The Size of Czech Agricultural Enterprises: Implications for Economic Efficiency

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Abstract

This study analyses the economic efficiency and size structure of agricultural enterprises in the Czech Republic, focusing on differences between organic and conventional farming systems during the 2016-2022 period. Key objectives include evaluating farm size distribution, profitability, and efficiency under varying conditions. Results reveal that organic farms are generally smaller and more reliant on subsidies, achieving lower production per hectare compared to conventional farms. However, their profit becomes comparable when subsidies are included. Conversely, conventional farms demonstrate greater efficiency, particularly among larger enterprises. These insights are pivotal for shaping agricultural policy with respect to production efficiency and food self-sufficiency.

Keywords

Farm structure, farm size, farm results, profitability, organic agriculture, conventional agriculture.

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Introduction

Agriculture is a complex sector characterized by intricate relationships and interconnections among various actors within the supply chain. Over the past decade, alternative farming systems have gained importance, with a greater focus on factors related to natural conditions and sustainability. Organic and conventional agriculture represent two entirely distinct farming systems that respond to these challenges in different ways. Conventional agriculture is traditionally associated with intensive production and effective use of technology, while organic agriculture emphasizes sustainability and minimal reliance on chemical inputs.

Diversification of agricultural production systems can enhance sustainability and resilience, particularly by reducing inputs (Dumont et al., 2020) and leveraging synergies among agricultural components in organic farming (Ponisio et al., 2015). Furthermore, the increasing demand for organic agricultural products among consumers in high-income countries strengthens support for the organic farming system. Consumers in these regions associate organic products with sustainable development and environmental quality (Brătulescu et al., 2019).

Although conventional agriculture is generally more economically efficient, certain crops demonstrate long-term profitability in organic agriculture even without subsidies (Tudor et al., 2022). As such, exploring organic and conventional agricultural practices is key to understanding the broader economic and environmental implications of agriculture today.

This article focuses on changes in the size structure of agricultural enterprises in the Czech Republic that operate under these two systems. The objective is to determine whether there are differences in the size structure of these enterprises and, if so, how these differences translate into economic efficiency. Given the growing interest in organic products and changing market conditions, it is also important to understand how these factors influence the distribution of profitability and economic sustainability of the respective companies.

Previous studies suggest that the size of a farm can influence input utilization and the overall productivity of the enterprise and, by extension, the agricultural sector. For instance, Cheng et al.

(2018) highlight that smaller farms tend to utilize more labor and non-productive inputs per unit of land compared to larger farms, achieving higher labor productivity due to intensive usage and precision in agricultural techniques. A report by the International Fund for Agricultural Development (IFAD) demonstrates that larger farms often exhibit stronger labor productivity and highlights the influence of regional variations and policy frameworks. Similarly, Norboo and Dolma (2023) found that smaller farms are frequently more productive per unit of land due to incentives for intensive farming practices.

These findings underline the complex dynamics of farm size in relation to input utilization and productivity, suggesting that smaller farms may excel in productivity per unit of land, whereas larger farms often demonstrate superior labour productivity. However, there is limited research that integrates the economic efficiency and resilience of farms under different farming systems, particularly in the context of varying market and policy conditions. Studies have shown that organic farming practices often yield lower economic returns without subsidies but perform better in terms of environmental sustainability (Ponisio et al., 2015).

Under favourable economic conditions, even small-scale farmers can prosper and expand. However, small-scale farming can also impede the sustainable development of agriculture, particularly in countries where smallholders predominate. Previous research has indicated that fertilizer application per hectare tends to decrease as farm size increases (Ren et al., 2019), illustrating the challenges faced by smaller farms in optimizing input use. The efficiency of smaller farms compared to larger agricultural enterprises in most low-income countries can be attributed to labour market transaction costs. At the same time, increases in machine capacity with operational scale globally led to larger sizes of agricultural enterprises (Foster and Rosenzweig, 2022).

Several factors determine the susceptibility of agriculture and the food system to disturbances, leading to elevated levels of uncertainty, risks, and subsequent effects on economic performance. Natural influences, including weather patterns, diseases, pests, climate change, and environmental pollution, prominently affect this susceptibility. Additionally, the configuration and alterations in agricultural policy, farm size structure, the economic cycle, market concentration (Blažková and Chmelíková, 2015), and the overall economy play pivotal roles (Rosero et al., 2023).

This article specifically addresses changes in the size structure of agricultural enterprises certified for organic production in the Czech Republic in comparison to conventional agriculture. Farm size structure directly influences not only the economic performance of agriculture but also its environmental performance and sustainability (Ren et al., 2019). In fact, farm size structure is essential when considering ownership dynamics of agricultural land, as small-scale farms globally cover up to 40% of agricultural land (Lesiv et al., 2018). Small-scale farmers are commonly characterized as operating on less than 2 hectares, although the specific definition of a "smallholder" varies significantly in national censuses (Rigg et al., 2016).

Despite the nuanced economic advantages associated with large-scale agriculture, there are multiple vulnerabilities, some of which have exerted substantial influence during economic crises and the recent pandemic (Dudek and Piewak, 2022). This duality highlights a research gap in understanding how different farm sizes and systems adapt to economic shocks and changes in agricultural policy. The need to explore the interplay between profitability, environmental performance, and farm size is critical to informing future agricultural policy and supporting sustainable development (Zhou et al., 2022).

