

THESES OF THE DOCTORAL (PhD) DISSERTATION

INTEGRATION AND TRANSFORMATION IN THE UKRAINIAN DAIRY SECTOR: A COMPARATIVE STUDY WITH HUNGARY AND POLAND IN THE CONTEXT OF THE EU MARKET

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1. INTRODUCTION OF THE TOPICS AND OBJECTIVE

Global demographic projections indicate that by 2050, the world population will surpass 9.7 billion people, necessitating a 70% increase in food production to satisfy growing consumption requirements (FAO, 2018). This demographic shift will profoundly reshape consumption patterns and place unprecedented demands on agricultural systems worldwide. To address these emerging food security challenges, total factor productivity in agricultural production must increase by at least 1.28% annually over the coming decades.

The agricultural sector, as a strategic component of the global economy, faces multifaceted challenges including climate change, resource scarcity, volatile markets, and evolving consumer preferences, all of which require adaptive and innovative approaches to ensure sustainable food production.

Within this global context, the dairy industry occupies a pivotal position within agricultural systems, characterised by intricate production processes, complex stakeholder relationships and substantial socioeconomic implications for rural communities. As an essential component of food security architecture and rural economic development, the dairy sector's structure, performance and resilience merit thorough academic investigation. The global dairy landscape has undergone significant transformation in recent decades, with increasing consolidation, technological advancement, and changing consumption patterns reshaping industry dynamics across different regions.

Since the collapse of centrally planned economies in the early 1990s, Eastern European dairy landscapes have undergone profound transformations. These include fundamental restructuring of production systems, reconfiguration of market relationships and adaptation to novel policy environments. The trajectories and outcomes of these changes exhibit considerable variation across countries. Despite geographical proximity and shared historical experiences, Ukraine, Poland and Hungary have developed markedly distinct dairy sectors with different structural characteristics, integration mechanisms and economic performance metrics.

In Ukraine specifically, the agricultural landscape features farm units averaging 100-200 hectares, substantially exceeding the typical European farm size of approximately 50 hectares. Through large-scale dairy operations housing 500-2000 cows, Ukrainian

agribusiness enterprises are pursuing competitive positioning in international markets. Ukraine possesses abundant feed resources, including domestic maize and grain production, alongside substantial sunflower cultivation for feed formulation.

Integration within agricultural value chains has emerged as a decisive strategy for enhancing competitiveness, improving operational efficiency and ensuring long-term sustainability. In the dairy sector specifically, integration processes manifest across multiple dimensions: horizontally amongst similar entities (such as producer cooperatives), vertically across value chains (from farm to retail) and institutionally through policy frameworks and regulatory mechanisms. These integration forms create diverse organisational arrangements that significantly influence market performance, product quality and sectoral resilience.

Despite their growing significance, these structural transformations remain insufficiently documented in the academic literature. Whilst integrated agricultural structures in developing economies have attracted research attention, this has predominantly focused on land acquisition controversies rather than comprehensive organisational analysis. Consequently, there exists limited scholarly understanding of agroholdings' internal organisational structures, management approaches, operational efficiency metrics and the institutional preconditions that facilitate their development.

This research addresses several interconnected research gaps. First, while substantial literature examines dairy sector dynamics in established EU member states, comparatively less scholarly attention has focused on the specific challenges and opportunities within Eastern European contexts, particularly regarding integration mechanisms. Second, the comparative performance of dairy enterprises across different market structures and policy environments remains inadequately documented, limiting the evidence base for strategic decision-making. Third, the impacts of external shocks – including the recent Russian aggression against Ukraine – on dairy value chains have not been systematically analysed within integration theory frameworks.

To address these gaps, this dissertation aims to provide a comprehensive comparative analysis of dairy sectors in Ukraine, Hungary, and Poland, with particular attention to integration mechanisms, market relationships, and adaptation strategies.

The central objectives are to:

1. Analyse the structural characteristics, market concentration, and financial performance of dairy enterprises across Ukraine, Hungary, and Poland (2016-2020).
2. Evaluate milk price dynamics and market relationships between these Eastern European countries and the broader EU market.
3. Assess the impact of the Russian invasion on Ukraine's dairy industry, documenting production losses, infrastructure damage, and market disruptions.
4. Identify effective integration mechanisms and policy frameworks that could enhance the competitiveness and sustainability of the Ukrainian dairy sector.

To achieve these objectives, this dissertation addresses four primary **research questions**:

1. What is the relationship between enterprise scale and financial performance in the dairy sectors of Ukraine, Hungary, and Poland, and how do these relationships differ across the three countries' distinct market structures?
2. How have milk prices in Ukraine, Hungary, and Poland evolved relative to EU averages between 2014-2024, and what factors determine the degree of price integration or divergence in these markets?
3. What are the primary impacts of the full-scale Russian invasion on Ukraine's dairy sector in terms of production capacity, market structure, and operational efficiency, and what adaptation strategies have proven most effective for ensuring sectoral resilience?
4. Which integration mechanisms and policy frameworks from Hungarian and Polish dairy sectors could be effectively adapted to support the modernisation and reconstruction of Ukraine's dairy industry in the context of European integration aspirations?

