

Does size matter? The non-linear relationship between farm size and economic viability in Czech agriculture

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Abstract: This paper analyses the economic viability of Czech farms between 2015–2023 and examines the non-linear relationship between farm size and viability. Farm viability is measured using the Farm Economic Viability (FEV) indicator, adapted from the Modified Farm Net Value Added approach to account for constraints in accounting-based data. The analysis covers 1 443–2 211 farms annually, representing 44–65% of the utilised agricultural land area (UAA) in Czechia. Farms are classified by both UAA and by economic size. The results show that the share of economically viable farms ranged from 16.6% to 46.9%, with substantial year-to-year variability driven by market and policy conditions. Farms up to 150 ha exhibit higher average FEV values, whereas farms above 900 ha show below-average viability. In contrast, classification by economic size indicates higher viability among large farms, while small and medium-sized farms remain the most vulnerable. The predictive ability of the IN99 model is assessed using ROC (receiver operating characteristic) analysis; after modification, the optimised model achieves an *AUC* (area under the ROC curve) of 0.90 and a hit ratio of 83.3%. The findings confirm that farm size effects on viability depend critically on the chosen size definition and that accounting-based financial ratios can reliably predict farm economic viability.

Keywords: accounting data; agricultural enterprises; discriminant analysis; opportunity costs; predictive modelling; subsidy policy

The viability of agricultural holdings is a key concept in assessing's economic stability and sustainability, particularly regarding the design and implementation of the Common Agricultural Policy (CAP). Promoting a 'viable farm income' is one of the main objectives of the CAP (European Commission n.d.), with various definitions of viability emphasising different aspects. Agricultural viability is primarily understood as the ability to generate sufficient long-term income from farming to support the livelihood of the farming household and to provide a return on land and capital. It is measured in terms of income, often using the Farm Accountancy Data Network (FADN) and,

if available, supplemented by return on assets and opportunity costs (Vrolijk et al. 2010; Barnes et al. 2015; Allanson et al. 2017; Hlavsa et al. 2020). It is influenced by structural factors (Barnes et al. 2016; Leonard et al. 2017), biophysical conditions (Acs et al. 2010; Simensen et al. 2018) and spatial factors (Lange et al. 2013; Barnes et al. 2016).

In the European context, viability is often understood as the assurance of reasonable welfare for farm households or as a reflection of the opportunity costs (Vrolijk et al. 2010; Poczta-Wajda 2020; Hloušková et al. 2022). From a business economics perspective, viability can be defined as the long-term ability

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to maintain operational objectives and fulfil its mission despite changing external conditions (Barnes et al. 2015, 2020). Long-term viability in a changing economic context is also perceived as sustainability (Latruffe et al. 2016; Ribašauskienė et al. 2024) and is often associated with the serious phenomenon of agricultural land abandonment and rural depopulation (Quintas-Soriano et al. 2022; Calafat-Marzal et al. 2023). Although the causes of this phenomenon are numerous, the decisive factor is the persistently low level of economic viability (Barnes et al. 2020; Romero-Díaz et al. 2024; Fantechi et al. 2026). The growth of economic viability and sustainability of agricultural production is directly related to investments (Kelly et al. 2018), their support (Czubak et al. 2021) and access to credit (Varga 2017; Ribašauskienė et al. 2024).

Empirical studies often focus on profitability, solvency or liquidity when assessing viability (Coppola et al. 2020). According to Slavickienė and Savickienė (2014), a more effective assessment of farm economic viability can be achieved by combining methods. Financial indicators offer an incomplete picture, failing to incorporate the opportunity costs associated with labour, capital, and land (Poczta-Wajda 2020). Therefore, they are often supplemented with productivity indicators that reflect the efficiency of used production factors (Argilés 2001; Latruffe et al. 2016). Given the high volatility of income, it is important to use multi-year data to draw meaningful conclusions about farm viability (Barnes et al. 2020). In the case of family farms, viability is also closely linked to the ability to maintain generational continuity, i.e. passing the farm to successors (Latruffe et al. 2016; Barnes et al. 2020), and to resilience to shocks and threats in crisis years (Hooks et al. 2017; Loughrey et al. 2022). In contrast, for large corporate enterprises, profit maximisation and growth strategies are at the forefront (Špička et al. 2019).

Although there is a significant body of empirical work, there is a lack of a unified conceptual framework for systematic comparisons across regions and farm types (Loughrey et al. 2022). This limitation is also apparent regarding the impact of farm size on its economic viability. Farm size is considered one of the determinants of productivity, environmental impacts and resource efficiency (Ren et al. 2024). Small farms are often valued for their flexibility, importance in ensuring food security and role in supporting rural communities (Mugera et al. 2016), but at the same time they face problems with insufficient economies of scale, lower technical efficiency (Bojnec and Latruffe 2013) and weaker innovation potential (Lafuente et al. 2020).

On the contrary, large enterprises can adopt modernisation more quickly and benefit from large-scale production, but often at the cost of greater sensitivity to market fluctuations and negative environmental impacts (Ren et al. 2024).

Farm size can be defined in various ways – from the area of cultivated land, the area of arable land or harvested area (MacDonald et al. 2013), to the number of employees and the value of production, herd size, or economic size expressed in sales or assets (Guiomar et al. 2018). Given this heterogeneity, the choice of criterion is crucial, as it can lead to different conclusions when designing agricultural policy, especially regarding degressive support and redistributive payments (Lososová and Zdeněk 2023).