The interplay between farm size and the efficiency of resource utilization, particularly under organic and conventional systems, remains a largely underexplored topic, with limited studies addressing this issue, such as those by Nehring et al. (2021) and Durham and Mizik (2021). In the study by Durham and Mizik (2021), farm size is not the main focus of analysis; however, the authors mention that the economic efficiency and profitability of different agricultural systems (conventional, organic, and alternative) may be influenced by farm size. Conversely, Nehring et al. (2021) place greater emphasis on farm size, analyzing differences between small and large dairy farms in both organic and conventional systems. Their findings indicate that larger farms in both systems generally achieve higher productivity and efficiency due to better technologies and more effective utilization of fixed costs. This presents an opportunity for deeper investigation into how farm size mediates economic efficiency. Further research is needed to evaluate the comparative profitability of organic and conventional farms under changing economic and policy landscapes, particularly in Central Europe (Wang et al., 2022). Such analysis is crucial for identifying strategies that enhance resilience and sustainability across diverse farming systems.

Research gap and questions

Based on the above findings, this article aims to provide a new perspective on how different farming systems manage economic challenges and how the size of an enterprise can contribute to its efficiency and profitability. The research questions guiding this investigation are:

1. Are there differences in the size structure of organic and conventional farms?
2. What are the differences in profit levels for farms of different sizes and farming systems?
3. What are the differences in efficiency levels for farms of different sizes and farming systems?

Materials and methods

Based on these research questions the following hypotheses have been formulated:

1. H0 (1): There is no difference in the size structure of conventional and organic agricultural enterprises.
2. H0 (2): There is no difference in the level or development of profit between agricultural enterprises of different sizes and different farming systems.
3. H0 (3): There is no difference in the level or development of efficiency between agricultural enterprises of different sizes and different farming systems.

To address the research questions and assess the economic efficiency of agricultural enterprises, the following indicators were selected and defined. Economic efficiency, in this context, refers to the ability of an enterprise to achieve maximum output (or profitability) from a given set of inputs while minimizing costs. This approach aligns with widely accepted definitions in the literature (Foster and Rosenzweig, 2022; Ren et al., 2019).

Profit is one of the fundamental indicators used in economic analyses of enterprises, both at the company level and across industries. It is defined as:

Profit = Total Revenue − Total Cost

where:

Revenue = Crop Production + Livestock Production + Other Production + Operating Subsidies

Since subsidies are a significant part of the profit in agricultural enterprises (Cimpoieș and Coșalîc, 2024; Ponisio et al., 2015), we evaluated the profit in two variants:

- **With subsidies:** Includes all revenues, capturing the enterprise's ability to utilize both market returns and state support.
- **Without subsidies:** Excludes operating subsidies, focusing on the enterprise's intrinsic performance without external financial support.

This distinction allows for the assessment of an enterprise's capacity to generate sufficient revenue to cover its costs independently of subsidy policies:

Profit = Production Profit + Operating Subsidies

Production efficiency measures the output achieved relative to the inputs used. This is a core aspect of economic efficiency and is generally expressed as:

$$\text{Production Efficiency} = \frac{Inputs}{Production}$$

This approach has been widely used in studies assessing the sustainability of enterprises (Ray, 2024; Arbelo, 2020; Azizi, 2016). Specific ratios used to evaluate production efficiency include:

- $\frac{Profit}{Total\ Costs}$: Evaluates profitability per unit of cost.
- $\frac{Operating\ Profit}{Total\ Costs}$: Measures profitability while accounting for operational performance.
- $\frac{Total\ Production}{AWU}$: Assesses the productivity of labour, where:

Total Production = Crop Production + Livestock Production + Other Production

AWU = Annual Working Unit (labour input)

These indicators collectively provide a comprehensive measure of economic efficiency, capturing both the financial viability (profitability) and the productivity of resource use (efficiency). Similar approaches to measuring production efficiency have been applied in comparative studies of conventional and organic farming systems (Ponisio et al., 2015; Dumont et al., 2020).

The information used in this article was derived from the literature on the subject, data from the Institute of Agricultural Economics and Information (IAEI), and publicly available data and information on ecological and conventional agriculture at FADN CZ (Farm Accountancy Data Network – Czech Republic), which is managed by IAEI.

Data are collected by inspectors from each inspection organization directly on the farm during routine inspections. The foundation for this collection is a questionnaire prepared by IAEI, updated annually in accordance with the requirements of the European Commission/Eurostat and the Ministry of Agriculture. A web application is used for data collection, allowing inspectors to input farm-related information online. Since 2009, this application has significantly streamlined data collection, particularly in light of the growing number of organic farmers. An additional benefit is the ability for the IAEI to verify, allowing correction or supplementation of information provided by individual inspection organizations.

An additional information source is the Register of Ecological Entrepreneurs (REP) accessible on the Ministry of Agriculture's website: The Register of Ecological Entrepreneurs (eagri.cz), providing data on the count of ecological entities.

