

SCIENTIFIC ARTICLE

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Profitability Gaps and Convergence in Field-Crop Farms: A Decomposition for the Visegrad Countries, Austria, and Germany

ABSTRACT

This study investigates profitability gaps and convergence in field-crop farms across Austria, Germany, and the Visegrad countries, benchmarked against the EU27 average. Using harmonised Farm Accountancy Data Network data for 2013–2022 and a decomposition framework, profitability gaps are disaggregated into operational, financial, and fiscal components. The analysis reveals persistent cross-country disparities. Austria, Czechia and Hungary record above-average returns, while Germany, Poland, and Slovakia remain below. Operational components – revenues, costs, labour structures, and capital intensity – account for most cross-country differences, whereas financial and fiscal components play a minor role. Dynamic tests provide indicative evidence of partial convergence. Hungary maintains a comparative advantage, while Slovakia, initially the weakest, shows consistent signals pointing towards a catching-up process. The results suggest that harmonisation on its own is unlikely to eliminate profitability gaps; the paper's policy relevance lies mainly in how it highlights the importance of improving operational efficiency and labour productivity, as well as the need to target investment support without reinforcing inefficient capital accumulation.

ARTICLE INFO**Keywords:**

Common Agricultural Policy (CAP); profitability; convergence; decomposition; determinants; field-crops

JEL classifications:

Q12, Q14.

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Received: 10 October 2025; Revised: 8 January 2026; Accepted: 13 January 2026.

Introduction

Profitability is a key condition for farm viability and competitiveness, and agriculture is of particular importance due to its role in food supply and rural employment. Recent farmers' protests in Germany, France, and Poland have underlined this sensitivity (Finger *et al.*, 2024). In response, the Common Agricultural Policy (CAP) continues to emphasise productivity gains and the efficient use of production factors (European Commission, 2025). Assessing progress therefore requires profitability to be measured and the structural factors that shape it to be identified.

The present study addresses this gap by focusing on field-crop farms in Austria, Germany, and the Visegrad countries (Czechia, Hungary, Poland, and Slovakia). These countries share a long historical connection, similar environmental conditions, and comparable policy frameworks, despite having different institutional legacies and farm structures (Svatoš *et al.*, 2013). This makes them an appropriate setting for investigating return differentials under a common CAP framework. Using the EU27 average as a common external reference point, the study decomposes profitability gaps into operational, financial, and fiscal drivers and examines the significance of these gaps and whether they diminish over time. The analysis focuses exclusively on field-crop

farms, which are economically significant and structurally comparable across these countries, accounting for between 19% (Austria) and 54% (Hungary) of all farms, compared with 31% as the EU27 average, as shown in Table A1 in the appendix.

The theoretical foundations combine European integration theory (Balassa, 1961; Barro and Sala-i-Martin, 1992; Monge-Naranjo, 2020), which expects harmonised policy instruments to foster convergence, with institutional economics (North, 1990; Tambovtsev, 2021), which emphasises persistent structural divergence due to historical, institutional, and organisational factors. Both perspectives provide a basis for examining whether the CAP has contributed to the equalisation of economic outcomes, or whether profitability remains shaped by country-specific structures of land, labour, and capital use.

From a conceptual perspective, the Common Agricultural Policy may affect profitability convergence through several distinct channels. First, income support and coupled payments directly influence revenue stability and risk exposure. Second, agri-environmental and structural measures may affect cost structures, labour intensity, and capital use through compliance requirements and investment incentives. Third, the harmonisation of market regulations and eligibility rules provides a common institutional framework, while

national implementation, enforcement, and complementary policies may sustain cross-country heterogeneity. The empirical analysis undertaken in this paper does not isolate these channels causally, but the decomposition framework does nonetheless allow an assessment of whether observed profitability gaps are primarily associated with operational, structural, or financial components plausibly linked to these policy dimensions.

However, much of the existing research tends to focus on individual countries, specific farm types, or selected determinants of profitability, while comparatively few studies benchmark profitability across multiple Central European countries using a combined decomposition and convergence perspective. This study contributes to the literature in three ways. First, it provides a comparative analysis of profitability gaps among field-crop farms in Austria, Germany, and the Visegrad countries using harmonised FADN data within a unified accounting framework. Second, it applies a decomposition approach that allows the attribution of return differentials to operational, financial, and fiscal components. Third, it examines the dynamics of these gaps by assessing β - and σ -convergence patterns, thereby linking static structural differences with longer-term adjustment tendencies under the Common Agricultural Policy.

The next section sets out the methodological framework, introduces the relevant background and hypotheses, and describes the data and empirical approach. The results are then presented and discussed.

Methodology

Profitability in agriculture is commonly assessed using return on assets (RoA) and return on equity (RoE), which provide a standardised basis for comparing economic performance across farms and countries. These indicators have been widely applied in European agricultural studies across production systems, regions, and farm types (Bereznicka, 2018; Hyblova and Skalicky, 2018; Mijić and Jakšić, 2017; Parzonko *et al.*, 2023). Empirical research links profitability differences to farm structures such as labour productivity, capital intensity, cost levels, and subsidies. These relationships have been examined using DuPont-type decompositions, regression-based analyses, and dynamic panel models (Ladvenicová *et al.*, 2019; Szymanska, 2015; Góral and Soliwoda, 2021; Gómez-Limón *et al.*, 2023; Kryszak *et al.*, 2021). For Central and Eastern Europe, studies point to persistent cross-country differences shaped by labour structures, investment patterns, and institutional legacies (Aulová *et al.*, 2019; Lehenchuk *et al.*, 2023; Lososová *et al.*, 2023). While regression-based approaches are well suited to identifying statistical associations, decomposition frameworks offer a complementary perspective by attributing observed return differentials to structural components within an accounting identity (Kumbhakar *et al.*, 2023; Parzonko *et al.*, 2023; Száltekei *et al.*, 2024). Building on this literature, the present study applies a detailed decomposition approach tailored to field-crop farms to analyse cross-country profitability gaps and their evolution over time.

Against this background, the study formulates three hypotheses concerning the persistence of profitability gaps, their structural patterns, and their dynamic convergence:

- H1 (Existence of gaps): The RoA and RoE of field-crop farms in Austria, Germany, and the Visegrad countries exhibit statistically significant differences from the EU27 average.
- H2 (Structural associations): Observed profitability differentials are systematically associated with variations in revenues, subsidies, costs, labour, and capital intensities, as well as financial and fiscal conditions.
- H3 (Dynamics of gaps): Profitability gaps exhibit β - and σ -convergence tendencies over the period 2013–2022.

The study uses harmonised Farm Accountancy Data Network (FADN) data, providing a consistent cross-country basis for analysing profitability under a common policy framework. FADN publishes anonymised and aggregated accounting data from a large sample of holdings using defined sampling plans (FADN, 2020). It allows flexible selection by sector, country, and year and is one of the most reliable sources of European agricultural data (Vrolijk *et al.*, 2004).