2. MATERIAL AND METHODS

The comprehensive analysis of dairy sectors requires robust methodological approaches that can adequately capture the multifaceted nature of production systems, market dynamics, and integration processes. This dissertation employs a mixed-methods approach that combines quantitative and qualitative techniques to analyse structural changes, economic performance, and transformation processes in the dairy industries of Ukraine and the European Union.

The theoretical underpinnings of this research draw upon multiple disciplines, including agricultural economics, organizational theory, industrial organization, and strategic management. As HOBBS (2000) and BARKEMA and DRABENSTOTT (1995) emphasize, vertical coordination in agri-food supply chains creates competitive advantages through reduced transaction costs and enhanced information flows, particularly valuable in sectors characterized by product perishability and quality variability.

The quantitative methodologies employed in this research align with approaches established in previous agricultural economics studies, incorporating descriptive statistical analysis, time series analysis, correlation analysis, and comparative assessment of key performance indicators as utilized by researchers like Stokes et al. (2007), Agger et al. (2004), and Dijkhuizen et al. (1985). Data sources encompass official statistical repositories (EUROSTAT, State Statistics Service of Ukraine), industry reports by sectoral organisations (Ukrainian Agribusiness Club, Association of Milk Producers), and international databases (FAO, USDA, World Bank).

These data are systematically compiled to construct longitudinal datasets that track changes in production volumes, cattle numbers, milk prices, profitability metrics, and trade patterns over the 2014-2024 period. For price trend analysis, the research employs indexation methods to standardise comparisons across different currency regimes and inflation contexts. Correlation coefficients are calculated to assess the degree of market integration between Ukraine and EU countries, with particular attention to Poland and Hungary as regional comparators.

During the main research, financial data extracted from the EMIS database were used to provide comprehensive market intelligence on emerging economies. The selection process

for dairy enterprises followed a systematic approach whereby companies were identified using the primary activity filter "Dairy cattle and milk production" (NAICS code: 11212). Financial data were collected for 156 Hungarian companies, 112 Polish companies, and 35 Ukrainian companies. Of these, 5 Hungarian and 4 Polish companies did not report any data to EMIS, resulting in actual datasets of 151, 108, and 35 companies respectively.

The EMIS database was accessed through an institutional subscription, enabling the extraction of detailed financial statements and operational metrics. Data were exported in Excel format using the database's built-in export functionality, creating separate workbooks for each country to facilitate systematic analysis.

The study period was deliberately selected as 2016-2020 for several methodological considerations. First, the EMIS database contained the most comprehensive financial data for all three countries during this period. Second, the absence of post-2020 data for Ukraine was due to martial law restrictions implemented following the full-scale invasion on 24 February 2022, which resulted in limited public statistical information access. Third, to maintain methodological consistency across all three countries and enable meaningful comparative analysis, this specific timeframe was chosen.

Following the European Commission's SME definition, enterprises were categorised according to staff headcount, turnover, and balance sheet total. Given the EMIS database limitations regarding employee data, classification was primarily based on total operating value (turnover) or total assets (balance sheet total). Large enterprises were defined as those with 250 or more employees, turnover exceeding EUR 50 million, or balance sheet totals surpassing EUR 43 million. Medium-sized enterprises comprised those with fewer than 250 employees, turnover of EUR 50 million or less, or balance sheet totals of EUR 43 million or less. Small enterprises included those with fewer than 50 employees, turnover of EUR 10 million or less, or balance sheet totals of EUR 10 million or less. Micro enterprises were characterised by fewer than 10 employees, turnover of EUR 2 million or less, or balance sheet totals of EUR 2 million or less.

Market concentration was evaluated using multiple techniques. The Gini Index was calculated according to the standard formula, providing a measure of market distribution inequality. The Lorenz Curve offered graphical representation of market distribution, whilst

geographic concentration was mapped using Tableau software with regional data aggregation.

The analysis incorporated multiple profitability ratios derived from standard financial analysis frameworks. Return on Sales (ROS) was calculated as operating profit divided by total operating revenue, whilst Return on Assets (ROA) represented net income divided by total assets. Return on Equity (ROE) was determined as net income divided by shareholders' equity, Net Profit Margin as net profit divided by total operating revenue, and EBITDA Margin as earnings before interest, taxes, depreciation and amortisation divided by total revenue. Operating Profit Margin was determined as EBIT divided by Total Operating Revenue. Where EBIT (Earnings Before Interest and Taxes) represents operating profit. This metric differs from ROS in certain contexts, particularly when non-operating income or expenses are present. The distinction is important as Ukrainian accounting standards may report these metrics differently from EU standards.