The time series 2016-2022 (the latest data available at the time of the research in the FADN CZ database) was chosen to evaluate the development. The time series data are expressed in current prices. The groups of enterprises by size follow the FADN CZ methodology, i.e., they are based on the designated standard output (SO) as follows:

Enterprise Category	Total Standard Output (SO) in EUR
Small enterprises	8,000 – less than 50,000
Medium enterprises	50,000 – less than 500,000
Large enterprises	500,000 – less than 1,000,000
Very large enterprises	1,000,000 and more

Source: FADN CZ, 2024

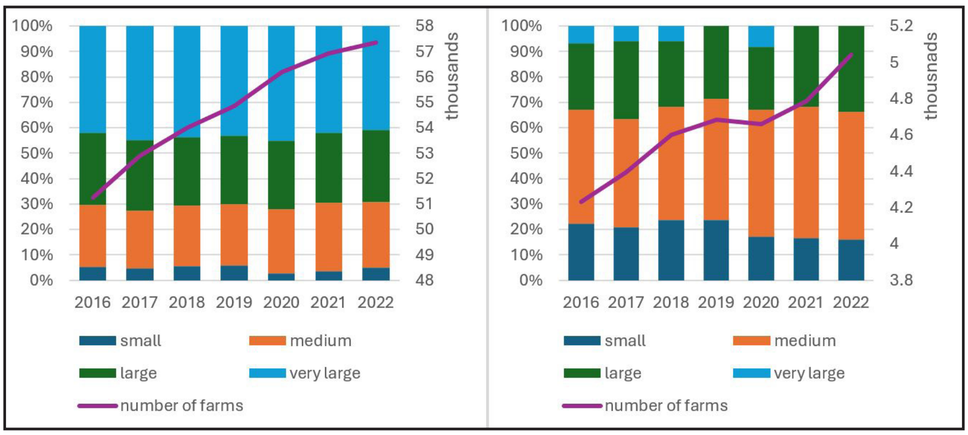
Table 1: Size categories of enterprises.

The data were subjected to statistical processing using the Statistica 14 software. Given the nature of the data, statistical hypothesis testing was employed. The specific proposed null hypotheses were tested at a significance level of α = 0.05. Due to the nature of the data, one-way and two-way ANOVA were used. The processed data meet the assumptions of normality and homogeneity of variance. Statistically significant results were further verified using post hoc testing methods, specifically Tukey's test for unequal sample sizes.

Results and discussion

Hypothesis 1 – size structure

In the period 2016-2022, the number of farms in the Czech Republic increased, both conventionally and organically (see Figure 1). The share of organically grown farms increased slightly (8.2 - 8.8%). In the case of the size structure, differences are noticeable between the two farming systems, with conventionally farmed farms being rather larger in size (large and very large farms have around 70% share), while in the case of organic farms, around 70% are made up of small and medium-sized farms.



Source: authors, 2024 (data: FADN CZ)

Figure 1: Number and structure of enterprises - conventional (left), organic (right).

Based on the first hypothesis, we tested the differences in size structure between groups of conventional and organic enterprises. The results of the analysis of variance (ANOVA) showed that the differences in the relative numbers of enterprises by size are statistically highly significant ($p < 0.01$) (Table 2).

To identify specific differences between individual groups, we used post-hoc testing methods, specifically Tukey's test for unequal sample sizes.

Tukey's test provided detailed insights into the results of the analysis of variance mentioned above (Table 3).

The test confirmed differences between individual groups of enterprises. For instance, differences between small organic enterprises and most other categories (e.g., medium-sized organic enterprises, small conventional enterprises) are highly significant ($p < 0.01$). Conversely, differences between large organic enterprises and medium-sized conventional enterprises were not statistically significant ($p > 0.05$).

Hypothesis 2 - profit

In terms of total production per hectare, conventional farms are more efficient than organic farms, by a factor of approximately 2 to 3 (Figure 2). It can be said that the ratio of total production of conventional farms to organic farms increases with increasing size.

However, for conventional farms, in recent years, the larger the farm, the higher its productivity per hectare. An interesting trend is that the productivity of small farms is decreasing, even though the productivity of the whole set of conventional farms is increasing. The initial identical productivity level (about 2000 EUR/ha in 2016) of small and very large enterprises has gradually changed in favour of very large enterprises, which in 2022 reach almost double the value of production per hectare compared to small enterprises (2800 EUR/ha and 1700 EUR/ha, respectively).

Small farms are generally the best performers in terms of production per hectare, by around 30%, as could be also seen in Figure 2.

In the evolution of farm profits there is no clear trend over time (Figure 3) that can be applied to the whole set of farms studied.

When analysing profit (EUR/ha) (Figure 4) small and medium-sized farms generally exhibit higher levels compared to the large and very large farms, with conventional farms achieving higher profits compared to organic farms.

In terms of profit net of subsidies (Figure 4 – right side), it becomes evident that organic farms of all sizes operate at a loss. Similarly, among conventional farms, very large enterprises are the least profitable, aligning with the earlier findings

	SS	DF	MS	F	p
intersection	714.2857	1	714.2857	3,009.690	0.000000
size	81.4394	3	27.1465	114.383	0.000000
standard error	11.3918	48	0.2373		

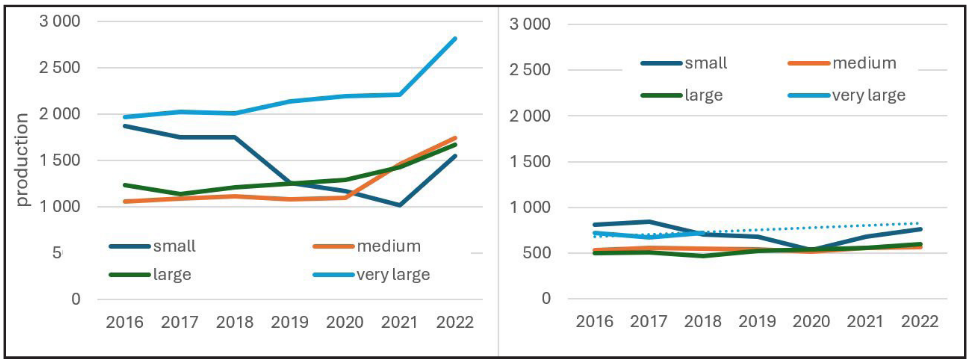
Source: authors, 2024 (data: FADN CZ)