The chosen ten-year period combines recency with a longer-term perspective. The most recent ten-year period, which includes data for all analysed countries and the EU27, covers the years 2013 to 2022. Annual FADN samples range from around 200 farms in Slovakia to more than 4,000 farms in Poland, representing between 1% and 23% of the farms in each country, as shown in Table A2 in the appendix. While crop composition differs somewhat across the countries, the dominant field-crops (mainly cereals and oilseeds) are broadly similar, ensuring comparability. The size structures of the agricultural units in this sample vary among the countries. Small family farms are common in Austria, Poland and Hungary, while larger transformed cooperatives dominate in Czechia and Slovakia, and Germany shows a mixture of the two types (Záhorský and Pokrivčák, 2017; Kryszak *et al.*, 2021). All monetary variables are expressed in euros. For cross-country comparisons, the figures for each country are benchmarked against the EU27 average for the same year. All ratios are calculated in nominal terms at current market prices, which is consistent with accounting practice. Year-by-year benchmarking against the EU27 average removes common nominal shocks (including EU-wide inflation), ensuring comparability within each year.

RoA, defined as EBIT/total assets, is refined here into operational components tailored to agriculture. Key determinants include revenues (Revenue Intensity, RI), subsidies (Subsidy Intensity, SI), and operating costs (Operating Cost Intensity, OCI) per hectare. Labour is represented by cost per worker (Average Labour Cost, ALC) and labour input per hectare (Labour Intensity, LI). The use of capital is captured via working capital (Current Asset Intensity, CAI) and fixed investments (Fixed Asset Intensity, FAI) per hectare. All ‘intensity’ measures used here are normalised per hectare to ensure comparability across farms of varying size. Together, these variables express RoA as an accounting identity of production inputs, cost structures, and support schemes, as shown in Equation (1).

$$RoA = EBIT/Total Assets = f(p^j) \quad j \in 1; \dots; J$$

$$= \left(\frac{RI + SI - OCI}{Land} - \frac{ALC \times LI}{Labour} \right) \times \frac{1}{\frac{CAI + FAI}{Invested Capital}}$$

Where:

ALC: Average Labour Cost (*Labour Cost / Labour Input*)

CAI: Current Assets Intensity (*Current Assets / Land*)

$f(p^j)$: Function of influencing parameters $j=1 \dots J$

FAI: Fixed Assets Intensity (*Fixed Assets / Land*)

LI: Labour Intensity (*Labour Input / Land*)

OCI: Operating Cost Intensity (*Operating Costs / Land*)

RI: Revenue Intensity (*Revenues / Land*)

RoA: Return on Assets (*EBIT / Total Assets*)

SI: Subsidy Intensity (*Subsidies / Land*)

This definition decomposes RoA into the basic factors of production – land, labour and capital – and into revenues, subsidies, and cost and asset structures. As all intensities are normalised per hectare, land cancels out in Equation (1), so RoA is expressed as an accounting identity of its operational components.

RoE is defined as net income relative to net worth and expressed as an accounting identity of RoA, financial leverage (FL), the interest rate on debt (IR), and the effective tax rate (TR). In the dataset, liabilities are always positive, so IR is well defined, while TR may be negative in loss years; these cases are retained. This structure reflects how operational returns are modified by financing and taxation. Equation (2) presents the relationship, providing a consistent basis for comparing RoE differences across countries.

$$RoE = Net Income/Net Worth = f(p^j) \quad j \in 1; \dots; J$$

$$= \left[\frac{RoA \times (1+FL) - FL \times IR}{\text{Operations}} \right] \times \frac{(1-TR)}{\text{Taxation}}$$

Where:

$f(p^j)$: Function of influencing parameters $j=1 \dots J$

FL: Financial Leverage (*Debt / Net Worth*)

IR: Interest rate on debt

RoA: Return on Assets (*EBIT / Total Assets*)

RoE: Return on Equity (*Net Income / Net Worth*)

TR: Effective tax rate

The variables entering the RoA and RoE decompositions are derived from standard FADN accounting items; their definitions, units, and construction formulas are documented in Table A3. The equations above serve as accounting identities structuring the decomposition.

Based on the previously mentioned RoA and RoE models, it is possible to analyse different levels of return caused by deviations in the drivers. The technique applied is a cumulative deviation decomposition, which is commonly used in management accounting (Bhimani *et al.*, 2023). Deviation (Δ) always refers to differences from the EU27 benchmark.

While the EU27 average is used as the primary benchmark to ensure a consistent external reference under the Common Agricultural Policy, the choice of the reference point may affect the magnitude of measured deviations. To assess the sensitivity of the results to this choice, all deviation and convergence analyses were replicated using the average of the six analysed countries as an alternative benchmark, shown in the appendix. This allows a comparison between an EU-wide reference and an internal peer-group average.

The total difference in return Δr is broken down into additive contributions Δr^j from specific explanatory parameters p^j . Each of these sub-deviations reflects the primary effect arising from the deviation of this country-specific parameter from the EU average, while all other factors are assumed to stay at the benchmark level. An additional synergy term Δr^{syn} captures interaction effects between the simultaneous deviations and cannot be assigned to a single parameter. The formal logic of this decomposition is summarised in Equation (3).

$$\Delta r_{C,t} = r_{C,t} - r_{EU,t} = \sum_{j=1}^J \Delta r_{C,t}^j + \Delta r_{C,t}^{syn}$$

where

$$\Delta r_t^j = f(p_{EU,t}^1, \dots; p_{C,t}^j, \dots; p_{EU,t}^J) - f(p_{EU,t}^1, \dots; p_{EU,t}^j, \dots; p_{EU,t}^J) \quad (3)$$

$$\Delta r_{C,t}^{syn} = r_{C,t} - r_{EU,t} - \sum_{j=1}^J \Delta r_t^j$$

Where:

Δr : Deviation of return between the analysed country and the EU average

C: Index of the analysed country

EU: Index of the European average (EU27)

$f(p^j)$: Function of influencing parameters $j=1 \dots J$

Δr^j : Contribution of specific parameter j to the total return differential

Δr^{syn} : Return differential of the synergistic interaction of all deviating parameters

t: Time index

This pragmatic deviation approach is order-independent, accommodates mixed additive and multiplicative structures with possibly non-positive values, and remains transparent for interpretation. The objective of this decomposition is descriptive rather than causal. It attributes observed profitability gaps to primary accounting effects of deviations in structural drivers, conditional on the underlying return identities. The resulting contributions therefore indicate how differences in revenues, costs, labour, capital, and financing are reflected in accounting outcomes. Alternatives such as LMDI (Ang, 2005) or Shapley decomposition (Shorrocks, 2013) are less suitable in this setting, as they typically rely on strictly multiplicative structures, non-negative values, or implicit ordering assumptions. By contrast, the approach used here allows for mixed additive and multiplicative relationships, accommodates negative values, and provides a complete decomposition of return differentials. The synergy term that is included quantifies the impact of the interaction between all deviating parameters (deviations of higher order), complementing their individual effects (primary deviations). Therefore, it does not

constitute an undesirable residual; rather, it shows the effects of favourable or unfavourable synergies between individual primary influences, which can reinforce or weaken each other. Splitting this synergy effect into individual components would be arbitrary and would risk overstating precision beyond what can be justified by the accounting identity. Figure 1 illustrates the whole analytic framework of returns and their influencing parameters.