It should be noted that EBITDA is not directly calculated in Ukrainian accounting standards. Due to the absence of depreciation and amortisation data in the EMIS database for Ukrainian companies, EBITDA margin could not be calculated for Ukrainian enterprises. Therefore, operating profit margin serves as the primary operational profitability indicator for Ukrainian companies in this analysis.

Due to differences in accounting standards between Ukraine and EU countries, certain adjustments were necessary for comparative analysis. Ukrainian financial statements exclude VAT and excise taxes from total operating revenue, whilst EU reporting may include these elements. To ensure comparability, all revenue figures were standardised to exclude indirect taxes. Additionally, where specific indicators were unavailable, the closest equivalent was utilised and documented. For instance, in cases where Operating Profit was not directly reported, it was calculated as EBIT, acknowledging that minor discrepancies may arise from non-operating activities.

Qualitative approaches complemented the statistical analysis by incorporating insights from sectoral policy documents, expert assessments, and industry publications. This methodological triangulation allows for richer contextualisation of quantitative findings and better understanding of causal mechanisms behind observed trends. In the analysis of

wartime impacts on the Ukrainian dairy sector, qualitative insights become particularly valuable given the limitations of centralised data collection in war-affected regions.

This study focuses on Ukraine, Hungary, and Poland due to their geographical proximity, historical ties, and interconnected roles within the Eastern European dairy sector. Each country reflects a distinct stage of agricultural transformation and European integration: Ukraine with its considerable agricultural potential and ongoing EU alignment; Hungary as a post-socialist state whose dairy industry has adapted to EU membership; and Poland as a leading European producer with strong regional influence. Collectively, they provide a balanced framework for analysing structural change, market links, and integration strategies.

My own research background strengthens the analytical approach. Over a decade of involvement in Ukraine's dairy industry has provided direct experience, access to key stakeholders, and use of non-public data, contributing depth to the study. Similarly, my academic and professional work in Hungary has enabled familiarity with its institutions, policy environment, and dairy sector developments, allowing a more nuanced interpretation of statistical and policy evidence. These embedded perspectives offer additional insight into both national contexts and comparative analysis. Poland plays a particularly important role in this framework. As the largest dairy producer among Eastern European EU members and an active cross-border partner with Ukraine, it exemplifies successful modernisation and integration into European value chains. Its experience highlights potential development pathways for Ukraine, while its strong trade links with the Ukrainian sector underscore the practical significance of this comparative analysis.

The triangulation of experiences across these three countries enables the research to isolate country-specific factors from regional patterns, thereby enhancing the analytical robustness of findings. By systematically comparing structural transformations, policy environments, and performance indicators across Ukraine, Hungary, and Poland, the methodology captures both convergent trends and divergent adaptation strategies within Eastern European dairy sectors. This comparative approach is particularly valuable for identifying transferable lessons and potential development pathways for Ukraine's dairy industry in the context of European integration aspirations and post-war reconstruction needs.

3. MAIN FINDINGS OF THE DISSERTATION

In the main chapter, the size, concentration, and financial performance of dairy enterprises in Hungary, Poland and Ukraine are compared for the period 2016-2020.

The companies were selected by the main activity filter – Dairy cattle and milk production (NAICS: 11212). Financial data from 156 companies in Hungary (5 of which did not report any data to the EMIS), 112 in Poland (4 did not reported), and 35 in Ukraine were processed. However, the number of companies surveyed varies according to the indicator in question, due to the non-uniformity of the data across years and the presentation of certain indicators for specific populations while others are absent. In the case of the total number of companies in the market without reference to a specific indicator, the number of records in EMIS will be used, regardless of the volume of data provided.

COMPARATIVE ANALYSIS OF EUROPEAN AND EASTERN EUROPEAN DAIRY MARKETS

According to the last data, small and medium-sized enterprises (SMEs) represent 99% of all businesses in the EU. It is recommended to use the following criteria for classifying companies depending on their size (Table 1):

Table 1. Factors determining the size of an enterprise

Company category	Priority (Step) 1	Priority (Step) 2		
	Staff headcount	Turnover	or	Balance sheet total
Large	≥ 250	$> \text{€ } 50 \text{ m}$		$> \text{€ } 43 \text{ m}$
Medium-sized	< 250	$\leq \text{€ } 50 \text{ m}$		$\leq \text{€ } 43 \text{ m}$
Small	< 50	$\leq \text{€ } 10 \text{ m}$		$\leq \text{€ } 10 \text{ m}$
Micro	< 10	$\leq \text{€ } 2 \text{ m}$		$\leq \text{€ } 2 \text{ m}$

Source: European Commission, EUROSTAT

In order to undertake a comparative analysis of the three countries under study, it is necessary to select a single criterion for determining the scale of an enterprise. As the data on the number of employees is provided by EMIS only for Ukraine, it is more appropriate to group enterprises by total operating value (turnover) or total assets (balance sheet total), depending on which of these indicators better reflects the economic essence of the currently assessed indicator. Furthermore, a comparison of the efficiency of asset utilisation (absolute distribution and return ratio) may prove fruitful, given that sales volume does not always

increase in proportion to the size of assets. A comparative analysis of the capacity of the national markets in the 3 countries is shown in the Table 2 below.