Table 2: ANOVA test H0 (1).

	small organic	medium organic	large organic	very large organic	small conven.	medium conven.	medium conven.	large conven.
small organic		0.000134	0.000881	0.000134	0.000134	0.272891	0.006131	0.000134
medium organic	0.000134		0.000134	0.000134	0.000134	0.000134	0.000134	0.396665
large organic	0.000881	0.000134		0.000134	0.000134	0.362873	0.997685	0.000134
very large organic	0.000134	0.000134	0.000134		0.999861	0.000134	0.000134	0.000134
small conventional	0.000134	0.000134	0.000134	0.999861		0.000134	0.000134	0.000134
medium conventional	0.272891	0.000134	0.362873	0.000134	0.000134		0.775548	0.000134
large conventional	0.006131	0.000134	0.997685	0.000134	0.000134	0.775548		0.000134
large conventional	0.000134	0.396665	0.000134	0.000134	0.000134	0.000134	0.000134	

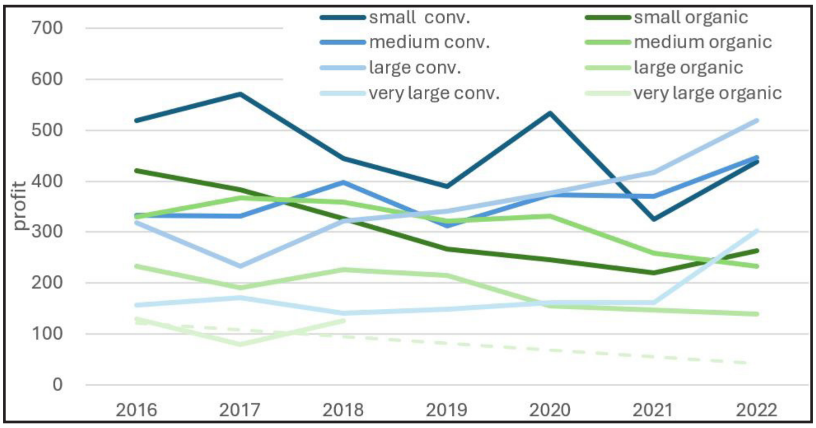
Source: authors, 2024 (data: FADN CZ)

Table 3: Tukey HSD test H0 (1)



Source: authors, 2024 (data: FADN CZ)

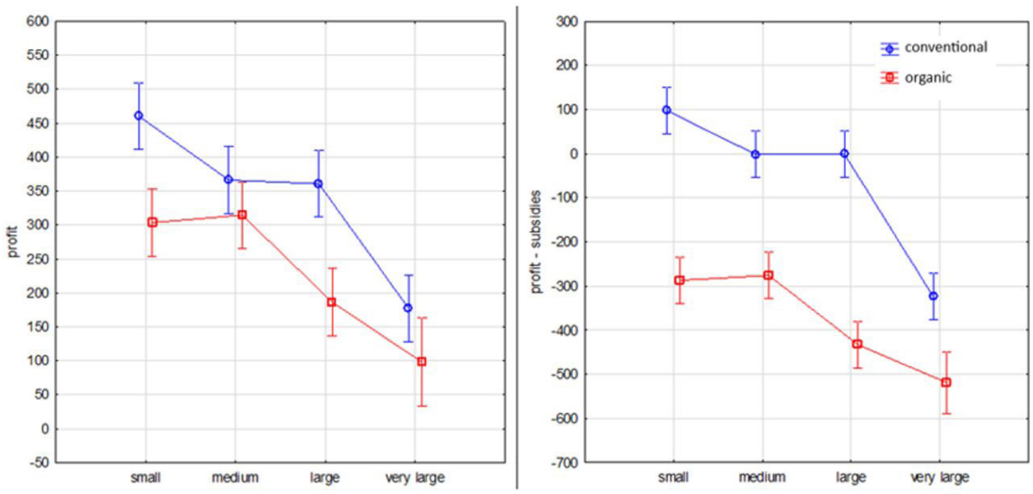
Figure 2: Total production of conventional (left) and organic (right) farms based on their size (EUR/ha).



Note: data for 2019, 2021 and 2022 were not available for very large organic companies, so a linear trend is indicated.

Source: authors, 2024 (data: FADN CZ)

Figure 3: Profit per hectare (EUR/ha).



Source: authors, 2024 (data: FADN CZ)

Figure 4: Profit and profit without subsidies per hectare (EUR/ha).

on profit including subsidies. A clear inverse relationship is observed between farm size and profitability per hectare in both farming systems.

A detailed overview of the basic characteristics of the profit of agricultural enterprises of different size categories and farming systems is provided by descriptive statistics (See Table 4). These data allow comparisons between conventional and organic farms and reveal differences in the distribution of profit values.

The statistical analysis of differences in profitability (ANOVA test of mean equality) between different sizes and farming systems showed the following results (Table 5).

