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The role of farm size in production efficiency: evaluating the farms in Czechia since the EU accession

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Abstract
The paper aims to evaluate the economic situation of Czech farms since the EU accession and to identify the impact that the farm size has on economic indicators. The analysis was based on our own database of farms sorted according to the acreage of utilised agricultural land. The analysis focuses on the structure of production, production indicators, asset and capital structure, profitability and cost ratios, the efficiency of production factors, financial stability and financial health. The profitability is characterised by significant fluctuations, with the largest decline in 2009. The company's financial health has a growing trend in all size groups although the average farm did not get out of the grey zone. Dependence on subsidies is growing; subsidies per hectare of utilised agricultural area are growing over time and towards a declining farm size. Trends are similar for all farm size groups; however, in some indicators, the smallest average farm differs. The share of fixed assets is the lowest, and the turnover rate of fixed assets increases. It is the only group with no significant decline in the workforce, and the share of leased land is also the highest. The development of profitability and financial health does not indicate significant differences affected by the size of the farm.

Keywords*:* farm size, profitability, labour productivity, subsidies

Introduction

The agriculture in the EU Member States is characterised by a wide range of production and high economic performance of farms. Large farms are widespread, such as in some regions of Spain, France, and Scandinavia. Very large farms are typical in Central and Eastern European countries that have experienced collective farming; however, for example, in Poland and Slovenia, where the peasantry has resisted collectivisation, large farms exist only marginally (Bojnec & Fertő, 2013).

After 1989, there were significant changes in the structure of agriculture in Czechia. Unlike the general trend of agricultural development in the EU, which is

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characterised by increasing concentration (Kryszak et al., 2021), in Czechia, the number of farms increased during the restitution process, and thus their average area decreased (Svobodová et al., 2022), which is exacerbated by the decline in agricultural land used. However, despite these structural changes, the average size of a farm in Czechia remains the largest in the EU (EUROSTAT, 2023), which is generally perceived as a competitive advantage. In contrast, small farms are considered to positively impact environmental protection, biodiversity and rural sustainability (Shucksmith & Rønningen, 2011; McDonagh et al., 2017). Therefore, policymakers are trying to reverse the concentration trend by increasing support for small farms (EC, 2022).

In the literature, considerable attention is paid to farm size and its economic, environmental and social impacts (Bojnec & Latruffe, 2013; Kryszak et al., 2021; Julien et al., 2019; Čechura et al., 2022). However, the results of studies are often ambiguous (Ren et al., 2019; Svobodová et al., 2022), which is caused by significant regional, structural and historical differences.

Given the significant structural differences of Czech agriculture within the EU, we aim to contribute with some empirical evidence at the corporate level. Identifying trends after 2004 can contribute to political decision-making affecting the competitiveness of the agricultural system. The article aims to analyse the economy of farms from 2004 to 2020 and to identify the factors influenced by the farm size, as the new system of direct payments will undoubtedly affect the farms' economy, depending on the utilised agricultural land area (UAA). We used the annual company data obtained through our questionnaire survey for that purpose. Methodologically, the work is focused on evaluating the main production indicators, production factors' efficiency and the farms' financial stability depending on the UAA.

The rest of the paper is organised as follows: first section summarises the significant events of the period under review and their impacts on the agricultural sector, the reasons for the size breakdown of farms and the political decisions related to it. The Data and Methods section specifies the dataset and methods for analysing farms' production and financial indicators. The next part presents the main results of the farms' economy with regard to significant trends/changes over time and within the breakdown. The final part provides a summary of the results and a discussion on policy decisions.

1. Theoretical background

The Czech agriculture has undoubtedly been significantly affected by political changes. Its accession to the European Union was a significant milestone. For the first time in the history of the Czech Republic, the agricultural sector faced direct competition due to the EU single market.

The economic situation of the Czech agriculture significantly improved after joining the EU, mainly due to the CAP implementation (Doucha & Foltýn, 2008),

which kept the agricultural sector profitable; however, there was a significant decrease in agricultural production and employment in agriculture (Věžník et al., 2013). The development of agriculture affected the import of cheap agricultural products from abroad, and the Czech Republic lost its food self-sufficiency (Svatoš & Smutka, 2009). The main changes in the Czech agriculture structure since 2000 have derived from the transition of natural persons to some form of company. The average size of the holdings of natural persons increased while that of legal persons decreased, with the share of farmed land owned by legal persons amounting to 70% (CZSO, 2022).

In the current turbulent times, the issue of business risk in periods of recession or growth is very topical. Agriculture, like other sectors, was negatively affected by the great recession, mainly by a significant drop in profits in the years 2007-2009 (Lososová et al., 2017); however, the number of insolvencies in the following years was lower than in other sectors (Horák & Dlouhý, 2021). Like in the neighbouring countries, the Czech agriculture is struggling with the effects of the Covid-19 pandemic and of the energy crisis. Agriculture is likely to survive crisis periods better than any other sector, as the demand for food is relatively independent (Junková & Matušková, 2011); in addition, heavily subsidised EU agriculture is strongly protected from the negative effects of external economic conditions. The Food and Agriculture Organization of the United Nations (FAO, 2020) stated that COVID-19 has affected agriculture in two significant aspects: food supply and demand. Food security is also at risk (Siche, 2020), and the emphasis is on food self-sufficiency and increasing demand for local food (Roubík et al., 2022).

Under the new CAP model for 2023-2027, Member States have increased subsidiarity in planning and implementing interventions. The strategic plan of each country is based on quantitative and qualitative up-to-date information that will provide a thorough analysis of the current situation in the country and will be linked to a set of indicators defined in the regulations (Kremmydas & Tsiboukas, 2022).