Table 2. National dairy markets' capacity (EMIS database 2016-2020 sample: Hungary, Poland, Ukraine)

Year	Number of operating companies, units*				Total operating revenue, thsd EUR				TOR, % **		
	Hungary	Poland	Ukraine	Total	Hungary	Poland	Ukraine	Total	Hungary	Poland	Ukraine
2020	134	90	31	255	517831	215992	189923	923746	56.1	23.4	20.6
2019	142	86	34	262	556110	214806	201620	972536	57.2	22.1	20.7
2018	126	87	33	246	504774	215071	179990	899835	56.1	23.9	20.0
2017	126	53	34	213	534094	149689	162543	846326	63.1	17.7	19.2
2016	138	14	21	173	507398	66529	101785	675712	75.1	9.8	15.1
Year	Total operating revenue per unit. EUR				Total operating revenue. annual growth				Operating companies. %		
	Hungary	Poland	Ukraine	Total	Hungary	Poland	Ukraine	Total	Hungary	Poland	Ukraine
2020	3864.4	2399.9	6126.5	3622.5	-6.88	0.55	-5.80	-5.02	52.5	35.3	12.2
2019	3916.3	2497.7	5930.0	3712.0	10.17	-0.12	12.02	8.08	54.2	32.8	13.0
2018	4006.1	2472.1	5454.2	3657.9	-5.49	43.68	10.73	6.32	51.2	35.4	13.4
2017	4238.8	2824.3	4780.7	3973.4	5.26	125.00	59.69	25.25	59.2	24.9	16.0
2016	3676.8	4752.1	4846.9	3905.8	-	-	-	-	79.8	8.1	12.1

*those companies that reported the main financial indicators to EMIS for the current year

**TOR, % – total operating revenue, % as a national impact share to the common market for the year

Source: own calculations based on EMIS sample

Based on the sample from EMIS the Hungarian companies have the largest market share, but from 2016 to 2020, their market share decreased by almost 20%, although in 2020 it was still quite significant, representing 56% of the total market of the three countries. Conversely, the number and volume of operations of Polish companies increased significantly over the five-year period under study. While in 2016 their market share stood at 9.8%, it had increased to 23.4% by 2020. Furthermore, the number of units increased from 14 in 2016 to 90 in 2020. A similar increase was observed in the share of Ukrainian enterprises in dairy sales, which rose from 15.1% to 20.6%. However, the dynamics of the structure remained the most stable: 12-13% of the total number of business entities in the three countries each year. Conversely, in Hungary, the actual number of enterprises remained relatively stable (approximately 130-140 units per year), while the relative share underwent a steady decline – from 75.1% in 2016 to 56.1% in 2020 of the total number of companies in the three countries. This decline was accompanied by a corresponding decrease in sales volumes. In 2017, the number of Polish companies increased by 3.7 times compared to the previous year, while sales revenues doubled. In 2020, Polish companies

were the only ones to demonstrate a positive growth rate of total operating value in comparison with the previous year.

Conversely, the efficiency of Hungarian enterprises demonstrated minimal fluctuations, with a range of EUR 3.7 to EUR 4.2 million in revenue per unit. Since 2017, a notable increase in profitability has been observed in Ukraine, from EUR 4.8 to 3.6 million, while in Poland, a substantial decline was recorded, from EUR 4.7 to EUR 2.4 million. This phenomenon may be attributed to the unbundling or restructuring of large enterprises and the concomitant increase in the number of SMEs (Figure 1).