Based on the probability result ($p < 0.01$), we reject the null hypothesis and confirm the existence of significant differences in profitability between different sizes and farming systems (Table 6).

The results of the post hoc testing using Tukey's test confirm statistically significant differences between different sizes of enterprises as well as between conventional and organic systems.

Hypothesis 3 - efficiency

The structure of revenues and total cost coverage (efficiency) did not differ significantly throughout the period under review for any of the business types. For this reason, only the last year, 2022, is shown in Figure 5. The data show a higher share of subsidies in total revenues for organic farms. The differences between size groups are not significant.

From previous results it is also possible to derive an indicative ratio of profit to total inputs (Figure 6). Small and medium enterprises can be said to be more efficient than very large enterprises in evaluating their input. In the last year, large enterprises have been the most successful. Excluding operating subsidies, the level of efficiency would have fallen by around 20-30 percentage points, with more significant differences (i.e. around 30 percentage

	average	SS	Min	Max	Q1	median	Q3
small conventional	460.3326	86.9645	324.5302	571.5795	389.7039	445.1129	534.0616
small organic	303.4439	74.8833	219.9128	420.1579	246.1437	266.4872	382.4769
medium conventional	366.2065	46.1497	312.3597	446.9884	331.851	370.345	396.9702
medium organic	314.4485	49.9685	233.3148	366.8928	259.1117	329.8703	359.3843
large conventional	360.8675	90.3497	232.0667	519.8749	318.3119	341.0612	416.5326
large organic	186.3387	39.1507	138.9961	231.9625	147.1019	190.4422	225.546
very large conventional	177.4598	56.0925	141.1559	302.8129	148.653	160.591	170.8208
very large organic	98.109	34.2265	60.043	128.8069	69.2142	101.7929	127.0038

Source: authors, 2024 (data: FADN CZ)

Table 4: Descriptive statistics (profit/ha).

	SS	SV	MS	F	p
profit	594,712.8	7	84,958.98	20.40654	0.00000
standard error	187,349.4	45	4,163.321		

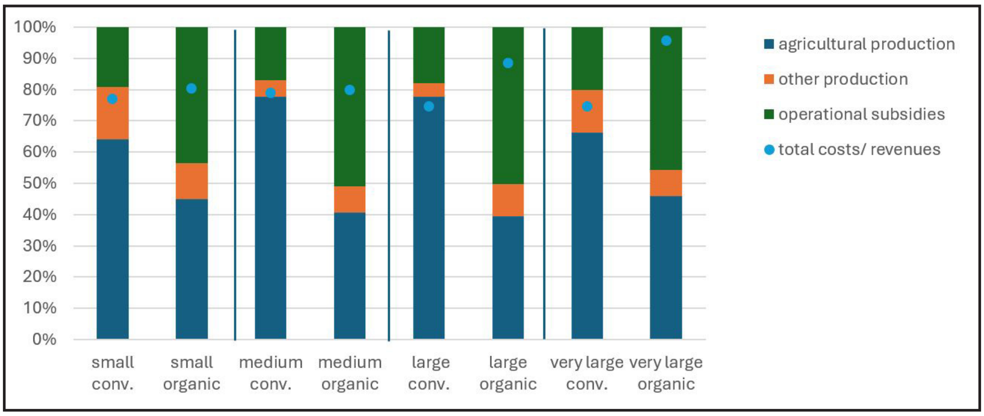
Source: authors, 2024 (data: FADN CZ)

Table 5: ANOVA test H0 (2)

		medium organic	large organic	very large organic	small convent.	Medium convent.	Large convent.	very large convent.
small organic		0.000134	0.000881	0.000134	0.000134	0.272891	0.006131	0.000134
medium organic	0.000134		0.000134	0.000134	0.000134	0.000134	0.000134	0.396665
large organic	0.000881	0.000134		0.000134	0.000134	0.362873	0.997685	0.000134
very large organic	0.000134	0.000134	0.000134		0.999861	0.000134	0.000134	0.000134
small convent.	0.000134	0.000134	0.000134	0.999861		0.000134	0.000134	0.000134
medium convent.	0.272891	0.000134	0.362873	0.000134	0.000134		0.775548	0.000134
large convent.	0.006131	0.000134	0.997685	0.000134	0.000134	0.775548		0.000134
very large convent.	0.000134	0.396665	0.000134	0.000134	0.000134	0.000134	0.000134	

Source: authors, 2024 (data: FADN CZ)

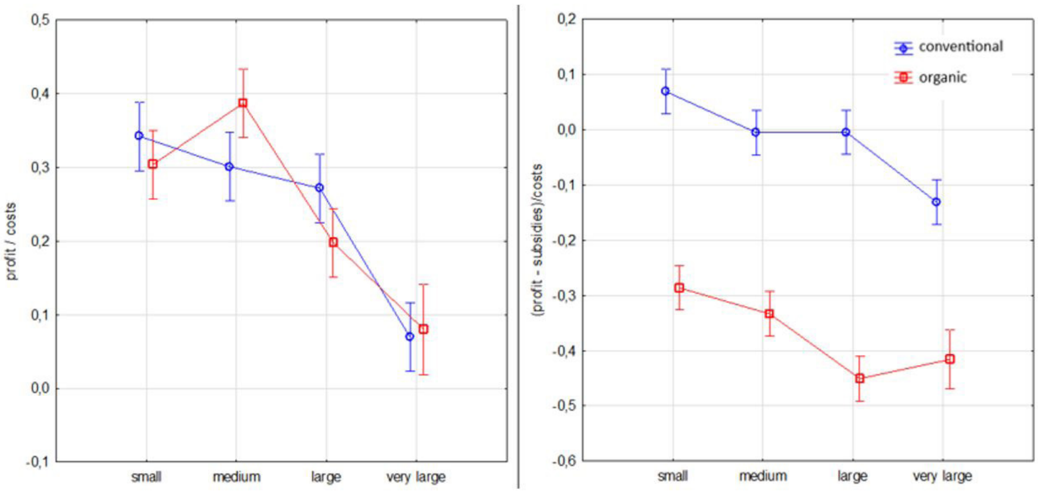
Table 6: Tukey HSD test H0 (2).