Several models have been developed to predict various economic phenomena, but models for predicting farm economic viability based on accounting data are less common. Argilés (2001) combined agricultural and accounting variables to predict non-viability, Savickienė and Miceikienė (2021) tested the estimation of farm viability using bankruptcy models, and Aggelopoulos et al. (2007) investigated the relationship between socio-economic indicators of young farmers and their financial viability. Zdeněk et al. (2024) indicated a connection between viability measurement and firm value creation using the IN99 model. The IN99 model (Neumaierová and Neumaier 2002) was primarily designed to estimate firm value creation (the model's output accounts for the cost of capital).

From the above overview, the following hypotheses can be formulated:

H_1 : There are significant differences in economic viability between farm size categories.

H_2 : The methodology used to define farm size influences the results of the assessment of economic viability.

H_3 : The economic viability of farms can be predicted using financial ratios based on accounting data.

This article aims to analyse the economic viability of Czech farms between 2015 and 2023 and assess the influence of farm size on their ability to survive in a changing market and subsidy environment. Although the concept of farm economic viability has been previously applied in Czech conditions (Hlavsa et al. 2020), existing studies rely predominantly on FADN data and a single definition of farm size. This paper extends the literature in three main ways. First, it applies the Farm Economic Viability (FEV) concept to a large panel of accounting-based data covering farms managing approximately half of the Czech utilised agricultural land area (UAA) over the period 2015–2023.

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Second, it explicitly compares two fundamentally different definitions of farm size (land-based vs. economic classification) and shows that they yield contradictory conclusions about farm viability. Third, it integrates the FEV concept with a modified IN99 model and empirically verifies that accounting-based financial ratios can reliably predict farm economic viability.

MATERIAL AND METHODS

Data for this study were sourced from the public financial statements of farms with primary economic activities falling within NACE categories 0110 to 0160, covering the 2015–2023 period. The data were supplemented with publicly available data on subsidy recipients (SZIF 2024). UAA was estimated based on the area payment paid, i.e. the area for which the Single Area Payment Scheme payment was paid. After excluding entities that did not receive direct payments or had incomplete data, the final annual sample ranges from 1 443 to 2 211 farms, covering 44–65% of the total utilised agricultural land in Czechia (Table 1).

In this article, we use a classification based on the thresholds for redistributive payments and the degeneracy of payments for less-favoured areas (Lososová and Zdeněk 2023). Due to a specific heterogeneity of agricultural production, the UAA may not be fully related to the economic size. For comparison, the classification according to the EU standards [Annexe I of Commission Regulation (EC) No. 800/2008] was additionally used to categorise micro, small, medium and large enterprises (Table 2). It is important given the fact that enterprises focused on breeding granivores may operate with little or no agricultural land, which could distort the results for groups of farms with small areas.

To assess the economic viability of farms, we apply the methodology proposed by Hlavsa et al. (2020). They analysed data from FADN and developed the

FEV indicator derived from the Modified Farm Net Value Added (MFNVA) approach. MFNVA is intended to cover employee wages, the imputed remuneration of unpaid labour, and the opportunity costs of equity and owned land. Taking the opportunity costs of capital, labour, and land into account, a farm is considered viable under condition:

$$FNVA - (IP + OCC) - (RP + OCL) > W + UL \quad (1)$$

where: *FNVA* – farm net value added; *IP* – interests paid; *OCC* – opportunity costs of equity (non-land); *RP* – rent paid; *OCL* – opportunity costs of own land; *W* – wages; *UL* – expected wages for unpaid labour.

Hlavsa et al. (2020) further define the *FEV* indicator as:

$$FEV = [FNVA - (IP + OCC) - (RP + OCL)] / (W + UL) \quad (2)$$

FEV varies in the interval $(-\infty, +\infty)$, with *FEV* = 1 indicating that MFNVA covers employees' wages, including the opportunity cost of unpaid labour (Hlavsa et al. 2020). Consequently, a farm with *FEV* > 1 is considered economically viable, whereas a farm with *FEV* < 1 is not.

The sample on which we process the evaluation differs from the FADN data for which the *FEV* indicator was derived by Hlavsa et al. (2020). It relates to the necessary adjustments in the definition of the content of Net Value Added, which is based on the published accounting statements. Net Value Added is determined as profit after tax + interest expenses + personnel expenses. The result is a relationship (Zdeněk et al. 2024):

$$FEV = (PAT + W - OCC) / W \quad (3)$$

where: *PAT* – profit after tax.