The Czech agriculture differs in many respects from that of other EU countries. The main differences are the larger average size of agricultural holdings, the high share of leased land and the high presence of corporations. According to the creators of the CAP Strategic Plan for the Czech Republic, the current system of direct payments is unfair for small farms, which have lower long-term incomes, and the redistributive payment should support a fairer distribution of payments that respects the benefits arising from the production scale of large enterprises. Therefore, compared to previous versions of the Strategic Plan, a change was published in January 2022, which significantly increased the redistributive payment from 10% to 23% of the total volume of direct payments. This payment will be provided to a farm for a maximum of 150 hectares of agricultural land and it is the largest share of a redistributive payment within the EU. This change has caused considerable resentment among agricultural organisations, which fear the reduced

competitiveness of the Czech agriculture, as most agricultural production is concentrated in medium-sized and large farms.

Agricultural economic research has long focused on the relationship between farm size and productivity. In the case of developing countries, an inverse relationship between farm size and productivity is often mentioned (Julien et al., 2019; Rada & Fuglie, 2019). In contrast, in developed countries, results indicate increasing returns to scale (Alvarez & Arias, 2004; Key, 2019; Svobodová et al., 2022).

The competitive weakness of small farms may be due to their lower probability of developing economies of scale (Rios & Shively, 2005; Hadrich & Olson, 2011; Mugera et al., 2016), higher technical inefficiencies (Bojnec & Latruffe, 2013) and lower innovation potential (Lafuente et al., 2020). For example, new automation and precision agriculture technologies may be unavailable for small farms (Key, 2019), which may lead to concentration into larger units (Čechura et al., 2022).

In contrast, Galluzzo (2018) points out that small farms and, especially small family farms, better optimise labour inputs through diversification of the agrarian process and reduce socio-economic marginalisation in areas at risk of rural emigration (Gorton & Davidová, 2004; Bojnec & Latruffe, 2008; Bielik & Rajčániová, 2004; Latruffe et al., 2004). However, there are differences between different types of production and regions.

Regarding the effects of the CAP, subsidies reduce efficiency but increase profitability (Bojnec & Latruffe, 2013) and reduce differences in labour productivity between size groups (Novotná & Volek, 2016).

Given the structure of the Czech agriculture, it is crucial to clarify the development of agriculture to date, especially the degree of dependence on subsidies, taking into account the current changes in the CAP. The main question asked by researchers (Svobodová et al., 2022; Lososová & Zdeněk, 2023) and the professional public is whether such a significant redistribution of support is fair. It is important to determine whether the differences in farm efficiency depend on the area of agricultural land and whether the redistribution of subsidies can influence these differences. In addition, in connection with the current crisis, the question which arises relates to the expediency of a significant redistribution of subsidy funds from the point of view of the competitiveness of the Czech agriculture and the self-sufficiency of food production.

Moreover, the situation is complicated by the absence of a fixed definition of the size of the farm. Many classifications are used, such as land area, number of employees, or total assets. Farm size can also be assessed by herd size, market participation (e.g., purchased inputs or crop sales) or economic activity (Guiomar et al., 2018). Kryszak et al. (2021) consider that the most objective criterion for defining farm size is economic production but, given the significant heterogeneity of EU agriculture, a simple dichotomy of large and small farms does not seem reasonable, so they categorised farms into six groups, according to their economic size.

In this work, the classification based on the categorisation for determining the degressivity of payments for disadvantaged areas is used (such as Rudinskaya et al., 2019). This classification was used given the significant dependence of farms on subsidies and in connection with the new system of direct payments, which will decrease as the size of the farm increases. This paper aims to evaluate the economic situation of Czech agricultural enterprises and its progress in the years 2004 to 2020 and to identify the factors affected by the size of the farm.

2. Data and methods

The data source for the evaluation is the questionnaire survey conducted by the University of South Bohemia since 1996. The original scope of the survey included 500 farms, approached in cooperation with the Agrarian Chamber of the Czech Republic. The return rate of the questionnaires was about 30%, while over the years, there were losses due to termination of activities, mergers of farms, changes in internal company policy, etc. Since 2004, there has been a change in the questionnaire structure and a drop in the number of farms (with regard to the return on the questionnaire) surveyed yearly to 200 (identical), with return rates in individual years of 35-52%. The farms operate throughout the territory of the Czech Republic, of which approx. 60% operate in Areas with Natural Constraints (ANC), and the altitude of the farms varies from 170 to 820 m. The total area managed by these farms in 2004 was 250 000 hectares. By reducing the return of questionnaires, the number of enterprises and the total land area decreased to 102000 hectares in 2020, representing 4.2% of land managed by legal entities.

According to the acreage, the structure of the groups represents, on average, 20% of farms up to 900 ha, 50% of farms from 900 to 1 800 ha, 15% from 1 800 to 2 500 ha, and 15% of farms over 2 500 ha (Table 1). The legal form of business is 40% cooperatives, 40% joint-stock companies, and 20% limited companies. According to the EU classification (EC, 2020), 71% of farms are small and 29% medium-sized. Regarding affiliation with the ANC, 10% of farms farm in mountain ANCs, 52% in other ANCs and 38% outside the ANC.

Table 1. Basic characteristics of the sample file

Year	Sample size	Sample structure according to the farm acreage (%)				Average UAA (ha/farm)	Share of UAA* (%)	The average number of employees
		Up to 900 ha	900-1800 ha	1800-2500 ha	Over 2500 ha			
2004	141	18	46	21	16	1 768	6.9	81
2005	122	16	45	23	16	1 794	6.1	81
2006	127	16	49	20	15	1 746	6.2	75
2007	115	17	45	22	17	1 824	5.8	75
2008	116	18	44	21	17	1 803	5.9	69

2009	112	19	46	21	15	1 765	5.6	63
2010	98	17	47	21	14	1 766	4.9	59
2011	91	18	51	18	14	1 693	4.4	55
2012	93	20	45	17	17	1 712	4.5	55
2013	103	19	46	20	15	1 712	5.0	53
2014	85	20	48	18	14	1 639	4.0	52
2015	104	21	49	14	15	1 614	4.8	51
2016	95	20	54	14	13	1 594	4.3	49
2017	84	21	52	13	13	1 536	3.7	49
2018	85	20	54	12	14	1 542	3.7	46
2019	72	19	51	14	15	1 556	3.2	47
2020	69	20	55	12	13	1 483	2.9	43

Note: *Share of land managed by farms in the sample to the total agricultural land fund in the Czech Republic
Source: Authors' calculations on a sample of farms;

The analysis of farms' structural and economic development is based on primary data obtained from standard accounting reports - Balance Sheet, Profit and Loss Statement (which companies must publish), Annual Harvest Report and Crop Area Report (required by the Czech Statistical Office - CZSO). These data are supplemented by a questionnaire, which contains other data on the land (area, structure, use, ANC, rented land, land rent, land price, altitude), number of employees, numbers and productivity of farm animals, the structure of sales by activity and subsidies structure.