The significance of cross-country deviations in returns and their drivers is tested using the Wilcoxon signed-rank test (Wilcoxon, 1945). This test was chosen for its non-parametric nature and its ability to withstand non-normal data, which are common in small-N, time-series contexts.

In order to analyse the model's dynamic aspects, the question of whether larger initial deviations Δ of these key figures shrink faster over time is tested. Based on the fundamental work of Barro and Sala-i-Martin (1992, 2004) and Sala-i-Martin (1996), the principles of β -convergence are applied by estimating the regression model in Equation (4):

$$G(|\Delta_{C,t}|) = |\Delta_{C,t+1}| - |\Delta_{C,t}| = \alpha + \beta|\Delta_{C,t}| + \varepsilon_{C,t} \quad (4)$$

Where:

$|\Delta_{C,t}|$: Absolute deviation of country C from the EU27 benchmark in year t

$G(|\Delta_{C,t}|)$: Change in the deviation between t and $t+1$

ε : Error term

A negative and statistically significant coefficient β indicates β -convergence (larger gaps diminish more rapidly). Applications of this approach to agricultural performance comparisons can be found, for example, in the work of Reztis (2010) and Gołaś (2019). Given the small number of years observed, these tests are interpreted as indicative rather than

as conclusive statistical evidence. As a robustness check, β -convergence was re-estimated using log-transformed gaps (testing $\beta < 1$); the results were qualitatively unchanged and, in part, even more significant.

As a complementary step, the regression model in Equation (5) tests whether the cross-country dispersion of standard deviations (SD) declines over time (σ -convergence), as proposed in the convergence literature (Baumol, 1986; Barro and Sala-i-Martin, 2004):

$$\sigma_t = SD(\Delta_{C,t}) = \alpha + bt + \varepsilon_t \quad (5)$$

Given the relatively short time span and the limited number of cross-country observations, the convergence tests are interpreted as indicative rather than as providing strong statistical inference. In line with the convergence literature, statistically weak or borderline significant coefficients are not taken as conclusive evidence of adjustment processes, but rather as signals of potential convergence tendencies. The analysis therefore focuses on the consistency of signs, magnitudes, and patterns across specifications, rather than on isolated significance levels.

As a robustness check, cross-country dispersion was also measured using the median absolute deviation (MAD); inference is based on a linear time trend in MAD, analogous to the SD-based test. A significantly negative slope coefficient ($b < 0$) is taken as an indication of σ -convergence (reducing dispersion across countries). All convergence tests are conducted using one-sided hypotheses, reflecting a theory-driven a priori expectation of convergence, based on the integration logic of the CAP (Balassa, 1961; Barro and Sala-i-Martin, 1992). All other tests remain two-sided.

This framework directly addresses H2, by attributing return gaps to operational, financial, and fiscal drivers, and H3, by testing whether these gaps diminish over time.

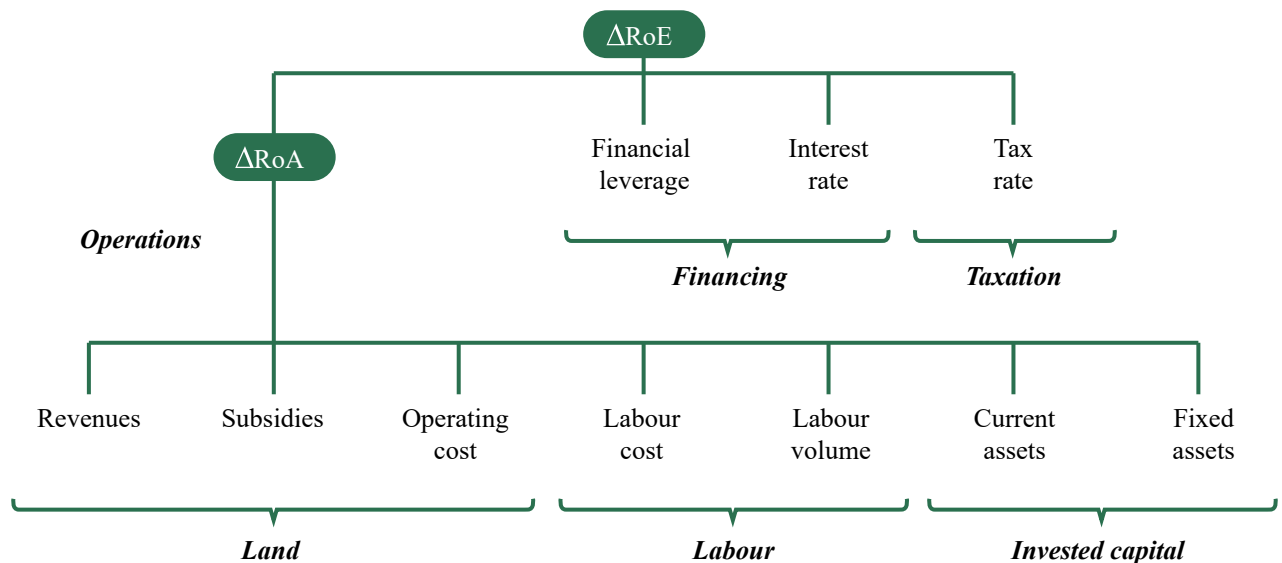


Figure 1: Analytic framework of the decomposition.