Table 1. Characteristics of the average farm

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023
Number of farms	2 211	2 042	1 951	1 714	1 732	1 740	1 694	1 674	1 443
UAA (ha)	1 034	973	1 010	1 038	1 028	998	1 102	1 064	1 081
Assets (thousand EUR)	3 863	4 313	4 789	5 148	5 418	5 566	6 142	7 360	7 260
Profit (thousand EUR)	162	190	206	213	205	214	285	466	221
UAA (% of Czechia)	65	57	56	51	51	49	53	51	44

UAA – utilised agricultural land area

Source: Calculation on a sample of farms

Table 2. Distribution of farms by utilised agricultural land area (UAA) and economic size

Category	Frequency (%)
1 (to 4 ha)	1.9
2 (4–150 ha)	18.4
3 (150–300 ha)	6.5
4 (300–500 ha)	11.1
5 (500–900 ha)	17.9
6 (900–1 800 ha)	26.3
7 (1 800–2 500 ha)	9.6
8 (over 2 500 ha)	8.1
Micro	35.7
Small	46.3
Middle	17.1
Large	0.9

Source: Calculation on a sample of farms

The simplified *FEV* formulation, compared to Hlavsa et al. (2020), omits the opportunity costs of owned land and unpaid labour. It reflects the structure of the analysed sample, which is dominated by legal entities that predominantly operate on rented land (Vomáčka and Leichmann 2022). From an accounting perspective, when land is owned and financed through equity, its opportunity costs are implicitly reflected in the costs of equity. Explicitly deducting opportunity costs of owned land in such cases could lead to double counting of capital costs. Moreover, as unpaid labour plays only a marginal role in corporate farms [in Czechia, commercial corporations (non-family farms) have a fundamental influence on employment in agriculture (Zavadil and Jančák 2024)], its omission is unlikely to have a material impact on the results.

OCCs are determined by the product of equity and the cost of equity rate. Mařík et al. (2018) recommend deriving risk premiums from global or, even better, US market data when applying the capital asset pricing model. Therefore, we adopt the cost of equity rates from Damodaran (2025) online, specifically following the values for European farming/agriculture sector, which are shown in Table 3.

ROC (receiver operating characteristic) curves will be used to evaluate the ability of the IN99 model to classify farms. These curves relate sensitivity and false positivity (Fawcett 2006). Sensitivity (*Se*) is the relative frequency of correct classification of positive cases (farms with *FEV* > 1), and false positive rate (*FPr*) is the relative frequency of incorrect classification of negative cases. The area under the ROC curve (*AUC*) is a quantity describing the ROC curve that can be used to compare several ROC curves (Fawcett 2006); its statistical testing is performed according to Hanley and McNeil (1982, 1983). The possibility of modifying the IN99 to achieve the highest possible concordance with farm economic viability will be investigated. New discrimination coefficients will be estimated using linear discriminant analysis. The possibility of simplifying or extending the model to include farm size and the impact of these modifications on accuracy will be verified. To determine the cut-off point, an approach known as the point closest-to-[0, 1] corner in the ROC plane, which defines the optimal cut-point as the point with minimum distance (Euclidean) between the ROC curve and the [0, 1] point, is used (Unal 2017).

Table 3. Costs of equity

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023
Cost of equity (%)	8.31	7.09	6.55	7.94	6.56	4.59	5.08	10.08	8.57

Source: Damodaran online (2025)

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RESULTS

The share of economically viable farms (i.e. with $FEV > 1$) ranged from 16.6% to 46.9% between 2015–2023. Regarding viability, the worst year observed was 2023, and the most favourable year was 2020. It confirms the high sensitivity of farms to external factors, especially price developments and subsidy policies. A detailed analysis by size group (Table 4) showed significant differences (Kruskal–Wallis H test) between size groups in the breakdowns by UAA and economic size in most years, which supports hypothesis H_1 . The importance of the chosen categorisation is demonstrated, e.g. in 2021, there are highly significant differences in the economic viability of farms broken down by UAA, while when broken down by economic size, the differences are insignificant (which supports hypothesis H_2). When classified by UAA, small farms (up to 150 ha) showed higher average FEV values, while for farms over 900 ha, the share of viable farms was below average (Table 5). On the contrary, the breakdown by economic size showed relatively higher viability of large farms, while small and medium-sized farms were among the most vulnerable groups in most years.

Table 5 shows the share of farms where $FEV > 1$. The below-average share of viable farms occurs in most monitored years in groups with UAA exceeding 900 ha. By economic size, the lowest share

of viable farms in most years is among small and medium-sized enterprises. According to both breakdowns, an above-average share of viable farms is evident in the groups of the smallest farms in all years except 2022 and among large enterprises in all years except 2017. Table 5 shows that the share of viable farms decreases with increasing UAA, most significantly in the last year. In contrast, the breakdown by economic size indicates a higher threat to small and medium-sized farms. More detailed results show that farms over 2 500 ha had a lower average FEV (Table 4) and a lower proportion of viable farms than the average in 8 out of 9 years. On the contrary, according to economic size, large farms showed above-average viability in 5 out of 9 years (Table 4). This difference confirms that the choice of size criterion (area vs. economic size) can lead to contradictory conclusions.