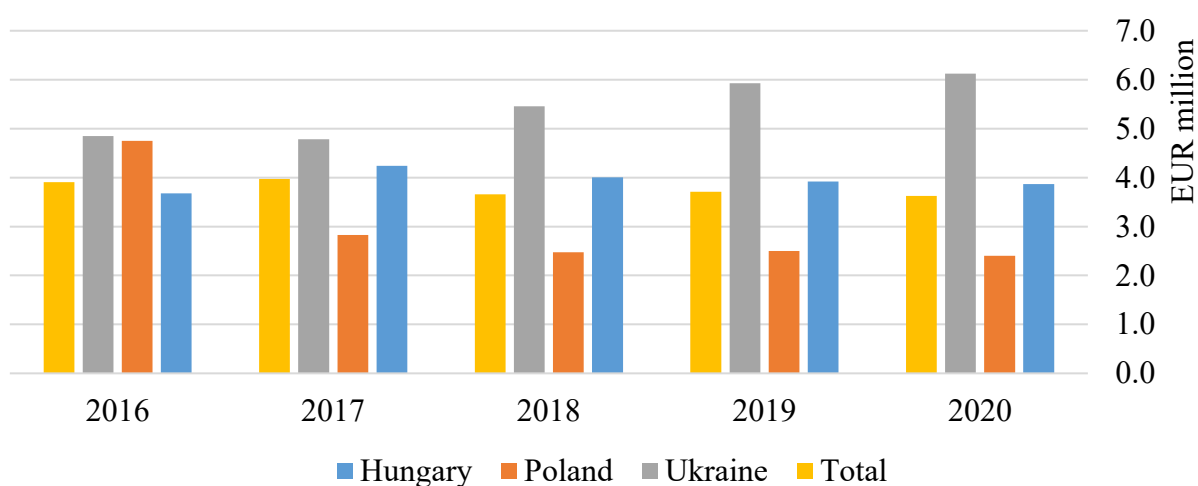


Figure 1. Efficiency of an enterprise's operating, total operating revenue per unit (EMIS database 2016-2020 sample: Hungary, Poland, Ukraine)

Source: own calculations based on EMIS sample

The geographical distribution of the studied companies is uneven, with regions in each country exhibiting the highest concentrations of dairy company revenues. In Poland, these are primarily the western regions, with the Wielkopolskie and Kujawsko-Pomorskie regions being of particular note (Figure 2). In Hungary, the production is concentrated in the eastern and western regions, with Győr-Ménfőcsanak in the west and Hajdú-Bihar in the east, and less involvement in the central part of the country (Figure 3). In Ukraine, by contrast, the dairy production is predominantly centred in the central-north-eastern region, with the Poltava and Chernihiv regions being the most prominent, and the Volyn region in the north-west being a notable exception (Figure 4).

I will further analyse the dynamics of market distribution between large, medium and small enterprises using the Gini index and assess the concentration in the industry (Figure 5), but

first it is notable to look in depth on the geographic redistribution of the dairy industry revenues.

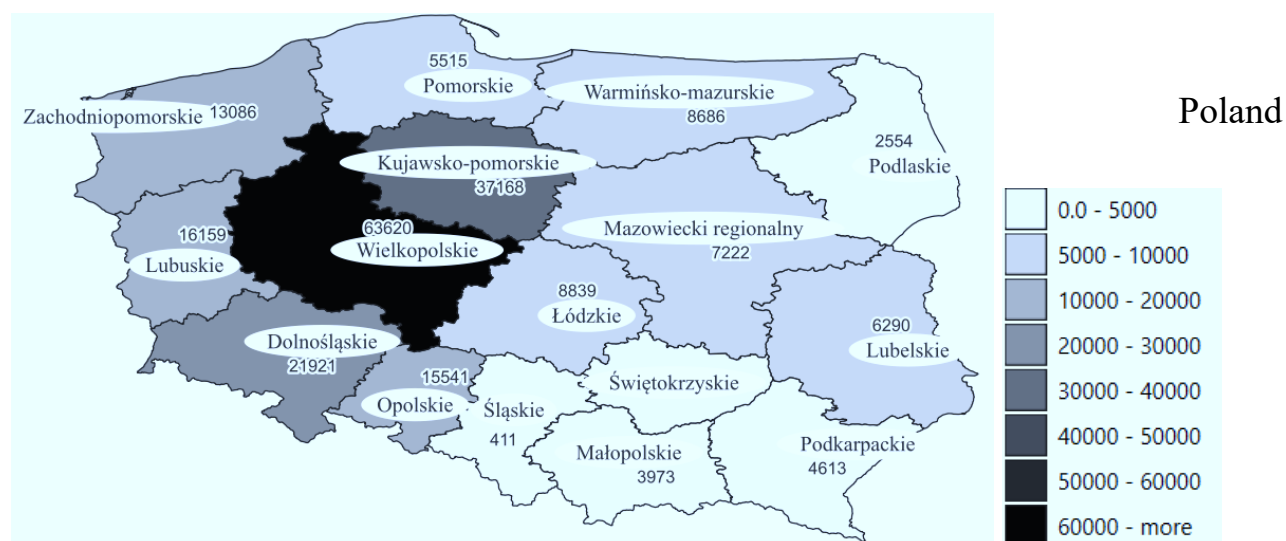


Figure 2. Total operating revenue by regions in Poland, EUR thousand, 2020

Source: EMIS sample data, built in Tableau

The map on Figure 3 provides a comprehensive overview of the geographical distribution of Polish dairy enterprises, based on their total operating profit in 2020. The regions have been grouped according to total operating profit as follows:

Highest Profit (above EUR 50 mln) – Wielkopolskie: the leading region with a total operating profit of EUR 63.6 million, indicating a significant concentration of highly profitable enterprises.

High Profit (EUR 30-40 mln) – Kujawsko-Pomorskie: with a total operating profit of 37.2 mln, this region demonstrates strong activity in dairy enterprises, second to the Wielkopolskie region.