Source: Authors' own elaboration

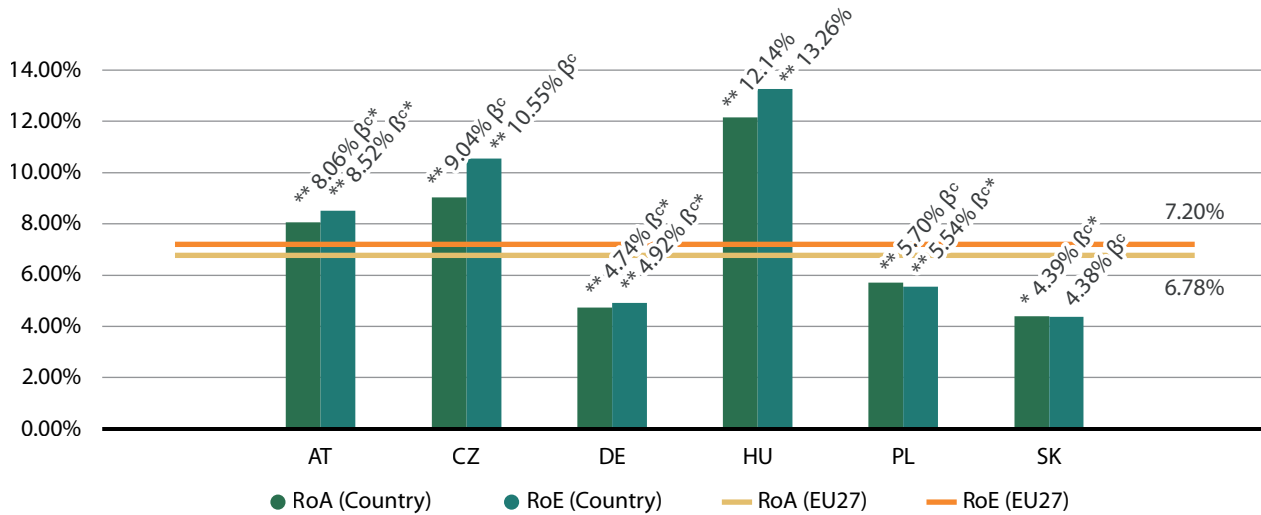


Figure 2: Average levels of profitability over the period 2013–2022, by country.

Significance of deviations (Wilcoxon, two-sided): * = $p < 0.05$; ** = $p < 0.01$; β -convergence (one-sided): β^c = weak ($\beta < 0$; $p < 0.10$); β^c = moderate ($\beta < 0$; $0.01 \leq p < 0.05$)
 Source: Authors' own calculations based on FADN (2025) data

Results

The first step of the analysis compares the average RoA and RoE levels of each country against the EU27 benchmark. Figure 2 shows that nearly all countries exhibit statistically significant deviations. Austria, Czechia, and Hungary perform above the EU average, while Germany, Poland, and Slovakia remain below. Hungary records the highest average RoA and RoE, whereas Slovakia displays the weakest performance. In terms of dynamics, the convergence tests indicate convergence tendencies, although the strength of the statistical evidence varies across countries and specifications. Convergence signals are present in Austria, Czechia, Germany, Poland, and Slovakia, but absent in Hungary. At the aggregate level, dispersion in RoA and RoE declines over time, providing indicative evidence consistent with σ -convergence. The MAD-based measure shows the same trend. Taken together, these findings support H1: profitability gaps remain significant across the analysed countries, while several countries exhibit tendencies towards narrowing gaps over time.

To understand the sources of these gaps, RoA is decomposed into its operational and structural drivers. Table A4 in the appendix summarises the country averages (2013–2022). The cross-country differences are sizeable: revenues and subsidies per hectare vary markedly; operating costs are high in Austria and low in Hungary; labour costs diverge depending on the balance between hired and family labour; and capital use is heterogeneous (Austria, Germany and Poland have high fixed assets; Slovakia low). Financial leverage is high in Slovakia and Czechia but minimal in Poland; taxation differences are small and tend to converge. Table A5 indicates frequent β -convergence in subsidies, operating costs, and labour intensity, while revenues and asset intensities show mixed patterns. The log-gap specification was consistent with these results.

Table 1 shows the impact of the underlying drivers on RoA; positive values indicate a comparative advantage relative to the EU27 average, while negative values point to a disadvantage. These contributions reflect descriptive accounting attributions based on the return identity and should not be interpreted as causal effects of the underlying

Table 1: Average RoA deviations from the EU27 average over the period 2013–2022 and their causes by country (in percentage points).

Deviations	Austria	Czechia	Germany	Hungary	Poland	Slovakia	σ -Conv.
ΔRoA^{RI}	**8.37%	-0.19%	**7.39%	** -3.34%	** -4.23%	-2.66%	-
+ ΔRoA^{SI}	**2.75%	**0.39%	**0.60%	-0.04%	-0.09%	** -0.65%	σ^c
+ ΔRoA^{OCI}	** -6.49%	** -1.13%	** -7.40%	**3.13%	**3.55%	0.09%	-
+ ΔRoA^{ALC}	*0.09%	** -3.24%	** -3.84%	** -0.73%	**1.18%	** -4.25%	-
+ ΔRoA^{LI}	**0.28%	**0.50%	**0.71%	**0.49%	** -1.75%	**0.55%	-
+ ΔRoA^{CAI}	** -1.40%	**0.29%	**0.44%	0.11%	**0.47%	**0.44%	-
+ ΔRoA^{FAI}	-1.08%	**6.83%	** -1.65%	**5.55%	** -1.34%	**11.60%	-
+ ΔRoA^{syn}	** -1.23%	-1.18%	**1.71%	*0.19%	**1.14%	** -7.51%	-
= ΔRoA	**1.29%	**2.27%	** -2.04%	**5.37%	** -1.08%	* -2.39%	σ^c

The reported components reflect the contributions of revenues (RI), subsidies (SI), operating costs (OCI), labour costs (ALC) and labour intensity (LI), fixed (FAI) and current asset intensity (CAI), as well as interaction (syn) effects, to the overall RoA gap. Positive values indicate an advantage relative to the EU27 average, negative values a disadvantage. Significance of deviations (Wilcoxon, two-sided): * = $p < 0.05$; ** = $p < 0.01$
 β -convergence (one-sided; cell shading): β^c = weak ($\beta < 0$; $p < 0.10$) β^c = moderate ($\beta < 0$; $0.01 \leq p < 0.05$) β^c = strong ($\beta < 0$; $p < 0.01$)
 σ -convergence (one-sided): σ^c = moderate ($b < 0$; $0.05 \leq p < 0.10$); - = no evidence of convergence
 Source: Authors' own calculations based on FADN (2025) data

drivers. In Austria and Germany, higher revenues and subsidies are offset by higher operating costs. In Hungary, Poland, and Slovakia, below-average revenues and subsidies reduce RoA, while lower capital intensity partly compensates in Czechia, Slovakia, and Hungary. High labour costs weigh on Czechia, Germany, and Slovakia. Synergy effects are substantial in Slovakia, where unfavourable combinations of structural factors produce a large negative impact.

The shading in Table 1, as in Tables 2 and A4, indicates the significance levels of the β -convergence tests, with the underlying coefficients and p-values reported in Table A5 in the appendix. RoA gaps tend to narrow in Austria, Czechia, Germany, Poland, and Slovakia, while no systematic adjustment is observed for Hungary. Cross-country dispersion of RoA declines over time, which is consistent with σ -convergence. Among the underlying drivers, labour use per hectare shows the most consistent convergence across all the countries. Subsidies also converge in most cases, often accompanied by a gradual adjustment in labour costs. Revenues and operating costs display convergence tendencies in several countries, whereas patterns of capital use remain mixed with barely any signals of convergence. Overall, RoA convergence is gradual but widespread, with Hungary main-

taining its advantage and Slovakia displaying consistent signals pointing towards a catching-up process.

Figure 3 illustrates the RoA decomposition for Hungary relative to the EU27 benchmark. Hungary's advantage of 5.37 percentage points is primarily explained by lower operating costs and reduced fixed asset intensity, partially offset by lower revenues. The figure shows how even moderate deviations in key operational parameters accumulate into significant differences in profitability.