Note: 100% = revenues (agricultural production + other production + operational subsidies); data for very large organic are from 2021.

Source: authors, 2024 (data: FADN CZ)

Figure 5: The Structure of revenues and costs (year 2022).



Source: authors, 2024 (data: FADN CZ)

Figure 6: Profit /costs ratio.

points) for smaller enterprises. It is therefore evident that for these size groups, subsidies account for a more significant part of revenues (which is also evident from the structure of revenues in the previous figure).

Subtracting subsidies has more than twice the impact on efficiency reduction for organic enterprises than for conventional enterprises, i.e. by 50-70 p.p. compared to the variant with subsidies. Again, this impact is more pronounced for smaller companies.

To verify the differences between the various groups of enterprises, statistical testing was performed using analysis of variance (ANOVA). The results indicate that the differences in the profit-to-cost ratio among the examined groups of enterprises are statistically significant ($F = 22.8336$; $p < 0.0001$).

Differences in the ratio of "profit after subsidies/ costs" were also tested, and significant differences were also found ($F = 95.1466$; $p < 0.0001$) (Table 7).

The Tukey HSD test revealed significant differences between specific pairs of groups. The most pronounced differences were found between small organic enterprises and very large conventional enterprises, as well as between small and medium-sized groups of organic enterprises. In conventional enterprises, the differences were less pronounced, with the proportion of subsidies to total income being an important factor (Table 8 and 9).

	SS	SV	MS	F	p
profit / costs	0.5944	7	0.0849	22.8336	0.0000
standard error	0.1673	45	0.0037		
(profit – subsidies) / costs	1.8581	7	0.2654	95.1466	0.0000
standard error	0.1255	45	0.0028		

Source: authors, 2024 (data: FADN CZ)

Table 7: ANOVA test H0 (3)

	small conven.	small organic	medium conven.	medium organic	large conven.	large organic	very large conven.	very large organic
small conventional		0.936202	0.907475	0.861918	0.394397	0.001537	0.000131	0.000131
small organic	0.936202		1	0.201902	0.973683	0.040778	0.000131	0.00014
medium conventional	0.907475	1		0.16806	0.984906	0.051416	0.000131	0.00015
medium organic	0.861918	0.201902	0.16806		0.019607	0.000142	0.000131	0.000131
large conventional	0.394397	0.973683	0.984906	0.019607		0.332194	0.000133	0.000344
large organic	0.001537	0.040778	0.051416	0.000142	0.332194		0.006563	0.064555
very large conventional	0.000131	0.000131	0.000131	0.000131	0.000133	0.006563		0.999993
very large organic	0.000131	0.00014	0.00015	0.000131	0.000344	0.064555	0.999993	

Source: authors, 2024 (data: FADN CZ)

Table 8: Tukey HSD test H0 (3) – profit / costs.

	small conven.	small organic	medium conven.	medium organic	large conven.	large organic	very large conven.	very large organic
small conventional		0.000131	0.172109	0.000131	0.182411	0.000131	0.000131	0.000131
small organic	0.000131		0.000131	0.712077	0.000131	0.000142	0.000172	0.007111
medium conventional	0.172109	0.000131		0.000131	1	0.000131	0.001415	0.000131
medium organic	0.000131	0.712077	0.000131		0.000131	0.003475	0.000131	0.227275
large conventional	0.182411	0.000131	1	0.000131		0.000131	0.001304	0.000131
large organic	0.000131	0.000142	0.000131	0.003475	0.000131		0.000131	0.963572
very large conventional	0.000131	0.000172	0.001415	0.000131	0.001304	0.000131		0.000131
very large organic	0.000131	0.007111	0.000131	0.227275	0.000131	0.963572	0.000131	

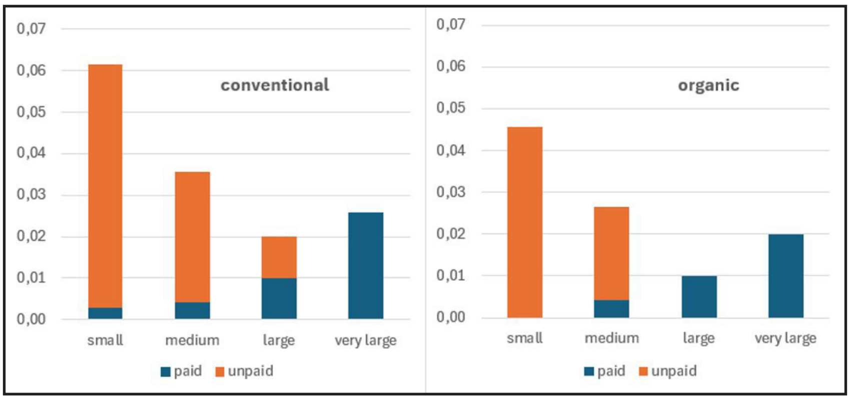
Source: authors, 2024 (data: FADN CZ)