Medium Profit (EUR 20-30 mln) – Dolnośląskie: achieving 21.9 mln in total operating profit, this region represents a moderate level of profitability.

Lower Profit (EUR 10-20 mln) – Zachodniopomorskie (13.1), Lubuskie (16.2), Opolskie (15.5). These regions exhibit consistent but lower profitability compared to the medium and high-profit regions.

Minor Profit (EUR 5-10 mln) – Pomorskie (5.5), Warmińsko-Mazurskie (8.7), Łódzkie (8.8), Mazowiecki Regionalny (7.2), Lubelskie (EUR 6.3 million). These regions maintain a noticeable presence of dairy enterprises but with relatively modest operating profits.

Least Profit (below EUR 5 mln) – Podlaskie (2.5), Śląskie (EUR 411,000), Małopolskie (3.97), Podkarpackie (4.6). These areas have the smallest total operating revenue, indicating either limited activity or smaller-scale operations.

The Wielkopolskie region is a prominent dairy hub, with the highest profitability levels in the sector. Regions such as Kujawsko-Pomorskie and Dolnośląskie are significant contributors to the dairy economy, exhibiting substantial economic activity in this sector. Areas where profits are minimal or non-existent may indicate a limited business presence, smaller-scale operations, or specific challenges within the industry.

The geographical distribution of Hungarian dairy enterprises is represented on Figure 3.

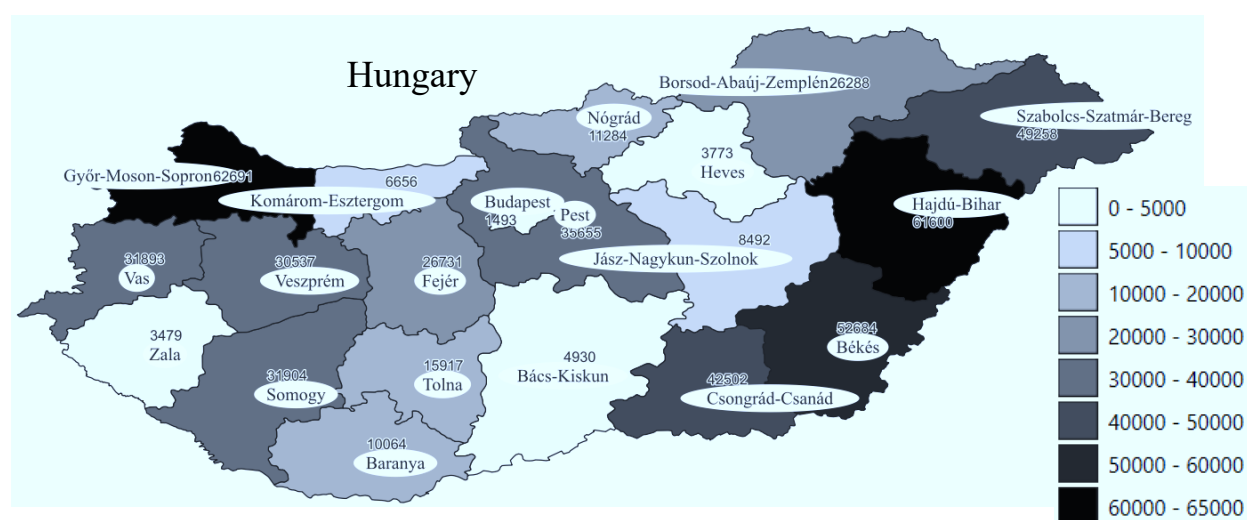


Figure 3. Total operating revenue by regions in Hungary, EUR thousand, 2020

Source: EMIS sample data, built in Tableau

The following regions have been identified as those with the highest total operating profit (60-65 EUR million): Győr-Moson-Sopron (62.7) and Hajdú-Bihar (61.6). These two regions dominate with the most significant concentration of highly profitable dairy enterprises, indicating strong industry performance and possibly favourable conditions for dairy production and trade.

Regions with high total operating profit from 50 to 60 EUR million are: Békés (52.7) and Szabolcs-Szatmár-Bereg (49.2). These areas also demonstrate robust profitability levels, ranking just behind the top two, indicating a significant presence of thriving dairy enterprises.

The following regions have been identified as those with medium total operating profit: Veszprém (EUR 30.5 million), Vas (31.9), and Somogy (31.9). These regions represent a

balanced distribution of enterprises with moderate profits, indicating stable but less significant activity compared to the leading regions.

Regions with lower total operating profit (10-20 EUR million): Fejér (26.7), Tolna (15.9), and Baranya (10.1). These areas demonstrate a smaller scale of operations and profitability compared to medium and high-ranking regions, suggesting potential for growth or challenges impacting performance.