Overall, the RoA deviations are statistically significant and systematically reflected in differences in structural components of the return identity. In this descriptive sense, H2 is supported.

The final step evaluates how RoA, financing, and taxation affect RoE. As shown in Table 2, most factors contribute significantly, but RoA is the dominant driver, while financial leverage, debt costs, and taxation have minor effects.

As a robustness check, the deviation and convergence analyses were repeated using the six-country average as an alternative benchmark (Appendix Tables A6 and A7). The resulting country rankings, the signs of profitability deviations, and the relative importance of the main drivers closely mirror the EU27-based results. In particular, countries per-

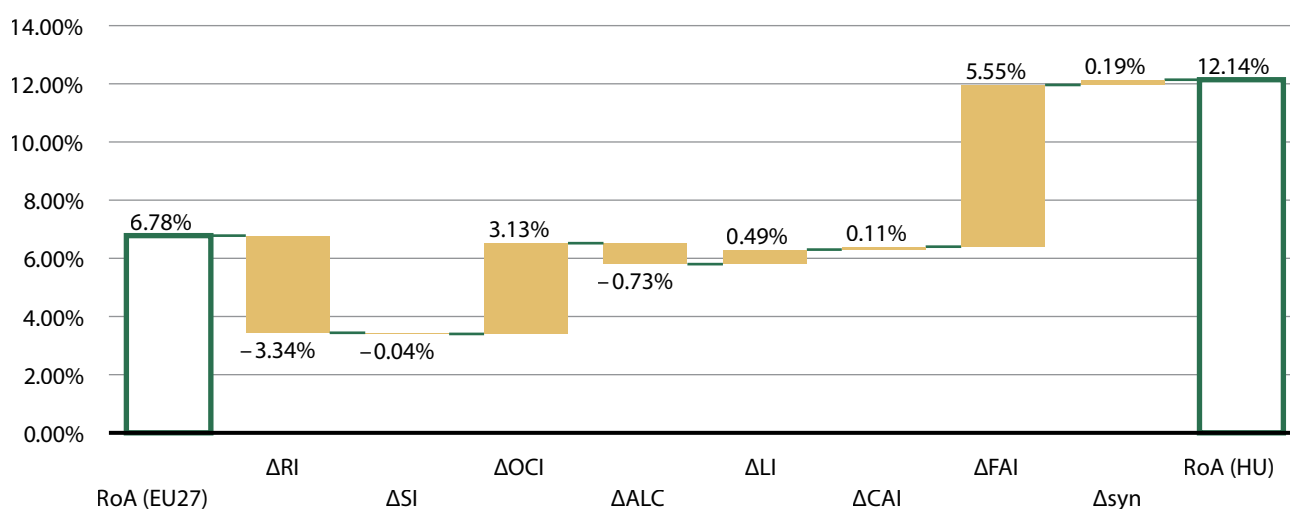


Figure 3: Average deviations of RoA between Hungary and the EU27 over the period 2013–2022 (in percentage points).

Source: Authors' own calculations based on FADN (2025) data

Table 2: Average RoE deviations from the EU27 average over the period 2013–2022, and their causes by country (in percentage points).

Deviations	Austria	Czechia	Germany	Hungary	Poland	Slovakia	σ -Conv.
Δ RoE ^{RoA}	**1.43%	**2.52%	**−2.29%	**5.99%	**−1.21%	−2.67%	σ^{c*}
+ Δ RoE ^{FL}	**−0.15%	**0.55%	**0.28%	**−0.14%	**−0.50%	**1.35%	−
+ Δ RoE ^{IR}	**0.08%	−0.06%	**0.01%	*0.06%	**−0.17%	*−0.02%	−
+ Δ RoE ^{TR}	0.02%	0.03%	−0.25%	**0.20%	−0.03%	1.25%	−
+ Δ RoE ^{syn}	**−0.07%	**0.31%	−0.04%	−0.05%	**0.25%	−2.73%	−
= Δ RoE	**1.31%	**3.35%	**−2.29%	**6.06%	**−1.66%	−2.82%	σ^{c**}

The reported components reflect the contributions of financial leverage (FL), interest (IR) and tax rates (TR), as well as interaction (syn) effects, to the overall RoE gap. Positive values indicate an advantage relative to the EU27 average, negative values a disadvantage.

Significance of deviations (Wilcoxon test, two-sided): * = $p < 0.05$; ** = $p < 0.01$

β -convergence (one-sided; cell shading): = β^c (weak: $\beta < 0$; $p < 0.10$) = β^{c*} (moderate: $\beta < 0$; $0.01 \leq p < 0.05$) = β^{c**} (strong: $\beta < 0$; $p < 0.01$)

σ -convergence (one-sided): σ^{c**} = strong ($b < 0$; $p < 0.01$); σ^{c*} = moderate ($b < 0$; $0.05 \leq p < 0.10$); − = no evidence of convergence

Source: Authors' own calculations based on FADN (2025) data

forming above or below the EU27 average show the same qualitative positioning relative to the six-country average. Similarly, the patterns of β - and σ -convergence for RoA and RoE remain qualitatively unchanged when the benchmark is altered, indicating that the convergence signals are not driven by the choice of reference point.

Signals indicative of RoE convergence can be found in Austria, the Czechia, Germany, Poland and Slovakia, while such signals are absent in Hungary. These patterns largely mirror those for RoA, underlining the central role of RoA in driving profitability differences, while financial and fiscal factors remain marginal.

Discussion and Conclusions

Even where structural and climatic conditions are comparable, significant profitability differences persist. Austria, Czechia, and Hungary record systematic advantages relative to the EU27 benchmark, while Germany, Poland, and Slovakia remain below average. These findings indicate that a harmonised policy framework does not automatically equalise farm performance in economic terms, even though several indicators point towards gradual convergence in selected dimensions.

The decomposition shows that profitability gaps are primarily driven by operational and structural factors rather than financial or fiscal conditions, indicating that differences in production performance matter more than financing or taxation, which is consistent with benchmarking evidence from typical-farm analyses (Deblitz, 2024). The findings reflect structural associations in accounting outcomes. References to institutional settings or management practices are intended as contextual interpretations rather than empirically identified causal mechanisms. High revenue intensity, as in Austria, or moderate operating costs, as in Hungary, create notable advantages. Subsidy intensity contributes positively but cannot offset weak operational efficiency, as seen in Slovakia. Austria and Germany combine high subsidies with strong revenues, while Slovakia and Poland suffer from lower values in both. Investment strategies also matter: undercapitalisation of fixed assets in Czechia, Slovakia, and Hungary may support short-term returns but risks undermining long-term competitiveness, echoing evidence that investment support can raise output and employment while at the same time weakening labour productivity (Pokrivčák *et al.*, 2025). Labour structures further reinforce divergence. Larger farms with more hired labour, such as those in Germany, Czechia, and Slovakia, face higher average costs, while smallholders in Austria and Poland benefit from unpaid family labour, a pattern that is consistent with evidence showing systematic efficiency differences between family-based and corporate farm structures, particularly in the allocation of labour and capital (Dong, 2023). These structural contrasts are only partly mitigated by subsidies, loans, and tax breaks, and point to a need for a more differentiated CAP that supports efficiency, labour productivity, and balanced investment.