Particular attention should be paid to farms with a negative FEV , whose share reached an average of 8.4%. The decrease in farms with a negative FEV occurs in the more successful years of 2020 and 2021, and, on the contrary, a more significant increase is observed in the last two monitored years. When categorised by UAA, the share of farms with a negative FEV decreases as farm area increases in all monitored years. The differences are not so noticeable for the breakdown by economic size; however, it seems that the smallest share of farms with a negative FEV value

Table 4. Economic viability of the average farm by size

Category	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	0.84	0.91	0.97	0.64	0.96	1.25	1.05	0.70	0.81
2	0.93	1.04	1.24	1.06	1.23	1.12	1.07	0.90	0.87
3	0.99	0.94	0.91	0.94	0.98	1.14	1.39	0.94	0.61
4	0.89	1.03	0.92	0.83	0.80	1.05	0.97	0.72	0.66
5	0.88	0.92	0.92	0.85	0.92	1.03	1.11	0.93	0.73
6	0.81	0.90	0.89	0.83	0.86	1.00	1.01	0.93	0.65
7	0.80	0.88	0.91	0.80	0.87	0.99	1.01	0.92	0.64
8	0.81	0.90	0.92	0.83	0.85	0.96	1.02	0.89	0.71
K–W P -level	0.003	0.012	0.097	0.106	0.588	0.001	< 0.001	< 0.001	0.001
Micro	0.94	1.01	0.86	0.87	0.89	1.10	1.04	0.81	0.60
Small	0.83	0.91	0.89	0.84	0.88	1.01	1.02	0.92	0.63
Middle	0.83	0.90	0.98	0.82	0.90	1.00	1.03	0.90	0.72
Large	0.86	0.98	1.07	1.16	1.01	1.05	1.18	0.91	0.84
K–W P -level	< 0.001	< 0.001	0.033	0.105	0.016	0.179	0.506	< 0.001	0.003
Total	0.84	0.92	0.95	0.85	0.90	1.02	1.04	0.90	0.70

K–W – Kruskal–Wallis H test

Source: Calculation on a sample of farms

Table 5. Proportion of viable farms by size (%)

Category	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	35.3	53.9	47.6	33.3	48.8	70.7	60.9	28.6	33.3
2	44.5	44.9	47.9	38.4	37.8	40.6	39.3	26.7	29.6
3	40.1	48.4	41.3	38.9	31.1	52.1	45.5	30.7	17.1
4	42.0	51.8	39.2	32.4	27.8	50.2	44.6	28.7	15.9
5	37.1	38.6	40.7	33.1	34.8	49.3	55.3	41.2	11.9
6	25.1	32.1	31.6	23.9	23.2	47.1	45.9	36.3	12.3
7	18.2	24.2	32.5	19.5	24.5	43.7	42.3	30.4	9.2
8	25.8	30.1	35.1	21.4	21.8	41.8	43.2	34.3	8.9
Micro	42.8	47.4	43.4	37.9	36.5	51.7	47.5	30.7	23.9
Small	26.7	34.2	34.2	26.7	24.9	44.7	45.2	36.2	13.9
Middle	22.9	28.6	39.6	20.3	26.6	43.8	44.4	31.0	11.5
Large	60.0	40.0	36.4	38.5	52.9	55.0	57.1	40.0	30.4
Total	33.5	38.8	38.6	29.9	29.6	46.9	45.9	33.5	16.6

Source: Calculation on a sample of farms

occurs in medium-sized and micro farms (Table 6). If we compare the average farm with a negative *FEV* with the average of the entire sample, these are farms with a smaller UAA, which is also associated with lower operating subsidies. Total assets reach 50 to 75% of the average farm, and current assets reach 27 to 55%. Long-term receivables are significantly higher than the average farm, and debt is below average. Sales for own products and services are significantly lower, ranging from 17.8 to 34% of average sales. Most cost items are also at a third of the average, except

for interest expenses, which are close to the average. The most striking difference is in the profit(loss), while the average farm is profitable in all monitored years and groups, the average farm with a negative *FEV* realised a loss in most years and groups except for large enterprises.

Before analysing the suitability of the IN99 for assessing viability, it is appropriate to test its individual components for the equality of means between viable and non-viable farms (*t*-test). Viable farms showed higher profitability of assets, assets efficiency and

Table 6. Proportion of farms with negative Farm Economic Viability (*FEV*) by size (%)

Category	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	17.6	17.9	21.4	26.7	20.9	7.3	13.0	28.6	20.5
2	21.5	17.5	16.6	14.6	18.2	16.9	19.8	24.5	23.5
3	15.8	14.2	17.4	9.7	11.7	10.3	13.4	17.5	28.6
4	10.0	7.1	8.3	13.1	14.4	5.2	8.7	18.7	26.2
5	6.8	4.9	7.5	5.4	5.3	2.9	3.4	7.3	15.0
6	3.2	1.8	3.5	2.9	2.7	0.5	0.8	3.0	10.1
7	1.4	1.1	2.7	3.7	0.6	1.3	0.6	1.2	7.2
8	1.6	0.0	2.6	1.4	1.4	0.0	0.7	2.9	3.3
Micro	5.0	4.3	5.3	4.8	4.9	2.5	2.8	8.0	13.1
Small	14.3	11.4	14.1	12.8	15.1	11.7	13.6	20.4	25.7
Middle	4.2	3.6	3.0	3.0	2.3	1.6	1.8	1.7	4.5
Large	10.0	10.0	18.2	15.4	5.9	5.0	4.8	12.0	21.7
Total	9.0	7.1	8.4	7.4	8.0	5.3	6.0	10.5	15.2

Source: Calculation on a sample of farms

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Table 7. Coefficients of discriminant functions and their properties