Table 9: Tukey HSD test H0 (3) – (profit – subsidies) / costs

In terms of efficiency of the labour factor of production, organic farms, whose farming system is to some extent based on a higher proportion of manual labour, could be expected to have a higher number of workers per hectare and a related lower labour efficiency. However, the number of workers per hectare counted is slightly lower for organic farms of all sizes than for conventional farms (see Figure 7 below). There is no significant trend in the time series, so the graph below presents average values for 2016-2022, distinguishing between paid and unpaid labour. The results can be assessed that small enterprises, regardless of the farming method, have a higher number of workers per hectare than large enterprises. This can be explained by the lower ability to take advantage of the factor of production capital (technology), which can be very costly for small enterprises and less profitable due to the smaller size of the cultivated land.

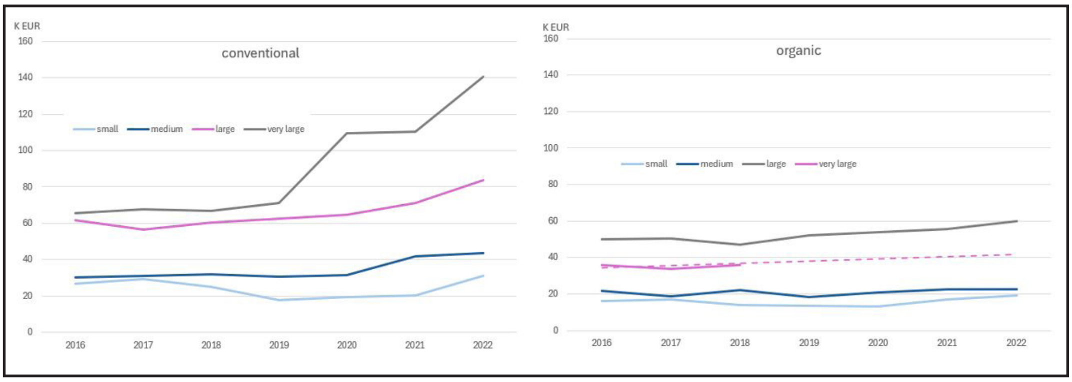
Unlike conventional farms, small organic farms have no paid labour and the amount of unpaid labour per hectare is lower.

The total factor productivity of labour is also lower for organic farms in all size groups (see Figure 8 below). Some of the lower productivity is very likely linked to the farming system, where organic farms rely to a greater extent on manual labour, which they prefer to use, for example, over pesticides. Their lower capital endowment is probably also an influence. Another factor that may influence this result is the different structure of production. Conventional farms are more focused on intensive livestock production that requires a larger number of workers. Livestock production



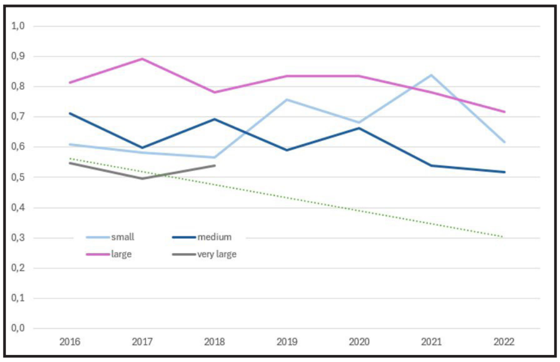
Source: authors, 2024 (data: FADN CZ)

Figure 7: Number of workers per hectare.



Note: data for 2019, 2021 and 2022 were not available for very large organic companies, so a linear trend is indicated.
Source: authors, 2024 (data: FADN CZ)

Figure 8: Total production per worker.



Note: data for 2019, 2021 and 2022 were not available for very large organic companies,
so a linear trend is indicated.
Source: authors, 2024 (data: FADN CZ)

Figure 9: The organic / conventional ratio of labour productivity.

on organic farms tends to take the form of grazing on permanent grasslands and is therefore not as labour intensive.

The efficiency ratio between organic and conventional farms can be seen in 9 (above).

In general, from the data presented it can be inferred that the differences between the productivity of organic and conventional companies tend to widen over time. The most balanced efficiency is found in large enterprises (about 80 %), while the largest difference is found in very large enterprises (50 %). Here, roughly twice as many workers are needed to produce one unit of output. Small and medium enterprises are between 60 and 70 %. Baser and Bozoğlu (2019) reached similar conclusions regarding low productivity in Turkish beef farms and highlighted the necessity of addressing this issue. They propose state-level support to increase farm size. The relation of farm size on its efficiency has been proven by Ren et al. (2019) based on whom economic efficiency is deeply connected to the economy of scale that is reached by larger farms.

Ecological farms, despite growing interest and support due to environmental considerations (Ponisio et al., 2015), often operate at a productivity disadvantage. This is seen in lower yields per hectare compared to conventional farms, attributed to differing input and farming methodologies. Despite this, Ponisio et al. (2015) argue for the potential of organic practices to close yield gaps through techniques such as crop rotations and polycultures, potentially increasing ecological farm productivity. Baudron et al. 2022 lean towards diversification practices in their global research take, as do Tudor et al. (2022). Dumont et al. (2020) and Ren et al. (2019) also emphasize resilience through diversity and farm-level innovation. Their insights are particularly relevant as ecological farms often rely on diverse cropping systems and innovative practices to improve resilience against both economic and environmental shocks. Such strategies are imperative for smaller ecological farms in the Czech Republic, which need to leverage their adaptability to ensure economic viability and competitive positioning against larger conventional counterparts.

