large	Very Large	Average
Fieldcrops production	827	939	967	1242	1208
Milk production	N/A	1263	1508	1811	1785
Other grazing livestock	450	512	600	1050	753
Mixed production	943	810	985	1711	1687

Note: N/A—there are not enough farms in the sample for the result to be reliable. Source: authors' calculation. Source: [45].

Based on the indicator of land productivity in Table 6, it could be concluded that very large farms reach significantly higher productivity. In contrast, other size groups (small, medium and large) are differentiated substantially less from the viewpoint of land productivity. As for the product orientation, the highest land productivity is reached by farms oriented on milk production, and the differences between size groups are less significant. Relatively lower differentiation in the land productivity level is among the farms oriented on fieldcrops production, the highest differences from the viewpoint of farm size are among the other grazing livestock.

As for the differentiation in labour productivity among the farms under observation, Table 7 shows smaller differences among the size groups of companies within the farms oriented on milk production and larger differentiation among companies in other grazing livestock and mixed production. The differentiation in labour productivity within farms of different production orientation and size relates both to the differences in the land productivity (see Tables 3 and 6) and the different level of employment (AWU/100 UAA). The different employment in larger farms is connected with higher level of technology used.

Table 7. Labour productivity (2015–2020 average).

Production Orientation	The Size of the Farms				
	Small	Medium	Large	Very Large	Average
Fieldcrops production	22,172	37,630	71,811	84,133	81,210
Milk production	N/A	27,265	43,169	57,005	55,824
Other grazing livestock	13,105	22,320	41,125	55,587	38,814
Mixed production	15,940	28,527	54,073	78,576	77,618

Note: N/A—there are not enough farms in the sample for the result to be reliable; Source: authors' calculation; Source: [45].

The overall capital productivity is the highest in very large companies. More detailed analysis considering the production orientation shows (see Table 8) that there are substantial differences based on the prevailing product. Mixed production seems to be, in general, the most capital productive. In the fieldcrops production, there are the most significant differences among the different sizes of companies, as the very large farms are more than ten times more capitally efficient than the small ones. In this production orientation, the small farms are the size group with the best capital productivity and the differences among the sizes are the lowest compared to the other production orientations. The maximal production using the one capital unit is 1.29 (other grazing livestock, very large farms).

Although the main focus of the article is the issue of the effect of farms´ size on their performance, we are aware that there are number of other influencing factors. The results of the estimated model (see Table 9) show the influence of selected determinants on TFP.

Table 8. Capital productivity (2015–2020 average).

Production Orientation	The Size of the Farms				
	Small	**Medium**	**Large**	**Very Large**	**Average**
Fieldcrops production	0.05	0.16	0.61	0.61	0.76
Milk production	1.01	0.43	0.60	0.69	0.68
Other grazing livestock	0.19	0.19	0.37	1.29	0.63
Mixed production	0.25	0.30	0.51	0.83	0.82

Source: authors' calculation; Source: [45].

Table 9. Model table—the determinants of total factor productivity.

	Model
Independent Variable	**Dependent Variable**
Company size_medium	0.1152 *** (0.0199)
Company size_large	0.3424 *** (0.0488)
Company size_verylarge	0.4587 *** (0.0747)
Company size_small	
Type of farming_mixed	−0.1224 *** (0.0199)
Type of farming_milk	−0.0330 (0.0220)
Type of farming_grazing livestock	−0.2105 *** (0.0195)
Type of farming_ fieldcrops	
ANC_dummy	0.0263 (0.0180)
FWU_AWU	0.1877 *** (0.0677)
Constant	0.4231 *** (0.0645)
R-squared	0.7918
Adj. R-squared	0.7795
F-statistic	110.5039
Observations	145

Notes: Standard errors are in parentheses; *** statistical significance at 1% level; ** statistical significance at 5% level; * statistical significance at 10% level. Source: GRETL, authors' elaboration.

The results in Table 9 suggest higher total factor productivity of larger farms in comparison with the small ones. The coefficients of dummy variables indicating company size, (i.e., Company size_medium, Company size_large, and Company size_verylarge) have positive sign, which implies that during the analysed period higher size of farm yielded higher TFP. This finding was proven to be statistically significant and brings the contribution to the answer on our first research question about the relationship of performance and farm size. As for the production orientation, fieldcrops farming seems to have the highest performance expressed by TFP, which is indicated by negative coefficients of all other dummy variables indicating type of farming (Type of farming_fieldcrops is used as reference variable in the Model). Except for the milk production, statistical significance of these results was demonstrated, thus the TFP reached by farms focusing on mixed and grazing livestock production in the analysed period was lower than TFP reached by farms focused on fieldcrop production. The environmental conditions represented by location in areas with natural constraint (ANC_dummy) has no statistically significant effect on the total factor productivity of analysed groups of farms. Finally, the results show significant effect of the share of unpaid labour on the number of employees (FWU_AWU) on the level of total factor productivity. The higher this share, the better results the company reaches in terms of total factor productivity.