The following regions have the lowest total operating profit (0-5 EUR million): Budapest (1.5), Zala (3.5), and Heves (3.8). Dairy enterprises in these regions are operating on a minimal scale, either due to smaller markets, fewer enterprises, or less favourable conditions for the industry.

It is notable that Győr-Moson-Sopron and Hajdú-Bihar have a clear advantage in terms of profitability, making them the primary hubs for dairy enterprises. Regions such as Békés and Szabolcs-Szatmár-Bereg constitute the next cluster and continue to demonstrate a substantial economic impact within the dairy sector. Budapest and Zala, which have the lowest profit margins, are experiencing limited activity in the dairy industry. This may be due to urbanisation or other economic priorities. Ukrainian figures are shown on Figure 4.

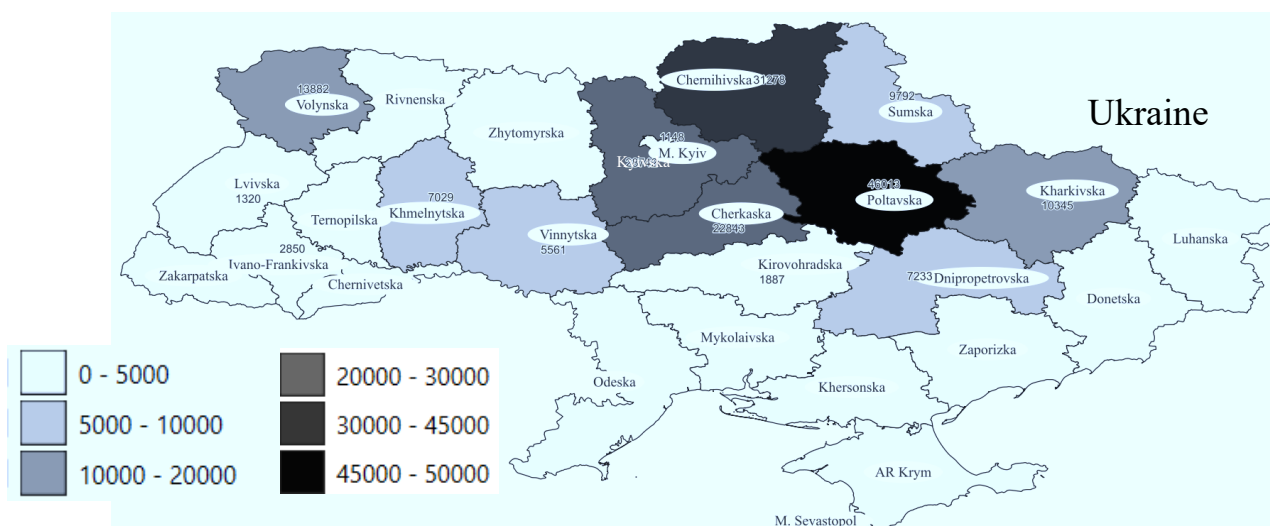


Figure 4. Total operating revenue by regions in Ukraine, EUR thousand, 2020

Source: EMIS sample data, built in Tableau

The distribution of Ukrainian dairy enterprises based on total operating profit across regions (oblast in Ukrainian) in 2020 is as follows:

Highest Profit (above 40 EUR million) – Poltavaska oblast (40.0). This region is distinguished as the most profitable area for dairy enterprises, emphasising its substantial industry scale and economic contribution.

High Profit (30-40 EUR million) – Chernihivska oblast (31.3). A notable centre for dairy farming with robust profitability, second only to the Poltavaska region.

Medium Profit (20-30 EUR million) – Cherkaska oblast (22.8) indicates moderate profitability, suggesting stable and significant dairy industry activity.

Lower profit (10-20 EUR million). Volynska (13.9), Kharkivska (10.39), Sumska (9.8), Dnipropetrovska (7.2), Khmelnytska (7.0) and Vinnytska (5.6) oblasts demonstrate smaller but consistent profitability levels, which may be indicative of regional-scale operations.

Minor Profit (5-10 EUR million). Enterprises in the following areas operate on a limited scale and contribute modest profits: Kyivska oblast (11.5), the city of Kyiv (23.7), and Ivano-Frankivska (2.8) oblasts.

Lowest Profit (0-5 EUR million) – Lvivska (1.3) and Kirovohradska (1.9) oblasts, and the remaining blank regions are characterised by minimal profitability or sparse dairy enterprise presence.