The dynamic analysis indicates partial and uneven convergence, with adjustment occurring in some dimensions while

remaining limited in others. The robustness checks based on the six-country average confirm that the main conclusions regarding profitability gaps and convergence tendencies are not sensitive to the choice of benchmark. Labour intensity, revenues, subsidies, and operating costs tend to adjust over time towards the EU benchmark, and RoA dispersion has narrowed over time. However, the country profiles diverge: Hungary combines strong profitability with limited convergence, while Slovakia, despite low initial levels, shows broad catching-up signals across revenues, subsidies, costs, and labour use. The CAP has thus promoted harmonisation in selected dimensions, but institutional constraints still prevent full alignment, implying that convergence in accounting indicators does not necessarily translate into uniform farm structures or strategies. Profitability patterns are consistent with differences in management practices, ownership structures, and national institutions, which are discussed here as descriptive association rather than causal evidence. Taken together, these findings are consistent with integration theory in pointing to partial convergence, while also aligning with institutional economics in highlighting persistent structural divergence.

The results align with studies stressing operational drivers, subsidies, and farm size (Hyblova and Skalicky, 2018; Száltelegi *et al.*, 2024), and with recent cross-country benchmarking assessments indicating that government payments shape profitability outcomes, while operational performance remains decisive (Deblitz, 2024). The prominent role of fixed-asset investment compared with working capital echoes the findings of Mijić and Jakšić (2017) and Lehenchuk *et al.* (2023). By contrast, the minor role of financial and fiscal conditions diverges from some earlier findings (Bereznicka, 2018; Kryszak *et al.*, 2021; Mijić and Jakšić, 2017).

This study has several limitations. It focuses on field-crop farms in six Central European countries, so it may not be possible to generalise the results to other farm types or EU regions. The ten-year window restricts the power of the convergence tests. FADN data focus on commercially active farms and therefore do not fully capture heterogeneity among smaller and semi-subsistence holdings. Labour input is measured in Annual Work Units (AWU), which may understate unpaid, part-time or seasonal labour, particularly where family labour plays an important role. Although the dominant crop types are broadly similar, residual differences in crop composition (e.g. cereals versus oilseeds or sugar beet) may affect intensity indicators and observed returns. In addition, cross-country differences in asset valuation and depreciation practices may influence capital-based profitability measures; however, the consistency of results across alternative benchmarks and specifications suggests that the main comparative patterns are not driven by these measurement issues. Finally, the analysis is framed by the CAP but does not isolate specific instruments. Market integration, climate shocks, or national implementation quality may also shape outcomes.

Despite their EU membership, proximity, and broadly similar environments, the profitability gaps among Austria, Germany, and the Visegrad countries remain substantial. Convergence is evident in labour use, subsidies, and operating costs, but it is partial and uneven: Hungary continues

to hold a persistent lead, while Slovakia shows consistent signals pointing towards a catching-up process. The CAP has thus promoted harmonisation in selected dimensions, yet structural and institutional constraints remain decisive. From a policy perspective, the findings indicate that harmonisation has reduced disparities in selected dimensions, but persistent profitability gaps remain closely linked to operational and structural factors. Policy effectiveness therefore depends less on further uniform measures than on improving operational efficiency and labour productivity, as well as on the design of investment support aligned with country-specific production structures, particularly under Pillar II measures targeting capital deepening and labour-saving technologies. In this context, recent evidence suggests that targeted innovation and cooperation can enhance profitability, provided that support schemes are linked to actual experimentation and performance-based evaluation rather than uniform uptake (Bonfiglio, 2023). Against this background, the study provides a comparative and descriptive assessment of profitability patterns among Central European field-crop farms within a common policy setting.

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Appendix

Table A1: Average percentage of field-crop farms in relation to all farms, 2013–2022

Area/Country	Share of field-crop farms
European Union (EU27)	31%
Austria	19%
Czechia	38%
Germany	27%
Hungary	54%
Poland	44%
Slovakia	52%

Source: Authors' own calculations based on FADN (2025) data

Table A2: FADN sample size and coverage

Area/Country	Annual FADN sample size	Average number of farms represented	Average coverage	Average economic size (Standard output in TEUR)
EU27	20,000–30,000	1,276,822	1.6%–2.3%	59
AT	200–500	14,512	1.4%–3.4%	64
CZ	200–500	6,308	3.2%–7.9%	237
DE	2,000–3,000	45,912	4.4%–6.5%	211
HU	900–1,800	56,573	1.6%–3.2%	54
PL	3,700–4,700	312,793	1.2%–1.5%	23
SK	200–500	2,179	9.2%–22.9%	337

Source: Authors' own calculations based on FADN (2025) data

Table A3: Definitions of the determinants of profitability based on FADN data

Variable (Symbol)	Unit	Notes	Calculation based on FADN data
Revenue Intensity (RI)	TEUR/ha	Revenues include value of total output (SE131) and the VAT balance on current operations (SE395), taking into account the special agricultural VAT system of several countries. These revenues are divided by the land used (SE025).	$= (SE131 + SE395) / 1000 / SE025$
Subsidy Intensity (SI)	TEUR/ha	The total amount of subsidies on current operations (SE605) and on investments (SE405) is divided by land used (SE025).	$= (SE405 + SE605) / 1000 / SE025$
Operating Cost Intensity (OCI)	TEUR/ha	Operating costs include intermediate consumption (SE275), depreciation (SE360) and rents paid (SE375). These amounts are divided by the land used (SE025).	$= (SE275 + SE360 + SE375) / 1000 / SE025$
Average Labour Cost (ALC)	TEUR/AWU	Wages paid (SE370) are divided by the total labour input (SE010) measured in annual work units (AWU).	$= SE370 / 1000 / SE010$
Labour Intensity (LI)	AWU/ha	Total labour input (SE010) is divided by the land used (SE025).	$= SE010 / SE025$
Current Assets Intensity (CAI)	TEUR/ha	Total current assets (SE465) are divided by the land used (SE025).	$= SE465 / 1000 / SE025$
Fixed Assets Intensity (FAI)	TEUR/ha	Total fixed assets (SE441) are divided by the land used (SE025).	$= SE441 / 1000 / SE025$
Financial Leverage (FL)	ratio	Total liabilities (SE485) in relation to the net worth, represented by total assets (SE441 + SE465) minus total liabilities (SE485).	$= SE485 / (SE441 + SE465 - SE485)$
Interest rate on debt (IR)	ratio	Interest paid (SE380) is divided by total liabilities (SE485)	$= SE380 / SE485$
Effective tax rate (TR)	ratio	Taxes (SE390) are divided by earnings before taxes, which is the balance of all other costs and revenues considered above.	$= SE390 / (SE131 + SE395 + SE405 + SE605 - SE275 - SE360 - SE370 - SE375 - SE380)$