4.3. The Profitability of Farms of Different Sizes and Production Orientation

Table 10 presents the profitability measured by ROR within particular size groups of companies divided according to their production orientation. The findings show differences in ROR, particularly between the group of large and very large farms and the group of medium and small farms. The profitability on revenues (ROR) of the total sample (in percentage points; based on data in Tables 2 and 11) was 11.1%. The ratio for very large farms was 11.1%, and for large ones 15.0%. On the contrary, the medium and small farms recorded losses of −6.0% and −31.0%, respectively. Taking the production orientation into account, the highest profitability is reached by the farms oriented on mixed production, contrary to the grazing livestock-oriented companies, where the profitability revenues ratio is the lowest.

Table 10. Profitability revenues ratio—ROR (2015–2020 average) in percentage.

Production Orientation	The Size of the Farms				
	Small	**Medium**	**Large**	**Very Large**	**Average**
Fieldcrops production	−28.3	−1.0	12.7	8.8	10.8
Milk production	N/A	−0.8	11.9	0.5	4.8
Other grazing livestock	−30.9	−7.0	3.8	0.7	−0.8
Mixed production	−30.8	−4.6	11.8	13.1	13.1
Together	−31.0	−6.0	15.0	11.1	11.1

Source: authors' calculation; data: [45].

Table 11. Profit (loss) per UAA (2015–2020 average); (in EUR/ha).

Production Orientation	The Size of the Farms				
	Small	**Medium**	**Large**	**Very Large**	**Average**
Fieldcrops production	−403	−13	178	160	189
Milk production	N/A	−14	249	124	130
Other grazing livestock	−323	−71	50	22	−17
Mixed production	−490	−58	176	351	343
Together	−387	−74	221	272	261

Source: authors' calculation; data: [45].

The results of profit (loss) per 1 hectare of UAA for the different production orientations and sizes of farm (Table 11) confirm the results presented in Table 10. Based on these data, the following main factors and circumstances of different profitability of farms of different sizes and production orientations could be stated:

- The different levels of land productivity are translated in the value of profit (loss)/hectare differentiation, namely in the group of very large farms;
- Probably there is a connection between the factors mentioned above having an impact on the substantial differences in profit generation of large companies and the larger extent and speed of innovations as well as the economies of scale and the position on the production factors and products markets of the agricultural food verticals;

- The differences in the value of profit (loss)/per hectare are also influenced by the employment differences. Small farms have higher employment per hectare, while the reward for paid workers is higher in very large farms. The employment in small farms is higher by 3.18 AWU per 100 hectares compared to the average. This represents approximately 400 EUR of costs per hectare, impacting profit. Very large farms have higher annual personal costs by 3 390 EUR per AWU, which means about 80 EUR of costs per hectare.

4.4. Subsidies on the Farms of Different Sizes

The subsidies to farms paid out of both EU, and national budgets currently account for a significant proportion of farm resources. The farms included in the research sample have reached an average profit of 261 EUR per hectare, having an average profitability revenue ratio (ROR) of 11.1%. If revenues did not include subsidies, the farms would have reached, on average, a loss of 207 EUR per hectare, and the profitability revenue ratio (ROR) would be negative, namely −8.8%. Such an economic result would surely threaten farms' economic and financial stability.

To be able to express the effect of the subsidies on the regular (annual) economic performance of farms, we would like to take into account only the types of subsidies that are intended to cover the costs connected to the production, not those that should help the companies with the capital recovery or innovations. That is why we have deducted investment subsidies from the total subsidies amount. The data in Table 12 show that the total subsidies excluding investment (SE605) were 468 EUR per hectare for 2015–2020. The higher amount in the group of very large farms is caused by the support for producing renewable energy (RES). Some very large farms were partly invested in the RES production capacity. As we would like to evaluate the subsidy policy using solely "agricultural subsidies", we have deducted RES support from the total subsidies excluding investment (SE605). These agricultural subsidies are derived mainly from the cultivated area: a small part of subsidies is based on the commodity and the support of environmental activities and measures. This is reflected in a relatively balanced level of agricultural subsidies per one hectare in the different sizes and production orientations (Table 12). The results presented in Tables 11 and 12 declare total subsidies excluding investment to be a crucial part of the financial sources of farms. Not considering the different sizes, the share of total subsidies excluding investment (SE605) on revenues has been 20%. In the small farms, the ratio has been 30%, in medium companies 28%, 27% in large and 19% in very large companies. These numbers demonstrate the lowering share of total subsidies excluding investments on the sales as the size of the farm is increasing.