	IN99	M1	M2	M3	M4
Assets/Total debt		–0.000 3			
Operational profit/Assets		9.523 4***	10.283***	10.274***	10.398 6***
Revenues/Assets		0.748 3***	0.715***	0.712***	0.664 1***
Current assets/Short-term liabilities		0.000 7	0.000 6		
Total debt/Assets			0.378 6***	0.377 6***	0.360 0***
UAA					–1.7e–4***
<i>AUC</i>	0.841***	0.873***	0.902***	0.902***	0.893***
(<i>SE_{AUC}</i>)	(0.003 53)	(0.003 21)	(0.002 85)	(0.002 84)	(0.002 97)
Minimum distance to [0, 1]	0.313	0.274	0.240	0.239	0.257
Optimal cut-off	0.535	0.953	1.125	1.116	0.867
Sensitivity	0.758	0.789	0.822	0.823	0.821
Specificity	0.802	0.824	0.839	0.839	0.815
Hit ratio	0.786	0.812	0.833	0.833	0.817

***significance at the 0.001 level; *AUC* – area under the ROC curve; UAA – utilised agricultural land area

Source: Calculation on a sample of farms

debt ratio ($P < 0.001$). On the contrary, the UAA was significantly higher in non-viable farms, which confirms that a larger area does not guarantee economic viability. Current ratio did not differ significantly.

Table 7 presents the results of the IN99 in identifying non-viable farms and its modification. The IN99 shows an *AUC* of 0.84, while for a cut-off of 0.53 (as the closest point to [0, 1]), the hit ratio is 78.6%. Using the cut-off points originally set for classifying bankrupt and value-creating enterprises to classify viable farms would be inappropriate (Figure 1) due to their low sensitivity. After estimating the new discrimination coefficients for the original ratios (model M1), the *AUC* increased to 0.87 and the reliability to 81.2%. Due to the low discriminatory power of the Assets/Total debt ratio, this ratio was replaced by its inverse form. After this modification, the *AUC* of the model increased to 0.90 and the overall reliability to 83.3% (model M2). Current liquidity was statistically insignificant in these models; after its exclusion from the model, its parameters almost did not change (model M3). By including the UAA, the classification power of the model decreased, *AUC* = 0.89, and the overall reliability was 81.7% (model M4).

The ROC curves show that all models are significantly above the main diagonal, which confirms their good classification ability (Figure 1). The lowest performance is shown by the IN99, all its modifications show clearly better results. The best discriminatory power was achieved by the modification with three

indicators (model M3), whose curve is closest to the upper left corner, indicating high *Se* with a relatively low *FPr*. The modifications based on four ratios (M2, its ROC curve is almost identical to the ROC curve of M3) and UAA (model M4) also achieved improved results compared to the IN99, but lag behind M3. Although models M1–M4 showed a higher *AUC* than IN99, the improvement is statistically significant at $P = 0.20$ (IN99 vs. M3). The graph also shows the optimal cut-offs. These points confirm that M3 and M4 models achieved *Se* exceeding 0.8 with an acceptable *FPr* (0.15–0.20), demonstrating their practical applicability and high robustness. The ROC results showed that the farm economic viability can be predicted with sufficient accuracy using accounting financial ratios. All tested models showed strong discrimination ability, providing empirical support for hypothesis H_3 . The IN99, after modifications, has proven to be a valuable tool for predicting viability, but it has limitations in considering structural characteristics such as UAA. The discriminant models were estimated and evaluated on the full sample to maximise statistical power. Although cross-validation or out-of-sample testing could further strengthen robustness, the primary objective of the analysis was to compare model performance rather than prediction in an operational setting. The consistently high *AUC* values across model specifications indicate stable discriminatory power.