The work uses the classification of farms into groups according to the area of agricultural land:

- up to 900 ha;
- 900 - 1 800 ha;
- 1 800 - 2 500 ha;
- over 2 500 ha.

Due to the nature of the data, the database only contains legal entities, as small farms of natural persons usually do not keep accounts. During the classification, a group of sizes up to 300 ha, 300-500 ha and 500-900 ha were merged into one group due to the low number of subjects. The authors are aware of the limiting factors of this study, which are the size of the sample and the absence of farms of natural persons; however, according to CZSO (2022), more than 70% of agricultural land in the Czech Republic is managed by legal entities. The benefit of the database itself is more detailed knowledge of the monitored farms and a relatively long time series. In addition, the comparison with more extensive databases makes it possible to follow similar trends.

We propose a methodological process that builds on and develops the procedures used in evaluating the economy of farms and the agricultural sector (Kopta, 2009; Hýblová & Skalický, 2018; Hlavsa et al., 2020; Syrůček et al., 2023).

As part of the analysis of the main indicators of the farm economy, we will focus on the structure of production, main production indicators, asset and capital structure, profitability and cost ratios, the efficiency of production factors, financial stability and financial health. For the analysis of profitability, activity, capital structure and liquidity, fundamental ratios of financial analysis (Giroux, 2003; Peterson & Fabozzi, 2006) will be used.

From operational indicators, we use fattening intensity, which is the daily weight gain of livestock (in kg per day), milk yield (annual milk production in litres per dairy cow) and livestock density (number of livestock units[1] (LU) per area of farmed agricultural land, in LU per 100 ha).

The effectiveness of the factors of production is evaluated by employing the indicators of production intensity (revenues to the acreage of agricultural land), labour productivity (revenues to the average registered number of workers) and turnover ratio (of revenues to assets (total and fixed). Monetary indicators are expressed in constant 2004 prices using the average annual inflation rate (CZSO, 2021).

For the evaluation of the subsidies, the so-called index of dependence on subsidies (IDS), which represents the cost rate adjusted for subsidies, where the value over 100% expresses what share of company costs is needed to be covered by subsidies (CZSO, 2010):

$$\text{IDS} = \text{Costs} / (\text{Revenues} - \text{Subsidies}).$$

The most widely used prediction and diagnostic models were used for the aggregate evaluation of farms' financial health. In our case, Altman's model in the form of Altman (2002) was used:

$$Z = 0.717\, x_1 + 0.847\, x_2 + 3.107\, x_3 + 0.420\, x_4 + 0.998\, x_5$$

where x_1 is working capital / assets; x_2 is retained profits / assets; x_3 is profit before interest and tax / assets; x_4 is equity / debt; x_5 is revenues / assets.

The second index is G-index (Gurčík, 2002):

$$G = 3.412\, x_1 + 2.226\, x_2 + 3.277\, x_3 + 3.149\, x_4 - 2.063\, x_5$$

where x_1 stands for retained profits / assets; x_2 for profit before tax / assets; x_3 for profit before tax / revenues; x_4 for cash flow / assets and x_5 for inventories / revenues.

The dynamics of indicators are evaluated using the average growth rate or the average increment.

3. Results

3.1 Production

In 2020, the average farm farmed on an area of 1 483 ha of agricultural land (Table 2), the share of ploughing was 77%, the share of leased land was 79.4%, while the

[1] Glossary:Livestock unit (LSU) https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Livestock_unit_(LSU)

average farm up to 900 ha managed the most leased land (87%). The production structure (share of individual activities in revenues) in individual groups does not show significant differences, except for the smallest farm (up to 900 ha), where the share of revenues from pig and poultry production is significantly higher than in other groups.

Table 2. Basic characteristics of the sample in 2020

Size group	Util. Agric. Area (ha)	Assets (thous. CZK)	Revenues (thous. CZK)	Number of workers	Subsidies (CZK/ha)
Up to 900 ha	653	80 213	59 956	28.5	13 857
900 - 1 800 ha	1 272	142 014	71 519	34.5	11 340
1 800 - 2 500 ha	2 104	248 991	133 307	73.8	12 148
Over 2 500 ha	3 113	382 792	184 428	76.6	11 204
Total	1 483	173 284	91 064	43.3	11 661

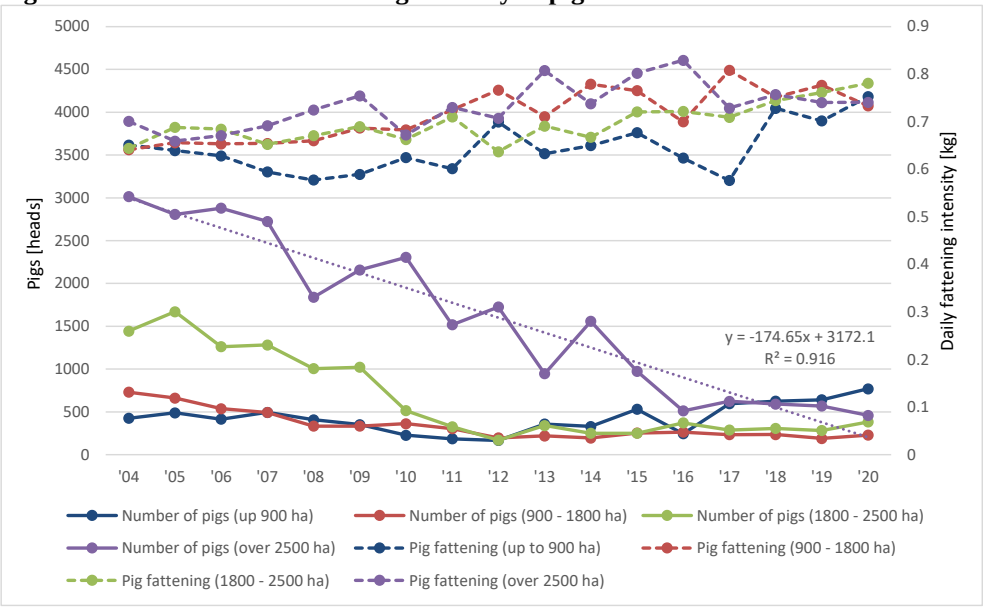
Source: Authors' calculations on a sample of farms