Source: Authors' own processing

Table A4: Average determinants of profitability over the period 2013–2022, by country

Area/Country	Revenue Intensity [TEUR/ha]	Subsidy Intensity [TEUR/ha]	Operating Cost Intensity [TEUR/ha]	Average Labour Cost [TEUR/AWU]	Labour Intensity [AWU/ha]
EU27	1.378	0.303	1.118	3.747	0.028
Austria	**1.943	**0.486	**1.552	**3.531	**0.023
Czechia	1.365	**0.329	**1.195	**11.549	**0.019
Germany	**1.871	**0.343	**1.614	**12.845	**0.015
Hungary	**1.157	0.301	**0.912	**5.523	**0.019
Poland	**1.096	0.297	**0.880	**0.926	**0.060
Slovakia	**1.199	**0.259	1.112	**13.989	**0.018
σ -conv.	–	–	–	–	σ^{c**}
Area/Country	Current Assets Intensity [TEUR/ha]	Fixed Assets Intensity [TEUR/ha]	Financial Leverage [ratio]	Interest rate on debt [ratio]	Effective tax rate [ratio]
EU27	1.267	5.433	0.177	0.023	0.050
AT	**3.047	**6.712	**0.132	**0.018	0.047
CZ	**1.002	**2.067	**0.311	*0.027	0.045
DE	**0.879	**7.605	**0.238	0.022	**0.082
HU	1.186	**2.427	**0.140	0.020	**0.023
PL	**0.837	**7.076	**0.062	**0.033	0.055
SK	**0.872	**1.193	**0.491	0.025	-0.157 ¹
σ -conv.	σ^{c*}	σ^{c**}	–	–	–

 Significance of deviations (Wilcoxon, two-sided): * = $p < 0.05$; ** = $p < 0.01$
 β -convergence (one-sided; cell shading): = β^c (weak: $\beta < 0$; $p < 0.10$) = β^c (moderate: $\beta < 0$; $0.01 \leq p < 0.05$) = β^{c**} (strong: $\beta < 0$; $p < 0.01$)

 σ -convergence (one-sided): σ^c = moderate ($b < 0$; $0.05 \leq p < 0.10$); σ^{c*} = strong ($b < 0$; $p < 0.01$); – = no evidence of convergence

Source: Authors' own calculations based on FADN (2025) data

¹ A negative effective tax rate is the result of negative earnings before taxes, with several taxes still being paid.

Table A5: Slope coefficients and p-values of the convergence analyses

Variable		Austria	Czechia	Germany	Hungary	Poland	Slovakia	σ -Conv.
Δ RI	β ; b	0.16	-1.11	-0.70	-0.64	-0.57	-1.41	0.01
	(p)	(0.623)	(0.010)	(0.009)	(0.032)	(0.174)	(0.004)	(0.833)
Δ SI	β ; b	-0.74	-0.69	-1.16	-0.32	-0.65	-0.96	0.00
	(p)	(0.004)	(0.047)	(0.008)	(0.346)	(0.057)	(0.013)	(0.118)
Δ OCl	β ; b	-1.01	-1.07	-0.66	-0.07	-0.90	-0.72	0.00
	(p)	(0.041)	(0.063)	(0.069)	(0.343)	(0.022)	(0.036)	(0.803)
Δ ALC	β ; b	-1.08	0.28	0.01	0.08	0.10	0.09	0.24
	(p)	(0.020)	(0.998)	(0.506)	(0.58)	(0.695)	(0.839)	(1.000)
Δ LI	β ; b	-0.90	-0.82	-0.42	-0.50	-0.16	-1.11	0.00
	(p)	(0.025)	(0.035)	(0.098)	(0.093)	(0.161)	(0.002)	(0.001)
Δ CAI	β ; b	-0.41	-0.62	-0.04	-0.43	-0.69	-0.03	-0.03
	(p)	(0.111)	(0.035)	(0.427)	(0.178)	(0.035)	(0.476)	(0.010)
Δ FAI	β ; b	-0.22	-0.91	-0.94	0.14	-0.38	-0.50	-0.07
	(p)	(0.226)	(0.009)	(0.001)	(0.758)	(0.114)	(0.124)	(0.005)
Δ FL	β ; b	-0.09	-0.78	-0.08	-0.34	-0.54	-0.67	0.01
	(p)	(0.365)	(0.033)	(0.380)	(0.118)	(0.001)	(0.009)	(0.951)
Δ IR	β ; b	-0.52	0.07	-0.55	-0.54	0.32	-1.19	0.00
	(p)	(0.072)	(0.585)	(0.063)	(0.078)	(0.774)	(0.000)	(0.977)
Δ TR	β ; b	-1.01	-0.42	-0.88	-0.52	-0.88	-1.27	-0.03
	(p)	(0.016)	(0.121)	(0.005)	(0.112)	(0.021)	(0.005)	(0.194)
Δ RoA	β ; b	-0.85	-0.69	-0.48	-0.72	-0.70	-0.86	0.00
	(p)	(0.033)	(0.053)	(0.049)	(0.179)	(0.054)	(0.032)	(0.018)
Δ RoA ^{RI}	β ; b	-0.20	-1.13	-0.57	-0.55	-0.39	-1.37	0.00
	(p)	(0.355)	(0.009)	(0.023)	(0.043)	(0.272)	(0.004)	(0.680)
Δ RoA ^{SI}	β ; b	-0.68	-0.68	-1.38	-0.42	-0.62	-1.03	0.00
	(p)	(0.005)	(0.049)	(0.003)	(0.282)	(0.064)	(0.008)	(0.041)
Δ RoA ^{OCl}	β ; b	-1.03	-1.02	-0.95	-0.05	-1.16	-0.70	0.00
	(p)	(0.018)	(0.052)	(0.015)	(0.385)	(0.015)	(0.039)	(0.486)
Δ RoA ^{ALC}	β ; b	-1.02	0.14	-0.53	-0.35	-0.50	-0.21	0.00
	(p)	(0.024)	(0.900)	(0.080)	(0.213)	(0.055)	(0.045)	(1.000)
Δ RoA ^{LI}	β ; b	-0.69	-0.87	-0.91	-0.89	-0.99	-1.01	0.00
	(p)	(0.047)	(0.009)	(0.018)	(0.028)	(0.019)	(0.000)	(0.179)
Δ RoA ^{CAI}	β ; b	-0.21	-0.39	0.32	-0.17	-0.33	0.39	0.00
	(p)	(0.336)	(0.124)	(0.933)	(0.354)	(0.166)	(0.807)	(0.256)
Δ RoA ^{FAI}	β ; b	-0.10	-1.21	-0.07	-0.15	0.14	-0.37	0.00
	(p)	(0.362)	(0.001)	(0.419)	(0.221)	(0.660)	(0.203)	(0.707)
Δ RoA ^{syn}	β ; b	-0.77	-0.88	-1.27	-0.98	-0.50	-1.34	0.00
	(p)	(0.091)	(0.016)	(0.004)	(0.019)	(0.191)	(0.003)	(0.289)
Δ RoE	β ; b	-0.89	-0.70	-0.54	-0.85	-0.67	-0.73	0.00
	(p)	(0.031)	(0.050)	(0.033)	(0.131)	(0.027)	(0.060)	(0.009)
Δ RoE ^{RoA}	β ; b	-0.85	-0.70	-0.47	-0.86	-0.70	-0.86	0.00
	(p)	(0.033)	(0.051)	(0.052)	(0.152)	(0.054)	(0.032)	(0.025)
Δ RoE ^{EL}	β ; b	-0.15	-0.36	0.24	-0.43	0.21	-0.23	0.00
	(p)	(0.301)	(0.218)	(0.866)	(0.072)	(0.832)	(0.086)	(1.000)
Δ RoE ^{IR}	β ; b	-1.44	-0.02	-1.79	-1.36	0.47	-5.60	0.00
	(p)	(0.194)	(0.981)	(0.117)	(0.215)	(0.655)	(0.001)	(0.990)
Δ RoE ^{TR}	β ; b	-1.04	-0.46	-0.52	-0.81	-0.94	-1.29	0.00
	(p)	(0.014)	(0.108)	(0.060)	(0.037)	(0.015)	(0.005)	(0.207)
Δ RoE ^{syn}	β ; b	-0.59	-0.70	0.17	-0.65	-0.40	-1.22	0.00
	(p)	(0.074)	(0.052)	(0.789)	(0.074)	(0.033)	(0.006)	(0.181)