Table 12. Subsidies level (2015–2020 average).

Indicator	Economic Size				
	Small	**Medium**	**Large**	**Very Large**	**Average**
Total subsidies excluding on investment/UAA (EUR/ha)	373	339	391	477	468
Subsidies on the production of renewable energy/UAA (EUR/ha)	2	8	30	95	88
Agriculture Subsidies/UAA (EUR/ha)	371	331	361	382	380
Total subsidies excluding on investment/Revenues	0.30	0.28	0.27	0.19	0.20

Source: authors' calculation; data: [45].

To evaluate the allocation of agricultural subsidies, the ratio of agriculture subsidies to agricultural production is one of the crucial aspects that must be specified. Table 13 presents a different level of this ratio in different-sized farms. Farms focusing on other grazing livestock recorded the highest agricultural subsidies to agricultural production among the different production-oriented groups (Table 13), which may be partially caused by their allocation in the areas with natural constraints and by an extensive farming system on permanent grasslands. Except for the group of farms oriented on the other grazing livestock, the average ratio of agricultural subsidies on agricultural production across the size categories was about 0.26 EUR. However, when we look at the differences in farm size, small farms received 2.3 times higher agricultural subsidies per unit of agricultural production compared to very large farms.

Table 13. Agricultural subsidies to agriculture production (2015–2020 average).

Production Orientation	The Size of the Farms				
	Small	Medium	Large	Very Large	Average
Fieldcrops production	0.35	0.29	0.34	0.22	0.24
Milk production	N/A	0.34	0.30	0.29	0.29
Other grazing livestock	0.98	0.90	0.78	0.55	0.68
Mixed production	0.36	0.43	0.39	0.23	0.24
Together	0.56	0.40	0.36	0.24	0.26

Source: authors' calculation; data: [45].

5. Discussion

The findings from the empirical analysis indicate that there is a dependence on farm performance and size in the Czech Republic. Our empirical results answer our research questions stated at the beginning of the paper:

- *How do farms' size and product orientation influence their economic performance in the current period of Czech agricultural development?*

In contemporary agriculture, there are substantial differences in the economic performance among the different size groups of farms. The very large farms substantially recorded significantly higher productivity and profitability. This is also valid in different production-oriented groups.

- *How does the Czech subsidy system, favouring smaller entities, influence the economic performance of farms? Does agricultural production from smaller entities get higher public support?*

The subsidies are a substantial part of farms' revenues. There is a 20% share of total subsidies excluding investment on the revenues, while the shares for small, medium, large and very large farms are 30%, 28%, 27% and 19%, respectively. This relates to the subsidy criteria that is based on the cultivated area. Small farms recorded the highest ratio of subsidies to a unit of agricultural production. This finding shows that products from smaller farms have higher public support compared to the same products from larger farms.