The volume of total revenues at constant 2004 prices in the average farm fell from CZK 69.8 million in 2004 to CZK 64.8 million in 2020. Revenues at current prices, calculated per hectare of utilised agricultural area, are the highest in the group of smallest farms up to 900 ha (91 763 CZK), the lowest in the average farm 900 to 1 800 ha (56 245 CZK), in the group 1 800 to 2 500 ha, it is 63 361 CZK and, over 2 500 ha, the revenues are 59 244 CZK/ha. The average growth rate since 2004 is also the highest for farms up to 900 ha (5.4%) and the lowest for farms over 2 500 ha (2%).

Yield in kind is growing in most crops despite frequent year-on-year fluctuations. Winter wheat yield at the average farm increased from 6.32 t/ha in 2004 to 6.38 t/ha in 2020, while the average farm achieved the highest yield up to 900 ha (7.45 t/ha). The average growth rate is also the fastest in this group (1.8% per year); the average rate in the group over 2 500 ha even decreases by 1.2% per year.

The density of cattle in 2020 was 46 livestock units per 100 ha, and since 2004 it has increased by 10% in the sample. The livestock density on the farm increased the most in the group over 2 500 ha, and the livestock density in the group up to 900 ha decreased by 6.7%. Fattening intensity on the average farm increased from 0.82 kg per day to 0.997 kg per day over the period under review, with the highest in the group over 2 500 ha (1.06 kg per day) and the lowest in the group up to 900 ha (0.84 kg per day). According to an analysis by Kopeček et al. (2009), all model results with the current intensity of cattle fattening show negative profitability in this sector. A prerequisite for achieving positive results in this sector would be increasing the fattening intensity to at least 0.9 kg daily. In our case, all but the smallest groups achieve such efficiency. The average annual milk yield has steadily increased from 5 828 l per dairy cow in 2004 to 8 494 l in 2020, with an average growth rate of 2.2% per year, with milk yields growing the fastest by 2.5% per year in the group of 900 to 1 800 ha.

Figure 1. The number and fattening intensity of pigs



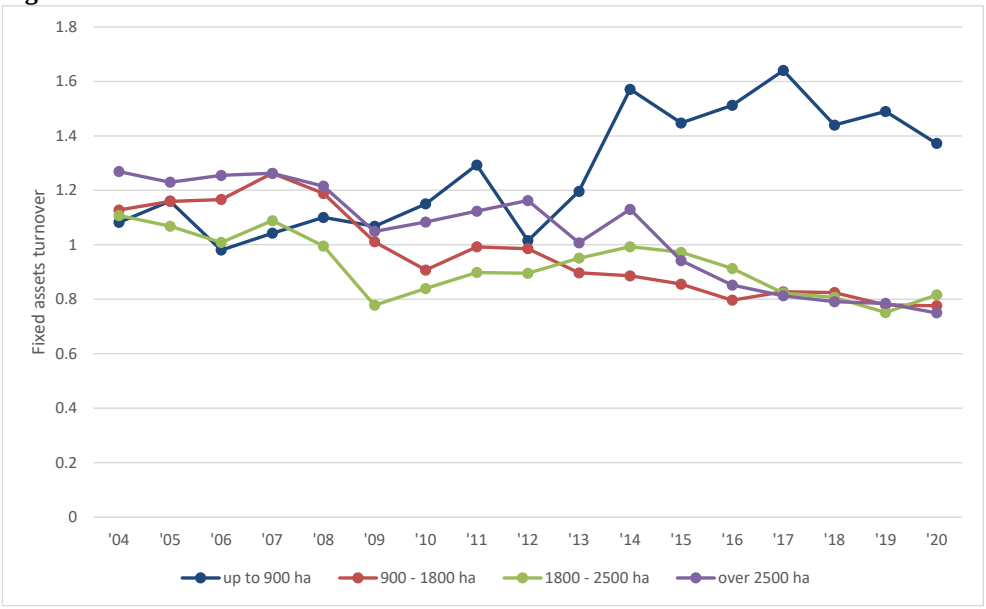
Source: Authors' calculations on a sample of farms

A significant long-term trend is a decline in pig numbers. Although the popularity of pork is almost unchanged among consumers, the situation in the Czech market is unfavourable for producers due to low production efficiency and to the lower meat prices from abroad (Duda & Křížová, 2010). According to the study by Boudný and Špička (2012), the average profitability of pig breeding is negative in all intervals of efficiency. In our sample, the average growth rate of pigs fattening intensity is 0.8% per year; in the group up to 900 ha, it is 0.8%; in the group of 900 to 1 800 ha, it is 0.9%; for the farms of 1 800 to 2 500 ha, the fattening intensity grows the fastest - 1.1% per year; and for farms over 2 500 ha, the growth is 0.3% per year. The number of pigs on the average farm fell from 1153 to 387 heads, i.e., only 34% of value in 2004. The most significant decrease occurred at the largest farms, where the annual decrease was 175 heads (Figure 1). On the contrary, the smallest farm increased the number of pigs. Holdings mainly engaged in the production of pigs and poultry do not have to farm the land if they do not produce their own feed, and thus, when broken down by acreage, these farms usually fall into the smallest area, although their economical size may correspond to larger farms. In contrast, large farms usually engage in mixed farming and find it easier to switch to profitable commodities than narrowly specialised farms. The intensity of production at constant 2004 prices shows a slightly increasing trend. The highest production intensity is in the category of the smallest farms and shows the fastest growth.