Source: Authors' own calculations based on FADN (2025) data

Entries report estimated slope coefficients β (or b for σ -convergence) with one-sided p-values in parentheses. Negative and statistically significant coefficients indicate convergence. The β -convergence results are robust to using log-transformed gaps (test against $\beta < 1$); the σ -convergence results are robust to using MAD instead of SD. Significance is indicated numerically here; shading is applied only in summary tables (Tables 1, 2, A4) to aid interpretation.

Table A6: Average RoA deviations relative to the six-country average over the period 2013–2022 and their causes by country (in percentage points)

The table follows the same structure as Table 1 to facilitate comparison across benchmarks.

Deviations	Austria	Czechia	Germany	Hungary	Poland	Slovakia	σ -Conv.
$\Delta\text{RoA}^{\text{RI}}$	**8.61%	**−1.23%	**7.54%	**−4.91%	**−5.92%	**−4.09%	–
+ $\Delta\text{RoA}^{\text{SI}}$	**2.61%	−0.12%	*0.13%	**−0.62%	**−0.67%	**−1.32%	σ^{c}
+ $\Delta\text{RoA}^{\text{OCI}}$	**−5.92%	*0.28%	**−6.96%	**5.23%	**5.68%	**1.69%	$\sigma^{\text{c**}}$
+ $\Delta\text{RoA}^{\text{ALC}}$	**2.00%	**−1.51%	**−2.17%	**1.13%	**3.14%	**−2.58%	–
+ $\Delta\text{RoA}^{\text{LI}}$	**0.37%	**0.91%	**1.44%	**0.90%	**−4.66%	**1.05%	–
+ $\Delta\text{RoA}^{\text{CAI}}$	**−1.39%	**0.33%	**0.48%	**0.14%	**0.52%	**0.49%	–
+ $\Delta\text{RoA}^{\text{FAI}}$	**−1.65%	**4.38%	**−2.07%	**3.39%	**−1.84%	**8.07%	–
+ $\Delta\text{RoA}^{\text{syn}}$	**−3.91%	**−1.34%	**−0.98%	−0.47%	**2.09%	**−6.25%	–
= ΔRoA	*0.72%	**1.70%	**−2.61%	**4.80%	**−1.65%	*−2.96%	–

The reported components reflect the contributions of revenues (RI), subsidies (SI), operating costs (OCI), labour costs (ALC) and labour intensity (LI), fixed (FAI) and current asset intensity (CAI), as well as interaction (syn) effects, to the overall RoA gap. Positive values indicate an advantage relative to the EU27 average, negative values a disadvantage.

Significance of deviations (Wilcoxon, two-sided): * = $p < 0.05$; ** = $p < 0.01$

β -convergence (one-sided; cell shading): = β^{c} (weak: $\beta < 0$; $p < 0.10$) = β^{c} (moderate: $\beta < 0$; $0.01 \leq p < 0.05$) = $\beta^{\text{c**}}$ (strong: $\beta < 0$; $p < 0.01$)

σ -convergence (one-sided): $\sigma^{\text{c**}}$ = strong ($b < 0$; $p < 0.01$); σ^{c} = moderate ($b < 0$; $0.05 \leq p < 0.10$); – = no evidence of convergence

Source: Authors' own calculations based on FADN (2025) data

Table A7: Average RoE deviations relative to the six-country average over the period 2013–2022, and their causes by country (in percentage points)

The structure corresponds to Table 2 to allow a direct comparison of results.

Deviations	Austria	Czechia	Germany	Hungary	Poland	Slovakia	σ -Conv.
$\Delta\text{RoE}^{\text{RoA}}$	**0.93%	**2.09%	**−3.13%	**5.83%	**−1.98%	−3.74%	–
+ $\Delta\text{RoE}^{\text{FL}}$	**−0.45%	**0.38%	*0.05%	**−0.42%	**−0.81%	*1.25%	–
+ $\Delta\text{RoE}^{\text{IR}}$	**0.13%	−0.06%	**0.03%	*0.11%	−0.21%	0.00%	–
+ $\Delta\text{RoE}^{\text{TR}}$	*−0.17%	*−0.16%	−0.47%	*0.03%	*−0.23%	1.00%	–
+ $\Delta\text{RoE}^{\text{syn}}$	0.22%	*0.44%	0.58%	−0.15%	*0.91%	−2.00%	–
= ΔRoE	0.66%	**2.69%	**−2.94%	**5.40%	**−2.32%	*−3.48%	–

The reported components reflect the contributions of financial leverage (FL), interest (IR) and tax rates (TR), as well as interaction (syn) effects, to the overall RoE gap. Positive values indicate an advantage relative to the EU27 average, negative values a disadvantage.

Significance of deviations (Wilcoxon test, two-sided): * = $p < 0.05$; ** = $p < 0.01$

β -convergence (one-sided; cell shading): = β^{c} (weak: $\beta < 0$; $p < 0.10$) = β^{c} (moderate: $\beta < 0$; $0.01 \leq p < 0.05$) = $\beta^{\text{c**}}$ (strong: $\beta < 0$; $p < 0.01$)

σ -convergence (one-sided): – = no evidence of convergence

Source: Authors' own calculations based on FADN (2025) data