The results clearly show that the economic performance depends on the farms' size. In the period of years 2015–2020, the larger farms had substantially higher productivity and profitability than the smaller ones, which is in line with the previous research by [21] that proved farm size to be a significant determinant of *TPF* in the Czech Republic. Likewise, Ref. [51] proved that the growth of total assets (used as a proxy for the firm size) was positively related with TFP growth in their sample of Czech agribusiness firms—as firms were getting larger, the productivity was growing. Similar differences are indicated when taking different production orientation into account. Our results thus add to the IR discussion with the conclusion that there is a strong effect of economies of scale among Czech farms. Similar finding were previously presented by [20], who provided evidence on economies of size in crop production in the Czech Republic. Thus, we add to the ambiguous evidence on this phenomenon for countries that underwent the transition process. Our findings also follow the results of [25], who provided evidence for the positive association between farm size and total factor productivity of crop farms in the Czech Republic and the findings of [26], who showed that the smallest producers lag considerably behind the largest ones and hence confirmed that size matters in the relationship to the total factor productivity. The positive relationship between farm size and performance of the farms in the Czech Republic confirmed by [20] is explained by the authors as a result of the bargaining power of big farms, better access to capital and more significant opportunity for diversification. Our results are opposite to [21,22], who showed on the data from Slovenian and Polish farms that size of the farms matters and negatively influences their technical efficiency. Their quantile regression analysis confirmed the positive impact of farm size and the negative impact of government subsidies on the technical efficiency of farms. Our results also contrast with empirical evidence from Slovakia [13], which examined the relationship between farm size and productivity and concluded that the impact of farm size on production is inverse. We also found significant differences in the ratio of agricultural subsidies per one unit of agricultural production. This finding does not support recommendations for another farm-size-based differentiation of agricultural subsidies. The preference of size eliminates the crucial subsidies reasons, i.e., the elimination of influence of price transmissions in food verticals on the final price of agricultural products, and does not help to fulfil the main goals of the common agricultural policy—to continuously increase productivity in European agriculture, to ensure the long-term security of supply for consumers, to stabilise the agricultural market, to provide farmers with a decent income and to ensure a fair income to farmers. These findings lead to the recommendation of some performance criteria as a part of the subsidies system. There are also differences in the volume of subsidies per one unit of production based on the production orientation of farms. Therefore, we offer the policy recommendation to pay attention also to the production structure and related differences in performance of farms with various production orientations.

The low economic performance of smaller farms shows the need for their strategic transformation. This transformation could be focused on specialisation, non-agricultural production, higher use of production services and agricultural intensity adequate to the natural conditions. The lower economic result could be acceptable for senior farmers and resident life-style farming, where the agricultural profit is just a part of the farmer´s income. This conception is the probable way for smaller farms to stay a part of agriculture. The differences in subsides-per-production volumes among the different sized and production-oriented farms highlight the production structure and performance as criteria for subsidy allocation.

6. Conclusions with Practical and Theoretical Implications

One of the main challenges for European policymakers regarding agriculture is an adaptation to climate change, generation renewal due to the high age of European farmers, quality of food and development of rural areas. The interest has moved to these topics from the original goal of agriculture—to continuously increase productivity, to ensure the long-term security of supply for consumers, to stabilise the agricultural market, to provide farmers with a decent income, and to ensure a fair income for farmers [2]. However, the dramatic change in the geopolitical situation has shown that even this original goal of the primary sector cannot be forgotten and, on the contrary, it is necessary to look for ways to achieve it systematically. In the context of the development of recent events in Ukraine, the food self-sufficiency of individual countries of the European Union is once again becoming the number one topic. Farm productivity should thus again be a key argument for the effective distribution of public support among agricultural producers.

In our study, we investigate farms' economic performance drivers and derive conclusions for the Czech agricultural sector. Our main focus has been on the role that size and product orientation play in enabling high productivity of farmers. We contribute to the body of theoretical and empirical research on the size-productivity relationship, we demonstrate that there is a strong effect of economies of scale among Czech farms. Our results clearly show that productivity as well as profitability increase with growing size of the farm due to the possibility of spreading more production over the same fixed costs level. Synergies from better management systems, easier access to innovation or better positions in the agribusiness verticals power this effect. In this regard, our empirical results further support the ongoing political debate on the subsidy rules for agricultural entrepreneurs. In a nutshell, the bone of contention lies in different settings of the redistributive payments favouring smaller farmers before the big ones. This phenomenon is common for all EU members. However, the preference for small companies over large ones proved to be more pronounced in the Czech Republic than in other countries. In the Czech Republic, 23 percent of the total amount for direct payments is to go to redistributive payments favouring small farms, while in neighbouring countries, the proportion is 10 to 12 percent. According to the Agrarian Chamber of the Czech Republic, this could lead to higher food imports from neighbouring countries and decrease Czech food self-sufficiency. In this regard, our empirical results further support the arguments of the Agrarian Chamber of the Czech Republic. Our empirical results also show that products from smaller farms have higher public support compared to the same products from more giant farms. New rules of the coming programming period will even deepen this discrepancy.

We also contribute to the body of theoretical research in this field as our results add to the IR discussion with the conclusion that there is a strong effect of economies of scale among Czech farms. We thus add to the ambiguous evidence on this phenomenon for countries that went through the transition process.

A limitation of our approach lays in the range of factors driving the differences in productivity and profitability among Czech farms. Not only size and production orientation of farms, but naturally quality of human resources, level of technologies, advisory services or innovations influence the efficiency of each farm. However, these types of information are not available from the FADN dataset and hence could not be affiliated to particular types of farms. At the same time, this fact opens up space for further research, which would be beneficial for further development.

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