3.2. Financial management

The fixed-assets turnover ratio is declining in all groups except the smallest farm (Figure 2). The highest value of 1.37 in 2020 is found in the group of up to 900 ha (this group has the lowest fixed-assets growth rate). In other groups, the differences have been negligible in recent years. The decrease in the turnover ratio is due to a higher increase in the value of fixed assets compared to the increase in revenues (the effect of investment subsidies is reflected here). In general, a decrease in turnover is considered an unfavourable situation in financial theory. However, when evaluating farms, considerable underinvestment before 2000 must be taken into account (a large part of the fixed assets was essentially or even completely depreciated), as well as the substitution of human labour using fixed assets. The result is a monotonously growing value of technical work equipment in all groups.

Figure 2. Fixed assets turnover



Source: Authors' calculations on a sample of farms

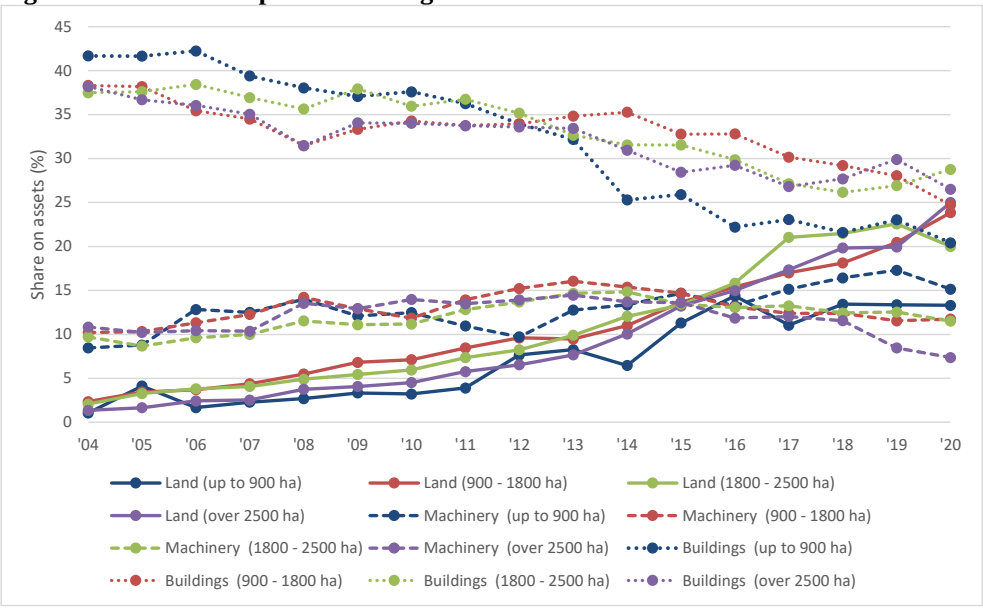
The average growth rate of labour productivity is 5.5% per year and does not differ significantly between size groups. The lowest labour productivity is in the group from 1 800 to 2 500 ha. The main reason for the long-term growth of labour productivity in all groups is the decline in the number of employees, except for the smallest farms up to 900 ha, where labour productivity growth is caused by production growth with a slight increase in employees. The average annual wage per worker is growing at a rate of 5% per year; the differences between the groups are

insignificant, growing the slowest on the smallest farms. The number of workers needed per 100 hectares of land declines over time, except for the smallest farms up to 900 ha.

The structure of assets of the average farm in terms of long-term and short-term items shows a slight increase in fixed assets in the period under review, represented by 65% of the average farm in 2020. A closer look at the individual groups already shows significant trends. While at the beginning of the period, the share of land in the value of total assets in the average farm was 1.85%, in 2020, it was already 22.6% (Figure 3). The share of the land on large farms over 2 500 ha is growing the fastest, by almost 19% per year. This trend is also evident in the share of own land in cultivated agricultural land, growing from 1.75% in 2004 to 20.6% in 2020 (Figure 6).

The share of buildings in the total assets has a declining trend in all size groups, and the most significant decrease occurred in the smallest farms up to 900 ha. The decrease is partly due to a decrease in the net asset value and especially to an increase in the share of non-depreciated land. In the case of movables, there is a slight increase in their share in assets in all groups (except for the largest farm), which averaged 11% in 2020.

Figure 3. Share of components of tangible fixed assets in total assets

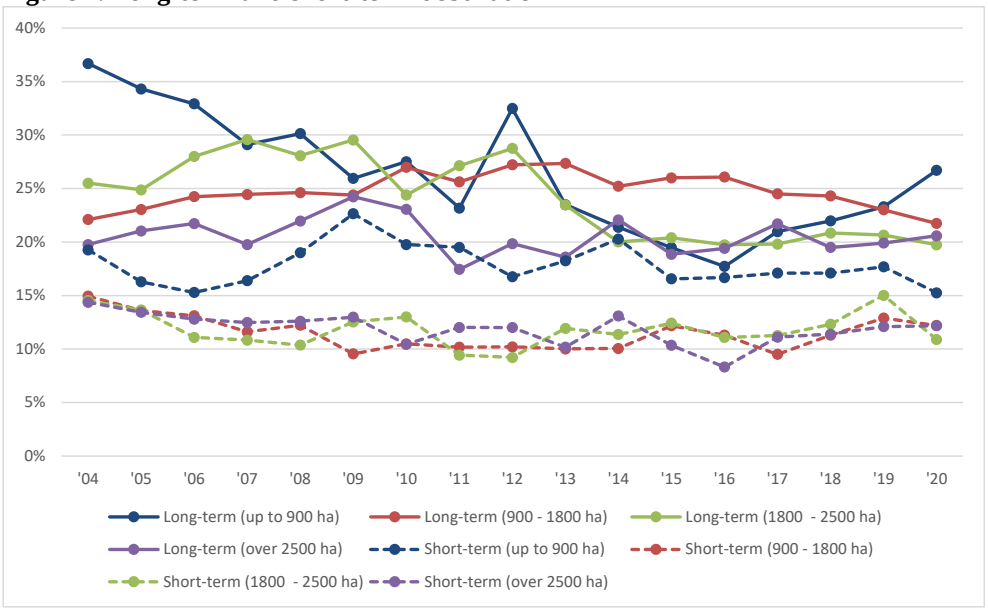


Note: Land, Machinery, and Buildings are the balance sheet items
Source: Authors' calculations on a sample of farms;