According to Mizik (2023), Karunathilake et al. (2023) or John et al. (2023), precision farming practices may be a pathway to improved productivity, but they have some constraints, especially financial, as is pointed out by Quaicoe et al. (2023) when implemented in small farms. Similarly, Choruma et al. (2024) or Lu et al. (2024) consider digitalization as a key factor to increase the productivity and sustainability of small and medium farms. The problem of labor productivity as one of the development factors was already highlighted by Rapsomanikis (2015), who also stressed the need for political support in this regard.

The landscape of agriculture in the Czech Republic, as assessed from 2016 to 2022, illustrates significant trends and characteristics. During this period, both conventional and ecological farming enterprises experienced growth. However, ecological farms, while increasing their number slightly relative to conventional farms, remain predominantly small to medium-sized, contrasting with the larger sizes typical of conventional farms (Rigg et al., 2016). This aligns with ongoing global observations of smallholder persistence due to their adaptability and the socioeconomic dynamics surrounding their operations, as demonstrated by Lesiv et al. (2019). Rosero et al. (2023) discuss limited market access and customer interaction issues due to external factors such as the COVID-19 pandemic, while Jellason et al. (2024) call for better customer relationships. Such challenges underscore the importance of ensuring effective support and communication strategies tailored to organic farmers, which is crucial for the Czech ecological farming sector as it navigates a competitive landscape dominated by larger conventional farms.

The analysis of profit structures reveals an interesting dichotomy. While larger conventional farms dominate in absolute production output, small to medium farms, conventional or ecological, often demonstrate higher profitability per hectare once subsidies are considered (Ren et al., 2019; Dudek and Piewak, 2022). The heavy dependence on subsidies, especially for ecological farms (Cimpoieș and Coșalîc, 2024 or Redlichová et al., 2023), indicates a critical dependence on state support to maintain financial viability. This suggests the need for policies that enhance independent profitability through market expansion and value-added production (Tudor et al., 2022 or Chmelíková and Redlichová, 2013). The broad trends highlight the increasing importance of subsidies in sustaining ecological agriculture but also pose questions about long-term sustainability and autonomy for these farms. Investment in technology, training, access to finance (Chmelíková and Redlichová, 2020) and market access could help transition these farms to more self-sufficient business models (Brătulescu et al., 2019). Simultaneously, improving consumer awareness and demand for organic products can catalyse growth and support a stable market for ecological products.

Conclusion

From the analyses, the results of which are presented in this paper, the research questions can be answered as follows.

1) Are there differences in the size structure of organic and conventional farms?

The number of farms that are farming in both conventional and organic systems has increased during the period under review. The number of organic farms is slightly less than 10% compared to the number of conventional farms. In the case of organic farms, the size structure tends to favor smaller farms, while conventional farms are larger. This conclusion is consistent with the nature of the production method, where organic will tend more towards family farms.

The summary of the analysis results suggests that the size structure of organic and conventional enterprises differs significantly, with organic enterprises being smaller and more diversified. This finding may have important implications for the development of policies supporting different types of enterprises.

2) What are the differences in the level and evolution of profit for farms of different sizes and different farming systems?

From the point of view of profit, due to the system of state subsidy interventions, which aim, among other things, to support ecological systems, it is necessary to define not only the profit itself, but also its structure, or the structure of the income side of the achieved economic result. The latter can be divided, with a certain degree of generalisation, into a 'production' and a 'subsidy' part.

The production per hectare (expressed in euros) of organic farms is half to a quarter of that of conventional farms. However, after considering the subsidy policy, profitability (profit/cost) is the same for both types of farms. Logically, therefore, the profit after deduction of subsidies is more strongly influenced by organic enterprises than by conventional enterprises. In both systems, small and medium companies have higher profit. Small conventional enterprises have a positive economic result even after deducting operating subsidies. Other groups of companies would make a loss without subsidy support.

3) What are the differences in the level and evolution of efficiency for farms of different sizes and different farming systems?

The efficiency does not show a significant trend during the period under review. In the case of cost profitability (including subsidies), the results for conventional and organic companies are de facto comparable. In both groups, small and medium enterprises have higher efficiency. After deduction of subsidies, there is a more pronounced decline for organic enterprises, especially SMEs, where subsidies account for a higher share of total revenues.

The number of workers per hectare is higher for conventional farms. However, due to their higher production, they still achieve higher labour productivity (labour efficiency) than organic enterprises. Again, no significant trend can be observed.

From these results, it can be concluded that organic farms have a higher share of subsidies. Subsidies make up a significant part of their income, and once they are received, profitability is brought back to the level of conventional enterprises. In the size structure of organic farms, there is a higher proportion of small and medium-sized enterprises compared to conventional farms

The Czech agricultural sector is defined by a growing but still limited ecological agriculture sector that needs strategic support to overcome inherent productivity challenges and to leverage its environmental and societal benefits. As observed globally, fostering innovation is one of the ways to increase productivity. Together with robust policy support, innovations are essential to maintain agricultural diversity and economic resilience in line with ecological priorities.

The findings of the paper can serve as a basis for agricultural policy decision making regarding production efficiency and food self-sufficiency.

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