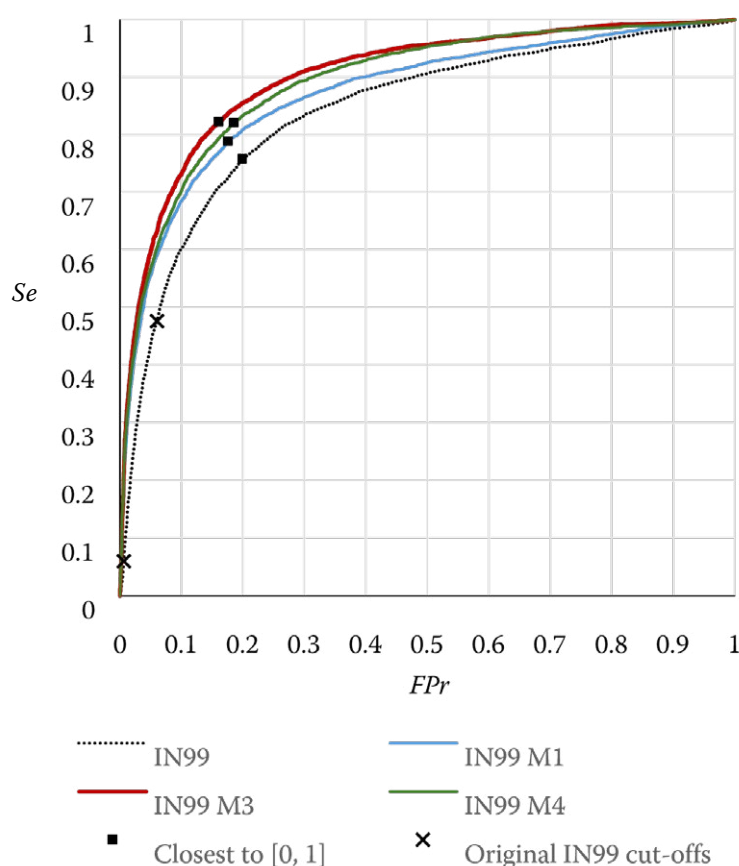


Figure 1. ROC (receiver operating characteristic) curves

FPr – false positive rate; *Se* – sensitivity

Source: Calculation on a sample of farms

DISCUSSION

The results of this study confirm that the relationship between farm size and its economic viability is non-linear and highly differentiated. Analysis based on the *FEV* indicates that farms with the largest UAA show, on average, lower economic viability than smaller farms, even though large farms achieve above-average values according to the economic classification. This apparent paradox reflects the complexity of the definition of farm size – whether it is understood as the area of farmed land or an economic category (MacDonald et al. 2013; Guiomar et al. 2018). Previous research showed that larger farms benefit from economies of scale and are more likely to adopt technological innovations (Ren et al. 2019; Lafuente et al. 2020). These farms are better able to manage fixed costs, invest in modernisation and reduce costs per unit of production (Bojnec and Latruffe 2013). However, as shown by Ren et al. (2024), increasing the area can also bring new environmental and market risks, which are subsequently reflected in the volatility of economic results. Therefore, the high share of viable micro farms can be interpreted as confirmation of their specific adaptability.

In addition, the high variability of agricultural production makes the classification of farms by area of agricultural land imperfect, especially for small areas. Not all of these farms can be described as small, as their production focus may not depend on land (e.g. fattening pigs and poultry, a high share of non-agricultural production, and further processing). The production intensity per hectare of these farms can be high, and their dependence on production-climatic conditions is lower; therefore, their resilience to shocks is higher than that of typical farms dependent on land production.

Regarding economic classification, it turns out that SMEs represent the most vulnerable group. This result is consistent with the findings by Coppola et al. (2020) or Hloušková et al. (2022), according to which small and middle-sized farms face limited access to investment capital, a weaker bargaining power in the market and are often dependent on subsidies.

Another interesting finding is that farms with negative *FEV* are more common among farms with smaller land areas, with fewer assets and lower sales from their own production. This profile corresponds to an extensive farming system with limited possibilities for generating added value. Similarly, Špička et al. (2019)

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emphasised that viability assessment must distinguish between family and non-family farms, as their objectives and strategies are fundamentally different.

The results of the discriminant analysis further show that the economic viability of farms can be accurately predicted using a limited number of financial ratios. The modification of the IN99 model led to an improvement in its classification ability, with profitability and asset efficiency playing a key role, which is in line with the emphasis on productivity as the basis of long-term viability (Barnes et al. 2015; Latruffe et al. 2016). In contrast, including land area did not improve the prediction ability, confirming that size is not a decisive factor in economic viability.

We face significant implications for agricultural policy when assessing the impacts of subsidy degressivity. Compared to Hlavsa et al. (2020), who focus on natural constraints, this study shows that conclusions about the size–viability relationship are highly sensitive to the chosen size definition. While Lososová and Zdeněk (2023) analysed redistributive payments primarily through land-based size categories, our results demonstrate that such an approach may misidentify economically viable farms. The novel insight is that UAA's large farms appear non-viable, but viable when classified by economic size, implying a potential misalignment between policy targeting and actual economic performance.

From the perspective of the Czech agricultural sector, the analysed data concern farms that manage approximately 50% of the UAA. However, the study excludes natural persons, as they usually keep records only for tax purposes and do not report financial statements. These farms are also affected to some extent by unpaid (family) labour. It implies that the results primarily reflect corporate and commercially oriented farms. We are aware of these limitations and see them as an incentive for further research.

CONCLUSION

The analysis of the economic viability of Czech farms showed that only a small proportion of farms are able to generate sufficient economic value. The share of viable farms ranged between 17% and 47%, with more than half remaining below the viability threshold even in the most favourable years. The results further confirm that the influence of farm size on viability is fundamentally conditioned by the chosen scale. While smaller farms measured by UAA often achieve

higher viability, large ones by economic classification are more stable and less at risk of economic failure. On the contrary, SMEs represent the most vulnerable segment in terms of revenue stability and the ability to finance their development.

Farms with negative *FEV* are concentrated mainly among farms with smaller land area and extensive farming, where the limited ability to generate added value is evident. These findings point to the need for targeted measures to increase these enterprises' efficiency and support the diversification of their income. From a methodological point of view, the modified IN99 model can distinguish viable from non-viable farms with high reliability.

From a practical and policy perspective, it can be argued that refining the definition of farm size in the context of agricultural policy would help avoid distortions in applying degressivity and redistributive payments, target support to SMEs, and support measures to increase farms' productivity and innovation capacity.