The differences in debt ratio (i.e., the share of debt in the total capital) between groups are not significant, in 2020 the value of total debt ratio in the group of farms

up to 900 ha was 43%, in the group 900 to 1 800 ha - 34%, for acreage 1 800 to 2 500 ha - 31% and in the largest farms, it was 34%. The dynamics of debt ratio in all groups show a declining trend; the average annual change in the group up to 900 ha is −1.7% points, for farms 900 - 1 800 ha, it is −0.7% points, for farms with an area of 1 800 - 2 500 ha, it is −1.6% points and in the largest farms −0.1% points. This decline is due to a faster decline in the short-term debt ratio and a slight decline in the long-term debt ratio (Figure 4). The predominant item of long-term debt is liabilities to credit institutions, and another significant item is other long-term liabilities, where cooperatives record liabilities from transformation.

Figure 4. Long-term and short-term debt ratio



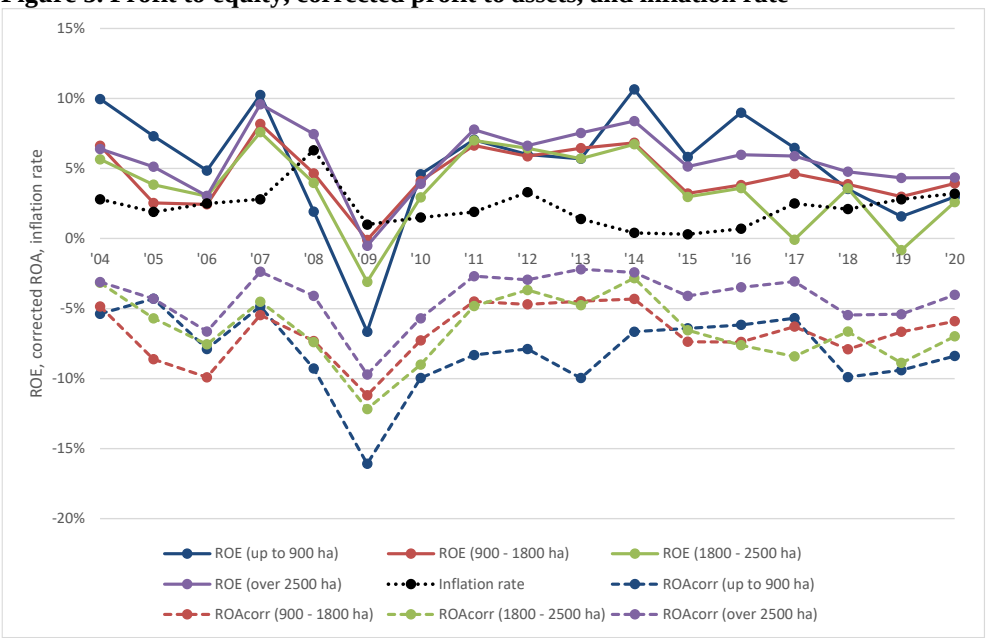
Source: Authors' calculations on a sample of farms

Profit/loss from previous periods accumulates within equity. Until 2004, these were cumulative losses, and the reversal occurred in 2005, and in the following years, there was an accumulation of profits; the share of this item in the capital is 19% for farms up to 900 ha, 21% in the group 900 - 1 800 ha, 7 % in the group 1 800 - 2 500 ha and 13% in farms over 2 500 ha in 2020.

The synthetic indicator of profitability is usually the return to equity, which is based on profit/loss after tax. This indicator includes the expression of the efficiency of the production process and its economy, the conditions of monetisation and, simultaneously, corporate capital structure. Significant fluctuations in the profit/loss and profitability can be observed in individual years, influenced by many external

factors. In Figure 5, the return on equity of the average farm in each area is compared with the average annual inflation and the return on assets adjusted for subsidies.

Figure 5. Profit to equity, corrected profit to assets, and inflation rate



Source: Authors' calculations on a sample of farms

A significant drop in profitability occurred in 2009, when the average farm in all size groups made a loss due to unfavourable external conditions. Since 2010, the average return on equity has been positive; however, it has declined slightly in recent years, and a loss in the farms of 1 800 to 2 500 ha occurred in 2017 and 2019. The average values for 2020 are 3% for 900 ha farms, 3.9% in the 900 to 1 800 ha group, 2.6% in the 1 800 to 2 500 ha group and 4.3% in the largest farms.

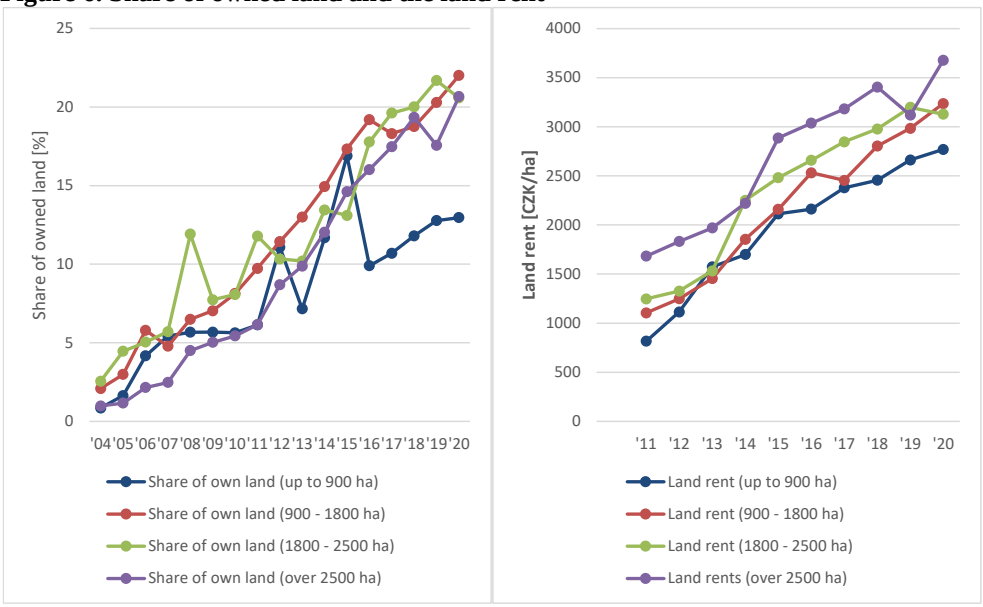
Long-term profitability which, in addition to current profit/loss also includes retained profits/losses and funds from profit, is growing in all groups; it reached 36% in the up to 900 ha group, 42% for 900 to 1 800 ha farms, 35% in the 1 800 to 2 500 ha group and 46% in those over 2 500 ha in 2020.

In terms of cost ratios, the most important item is the cost ratio of consumption from production. Its values are relatively stable, and the long-term average is 56%. In the monitored period, there are changes in the structure of consumption from production, which are due to changes in the cost of materials and services. The cost ratio of services is growing by an average of 2% per year.

The cost ratio of services includes, among other things, the cost of land rent. Although the land rent is not a significant component of the cost, it has increased significantly by an average of 6% per year, and the cost ratio of land rent was 2.6% in

the 900 to 1 800 ha group, 4.5% in the 900 to 1 800 ha group, 3.9% for farms ranging from 1 800 to 2 500 ha and 4.9% in the largest farms in 2020. This increase occurred despite the declining share of leased land. The average lease fee in 2020 was 2 770 CZK/m^2 in the up to 900 ha group, 3 236 CZK/m^2 in the 900 to 1 800 ha group, and 3 127 CZK/m^2 for 1 800 to 2 500 ha farms and 3 677 CZK/m^2 for farms over 2 500 ha. We have been monitoring land rent in the sample since 2011, and it has shown a rapid increase in the last ten years - the average growth rate is the highest in the up to 900 ha group, where it represents 13% per year, it is 11% in the 900 to 1 800 ha group; in rent, the farms in the 1 800 to 2 500 ha group grow by 10% per year and those over 2 500 ha grow by 8% per year (Figure 6).

Figure 6. Share of owned land and the land rent



Source: Authors' calculations on a sample of farms

Operating subsidies are part of corporate revenues and affect profit/loss. The share of operating subsidies in total revenues in 2020 was 15% in the group up to 900 ha, 18% in farms from 900 to 1 800 ha, 16% in the size group 1 800 to 2 500 ha and 21% in those over 2 500 ha. These shares have been stable since 2006 and slightly fluctuate from the stated values in individual years.

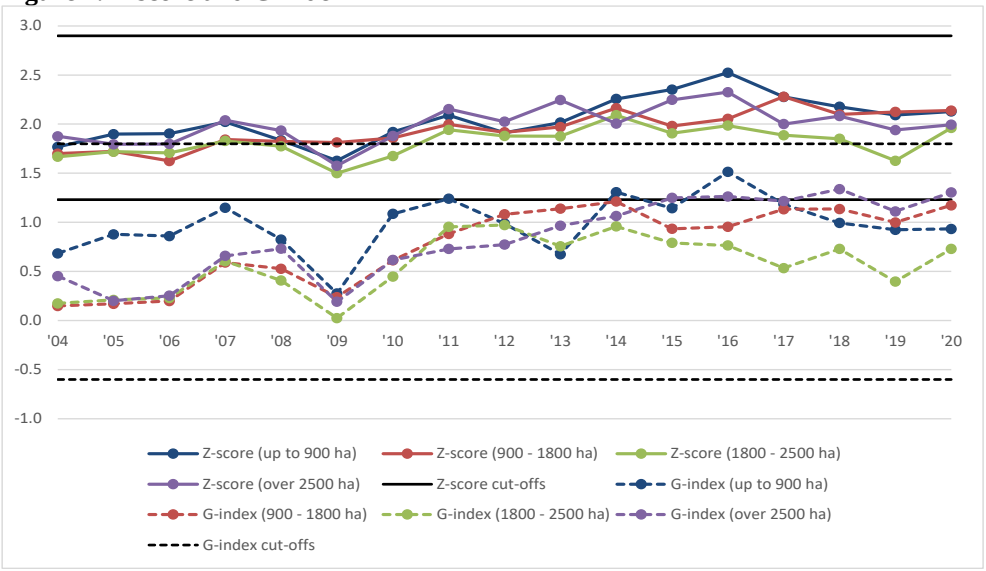
If we express the return on total capital adjusted for operating subsidies (operating profit/loss reduced by operating subsidies to total assets), there is a noticeable decrease in profit to the loss in all groups in the monitored period. The most extensive relative loss for almost the entire period is in the smallest farms, up to 900 ha, and the smallest relative loss is in the largest farms, over 2 500 ha (Figure 5).

The average growth rate of operating subsidies is 3.4% per year; the largest increase in subsidies per hectare of agricultural land occurred with the Czech Republic's accession to the EU, with the most dynamic increase in the first three years after accession. In 2020, subsidies for the average farm amounted to 11 661 CZK per hectare. In most monitored years, operating subsidies per hectare of agricultural land decreased with increasing farm size.