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REFERENCES

- Acs S., Hanley N., Dallimer M., Gaston K.J., Robertson P., Wilson P., Armsworth P.R. (2010): The effect of decoupling on marginal agricultural systems: Implications for farm incomes, land use and upland ecology. *Land Use Policy*, 27: 550–563.
- Aggelopoulos S., Samathrakakis V., Theocharopoulos A. (2007): Modelling the determinants of the financial viability of farms. *Research Journal of Agriculture and Biological Sciences*, 3: 896–901.
- Allanson P., Kasprzyk K., Barnes A.P. (2017): Income mobility and income inequality in Scottish agriculture. *Journal of Agricultural Economics*, 68: 471–493.
- Argilés J.M. (2001): Accounting information and the prediction of farm non-viability. *The European Accounting Review*, 10: 73–105.
- Barnes A.P., Hansson H., Manevska-Tasevska G., Shrestha S.S., Thomson S.G. (2015): The influence of diversification on long-term viability of the agricultural sector. *Land Use Policy*, 49: 404–412.
- Barnes A., Sutherland L.A., Toma L., Matthews K., Thomson S. (2016): The effect of the Common Agricultural Policy reforms on intentions towards food production: Evidence from livestock farmers. *Land Use Policy*, 50: 548–558.
- Barnes A.P., Thomson S.G., Ferreira J. (2020): Disadvantage and economic viability: Characterising vulnerabilities and

<https://doi.org/10.17221/408/2025-AGRICECON>

- resilience in upland farming systems. *Land Use Policy*, 96: 104698.
- Bojnec Š., Latruffe L. (2013): Farm size, agricultural subsidies and farm performance in Slovenia. *Land Use Policy*, 32: 207–217.
- Calafat-Marzal C., Pineiro V., Roig-Tierno N., Sánchez-García M. (2023): Demographic challenges and agricultural abandonment: Solutions for semi-arid wine-growing regions. *Journal of Rural Studies*, 104: 103159.
- Coppola A., Scardera A., Amato M., Verneau F. (2020): Income levels and farm economic viability in Italian farms: An analysis of FADN data. *Sustainability*, 12: 4898.
- Czubak W., Pawłowski K.P., Sadowski A. (2021): Outcomes of farm investment in Central and Eastern Europe: The role of financial public support and investment scale. *Land Use Policy*, 108: 105655.
- Damodaran A. (2025): Data Archives. [Dataset]. Stern School of Business, New York University. Available at https://pages.stern.nyu.edu/~adamodar/New_Home_Page/data-archived.html (accessed Feb 9, 2025).
- European Commission (n.d.): Key Policy Objectives of the CAP 2023–27. Available at https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/cap-2023-27/key-policy-objectives-cap-2023-27_en (accessed Apr 2, 2025).
- Fantechi T., Contini C., Casini L. (2026): From productivity to abandonment: Sub-national evidence from the Italian farm sector in the context of EU agricultural policy. *Journal of Rural Studies*, 121: 103949.
- Fawcett T. (2006): An introduction to ROC analysis. *Pattern Recognition Letters*, 27: 861–874.
- Guiomar N., Godinho S., Pinto-Correia T., Almeida M., Bartolini F., Bezák P., Biró M., Bjørkhaug H., Bojnec Š., Brunori G., Corazzin M., Czekaj M., Davidova S., Kania J., Kristensen S., Marracini E., Molnár Z., Niedermayr J., O'Rourke E., Ortiz-Miranda D., Wästfelt A. (2018): Typology and distribution of small farms in Europe: Towards a better picture. *Land Use Policy*, 75: 784–798.
- Hanley J.A., McNeil B.J. (1982): The meaning and use of the area under a receiver operating characteristic (ROC) Curve. *Radiology*, 143: 29–36.
- Hanley J.A., McNeil B.J. (1983): A method of comparing the areas under receiver operating characteristic curves derived from the same case. *Radiology*, 148: 839–843.
- Hlavsa T., Špička J., Štolbová M., Hloušková Z. (2020): Statistical analysis of economic viability of farms operating in Czech areas facing natural constraints. *Agricultural Economics – Czech*, 66: 193–202.
- Hloušková Z., Lekešová M., Prajerová A., Doucha T. (2022): Assessing the economic viability of agricultural holdings with the inclusion of opportunity costs. *Sustainability*, 14: 15087.
- Hooks T., Macken-Walsh Á., McCarthy O., Power C. (2017): Farm-level viability, sustainability and resilience: A focus on cooperative action and values-based supply chains. *Studies in Agricultural Economics*, 119: 123–129.
- Kelly E., Latruffe L., Desjeux Y., Ryan M., Uthes S., Diazabakana A., Dillon E., Finn J. (2018): Sustainability indicators for improved assessment of the effects of agricultural policy across the EU: Is FADN the answer? *Ecological Indicators*, 89: 903–911.
- Lafuente E., Leiva J.C., Moreno-Gómez J., Szerb L. (2020): A nonparametric analysis of competitiveness efficiency: The relevance of firm size and the configuration of competitive pillars. *BRQ Business Research Quarterly*, 23: 203–216.
- Lange A., Piore A., Siebert R., Zasada I. (2013): Spatial differentiation of farm diversification: How rural attractiveness and vicinity to cities determine farm households' response to the CAP. *Land Use Policy*, 31: 136–144.
- Latruffe L., Diazabakana A., Bockstaller C., Desjeux Y., Finn J., Kelly E., Uthes S. (2016): Measurement of sustainability in agriculture: A review of indicators. *Studies in Agricultural Economics*, 118: 123–130.
- Leonard B., Kinsella A., O'Donoghue C., Farrell M., Mahon M. (2017): Policy drivers of farm succession and inheritance. *Land Use Policy*, 61: 147–159.
- Lososová J., Zdeněk R. (2023): Simulation of the impacts of the proposed direct payment scheme – The case of the Czech Republic. *Agricultural Economics – Czech*, 69: 13–24.
- Loughrey J., O'Donoghue C., Conneely R. (2022): Alternative measures of family farm viability – Incorporating gap measures. *Journal of Rural Studies*, 89: 257–274.
- MacDonald J.M., Korb P., Hoppe R.A. (2013): Farm size and the organisation of U.S. crop farming. ERR-152. Washington, D.C., U.S. Department of Agriculture, Economic Research Service. Available at <https://www.ers.usda.gov/publications/45110>
- Mařík M., Čada K., Dušek D., Maříková P., Rýdlová B., Rajdl J. (2018): Business valuation methods – Valuation process, basic methods and procedures (Metody oceňování podniku – Proces ocenění, základní metody a postupy). 4th Ed. Prague, Ekopress: 494. (in Czech)
- Mugera A.W., Langemeier M.R., Ojede A. (2016): Contributions of productivity and relative price changes to farm-level profitability change. *American Journal of Agricultural Economics*, 98: 1210–1229.
- Neumaierová I., Neumaier I. (2002): Company performance and market value (Výkonnost a tržní hodnota firmy). Prague, Grada Publishing: 216. (in Czech)
- Poczta-Wajda A. (2020): Economic viability of family farms in Europe – A literature review. *Annals of the Polish Association of Agricultural and Agribusiness Economists*, 22: 161–172.