In no group has the subsidy dependence index fallen below the 100% threshold since 2000. This indicator has a growing trend over time. In 2020, the average farm with an area of up to 900 ha needed subsidies to cover 14% of costs, for farms 900 - 1 800 ha, it was 18%, in the group 1 800 - 2 500 19% of costs and in those over 2 500 ha, subsidies covered 14% of costs. The main change in the subsidy structure is the shift to decoupled payments; in 2004, the Single Area Payment Scheme accounted for 34.3% of operating subsidies, and in 2020 it was 48.8%.

Altman's model is one of the most widely used synthetic models for evaluating a company's finances. In practice, this model accurately predicts financial difficulties in the two-year forecast. For this reason, it is appropriate to monitor its values over time. We observe a growing trend in its value for the average farm, while the average farm fluctuated within the grey zone. In all groups, the dynamic of the Altman Z-score was very similar, with the highest values on an average farm of up to 900 ha, with the fastest growth rate on a farm of 900 to 1 800 ha. The average farm is in the grey zone, meaning that farms are neither directly threatened with bankruptcy, nor in an excellent financial condition. The most significant decrease in this indicator is evident in the crisis year of 2009 (Figure 7).

Figure 7. Z-score and G-index



Source: Authors' calculations on a sample of farms

The G-index considers the specifics of agriculture and is considered a creditworthy-ownership index. It makes it possible to differentiate between agricultural and non-prosperous agricultural holdings. According to Kopta (2009), the G-index is very effective in evaluating farms, although it considers successful farms with a return on equity above 8%, which is why the average farm does not approach the upper limit even in the most successful years. Average farms are in the grey zone during the reference period. Figure 7 shows a trend of improving the company's financial health in all groups, with a significant fluctuation in 2009, when all components of the index deteriorated. The average farm enterprise reached the highest value of the G-index in 2018.

Conclusions and discussion

Due to the database used, this study is limited to farms of legal entities, generally considered medium and large. Nevertheless, some significant development trends can be traced during the observed period. In the average farm, it is mainly a decrease in employees, a decrease in the number of pigs and the effort to buy agricultural land. Total production is growing, but the share of sales from crop production is increasing, and the share of sales from animal production is falling. Due to the high dependence of profit in agriculture on external conditions, the development of this indicator is characterised by significant fluctuations. The biggest loss occurred in 2009 when the impact of the Great Depression was amplified by adverse weather (MZe, 2010). A significant increase in support after 2004 helped farms overcome the crisis years. The farms' financial health shows an upward trend in all size groups, although the average farm did not break out of the grey zone during the period under review. Dependence on subsidies increases; subsidies calculated per hectare of agricultural land used to increase over time but decrease with farm size. The interest of farms to buy the land they farm is evident, but the share of rented land still constitutes the absolute majority of farmed land. Land rents have increased 2.7 times over the last ten years (the average growth rate is 10.5% per year).

Differences in trends between individual size groups were manifested in the group of the smallest (up to 900 ha) and the largest (over 2 500 ha) farms. The indicators of the middle groups (900 - 1 800 ha and 1 800 - 2 500 ha) develop very similarly and with minimal differences from the average.

In the largest farms group (over 2 500 ha), production intensity grew the slowest in the monitored period, and there was the most significant decrease in the number of workers. The share of the owned land is growing the fastest, and cattle numbers are oscillating; however, growing the number of suckler cows is at the expense of dairy cows. The decline in the number of pigs is the most significant in this group, reaching 15% of the level in 2004. Subsidies calculated per hectare of agricultural land are the lowest in this group.

The average farm of up to 900 ha reaches the highest production per hectare of agricultural land used, and production grows the fastest, which indicates a high intensity of agricultural production. Some opposite trends confirm this compared to the average, manifested only in this group, mainly a slight employee increase. The number of pigs in this group also increased, as farms with a production focus independent of land (pig and poultry fattening) often have the smallest acreage. Some studies (Schmidt et al., 2019; Petsakos et al., 2022) point to the lowest acceptance of ecological schemes among farms with this orientation. Higher production intensity makes farms more vulnerable to adverse external conditions. In the smallest farms group, underinvestment is evident, the share of fixed assets in the total is the lowest, and the fixed assets turnover rate is increasing. In small farms, there is not enough space for labour savings. Short-term indebtedness is also significantly higher than for other groups. These can be significant negative determinants of farm profitability (Kryszak et al., 2021). Regarding profitability and financial health, differences between farm sizes are negligible, probably influenced by higher operating subsidies per hectare of agricultural land.

In the smallest farms group, the subsidies per hectare are the highest, but the 2023 change in the direct payments system will have a minimal effect on their economy. Direct payments will be higher for farms up to 300 ha and, for farms with a larger area than 900 ha, there will be a significant reduction in payments against the average (Lososová & Zdeněk 2023). In addition, the targeted increase in support for small farms leads to a relatively small increase in overall productivity (Čechura et al., 2022). Although small farms differ in some indicators, we believe that the targeting of support should not primarily concern the area of land used but the production orientation and intensity. High support decoupled from production eliminates differences in profitability (Bojnec & Latruffe, 2013) and labour productivity (Novotná & Volek, 2016), increased support targeted at small farms allows them to grow (Appel et al., 2019) and a redistributive payment can lead to the formal division of large farms. According to Appel et al. (2019), abolishing direct payments would be fairer than redistributing them according to farm size.

Decoupled payments are suitable for supporting extensive farming in mountainous and threatened areas with a high emphasis on ecological farming. However, when the importance of food self-sufficiency and a sufficient supply of regional products is growing, the support of production, which the Czech Republic has not completely exempted itself from, is relevant. It prevented, for example, a decline in cattle as dramatic as that of pigs. However, payments targeted at sensitive commodities are marginal compared to the Single Area Payment Scheme and have not prevented the continued shift from predominantly mixed farm production to pure crop production.

We are aware of the limitations of this study; however, given the considerable regional differences and variability in farming systems, empirical evidence at the

farm level is important. The results can contribute to the debate on the future direction of agricultural policy and stimulate further research.

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