<https://doi.org/10.17221/408/2025-AGRICECON>

- Quintas-Soriano C., Buerkert A., Plieninger T. (2022): Effects of land abandonment on nature contributions to people and good quality of life components in the Mediterranean region: A review. *Land Use Policy*, 116: 106053.
- Ren C., Liu S., van Grinsven H., Reis S., Jin S., Liu H., Gu B. (2019): The impact of farm size on agricultural sustainability. *Journal of Cleaner Production*, 220: 357–367.
- Ren C., He L., Ma Y., Reis S., van Grinsven H., Lam S.K., Rosa L. (2024): Trade-offs in agricultural outcomes across various farm sizes. *Earth Critical Zone*, 1: 100007.
- Ribašauskienė E., Volkov A., Morkūnas M., Žičkienė A., Dabkiene V., Štreimikienė D., Baležentis T. (2024): Strategies for increasing agricultural viability, resilience and sustainability amid disruptive events: An expert-based analysis of relevance. *Journal of Business Research*, 170: 114328.
- Romero-Díaz A., Pérez-Morales A., Marín-Sanleandro P. (2024): Prevalence, causes, and consequences of agricultural land abandonment: A case study in the Region of Murcia, Spain. *Catena*, 241: 108071.
- Savickienė J., Miceikienė A. (2021): Predicting farm performance: Do indicators of farm economic viability and efficiency signify of probability of bankruptcy? *Agronomy Research*, 19: 1949–1961.
- Simensen T., Halvorsen R., Erikstad L. (2018): Methods for landscape characterisation and mapping: A systematic review. *Land Use Policy*, 75: 557–569.
- Slavickiene A., Savickiene J. (2014): Comparative analysis of farm economic viability assessment methodologies. *European Scientific Journal*, 10: 130–150.
- Špička J., Hlavsa T., Soukupová K., Štolbová M. (2019): Approaches to estimation the farm-level economic viability and sustainability in agriculture: A literature review. *Agricultural Economics – Czech*, 65: 289–297.
- SZIF (2024): List of Subsidy Beneficiaries. [Dataset]. Available at https://szif.gov.cz/en/list_of_beneficiaries (accessed Jan 19, 2025).
- Unal I. (2017): Defining an optimal cut-point value in ROC analysis: An alternative approach. *Computational and Mathematical Methods in Medicine*, 2017: 3762651.
- Varga M. (2017): Small farms survival and growth: Making investments despite credit constraints. *Sociologia Ruralis*, 57: 641–660.
- Vomáčka V., Leichmann J. (2022): Czech Republic: An open market dominated by large owners. In: *Acquisition of Agricultural Lands: Cross-border Issues from a Central European Perspective*. Legal Studies on Central Europe. Budapest, Central European Academic Publishing: 127–143.
- Vrolijk H.C.J., de Bont C.J.A.M., Blokland P.W., Soboh R.A.M.E. (2010): Farm viability in the European Union: Assessment of the impact of changes in farm payments. LEI report 2010-011. The Hague, LEI, Wageningen UR. Available at <https://research.wur.nl/en/publications/farm-viability-in-the-european-union-assessment-of-the-impact-of/>
- Zavadil T., Jančák V. (2024): Agricultural employment in Czechia: The role of family farms and geographical conditions (Zaměstnanost v zemědělství v Česku: Role rodinných farem a geografických podmínek). *Geografie*, 129: 299–322. (in Czech)
- Zdeněk R., Zeman P., Lososová J. (2024): Economic viability of farms. In: Opatrná E. (ed.): *Conference Proceedings – Inproforum 2024*. České Budějovice, Nov 7–8, 2024: 355–361.

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