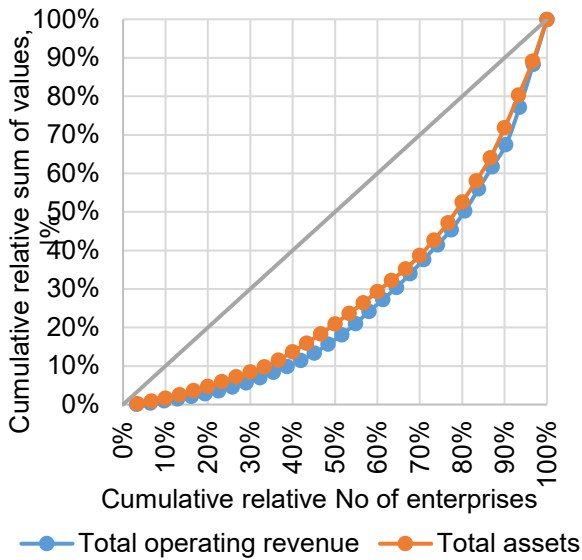
Thus, Poltavaska Region is the leading region, demonstrating the highest levels of profitability and likely functioning as a hub for the dairy industry in Ukraine. Chernihivska and Cherkaska oblasts follow as secondary centres, contributing significantly to the overall operating profits. Regions with lower or minor profits may encounter industry challenges, limited dairy enterprise activity, or reflect smaller-scale operations.

As a next step I will analyse the dynamics of market distribution between large, medium and small enterprises using the Gini index (Table 2, Figure 5) and assess the concentration in the industry.

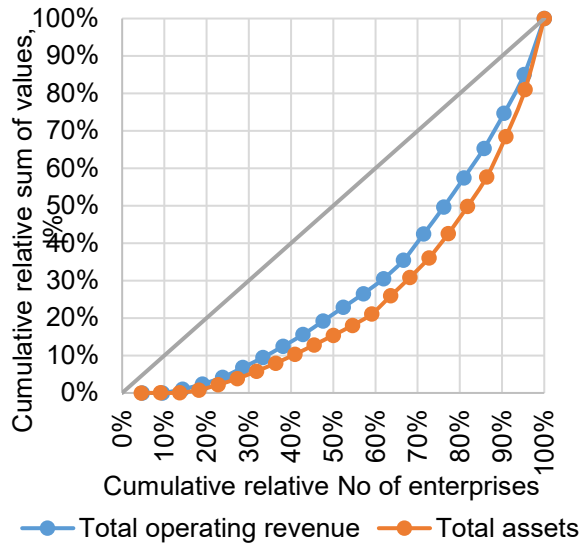
Table 2. Gini Index by countries, 2016-2020

Gini index	By total operating revenue, %					By total assets, %				
	2016	2017	2018	2019	2020	2016	2017	2018	2019	2020
Year										
Hungary	46.92	46.23	45.05	46.52	45.30	52.45	49.58	49.42	49.77	50.07
Poland	37.32	58.48	58.77	60.14	59.80	32.79	67.11	64.45	64.98	64.42
Ukraine	41.80	46.14	48.10	44.72	47.22	50.85	46.14	44.03	45.56	42.17

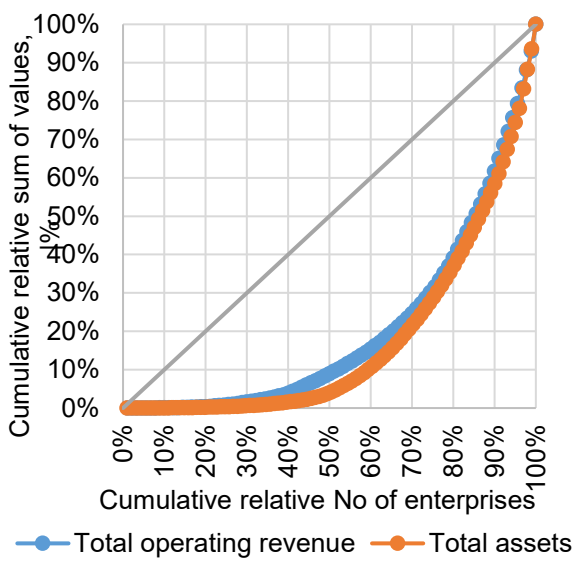
Source: Calculated by the author based on EMIS sample



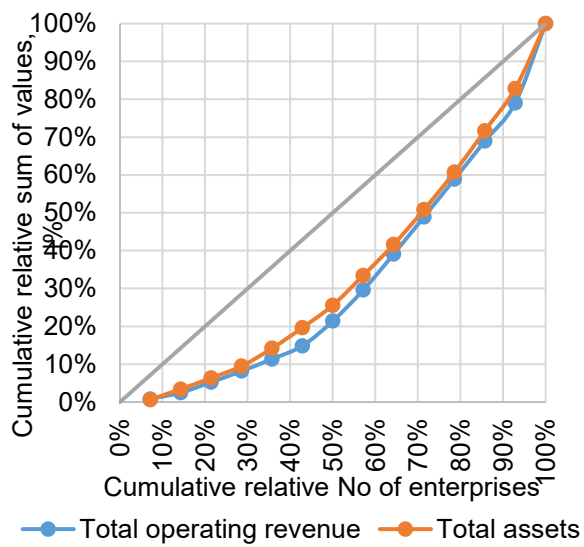
Ukraine, 2020



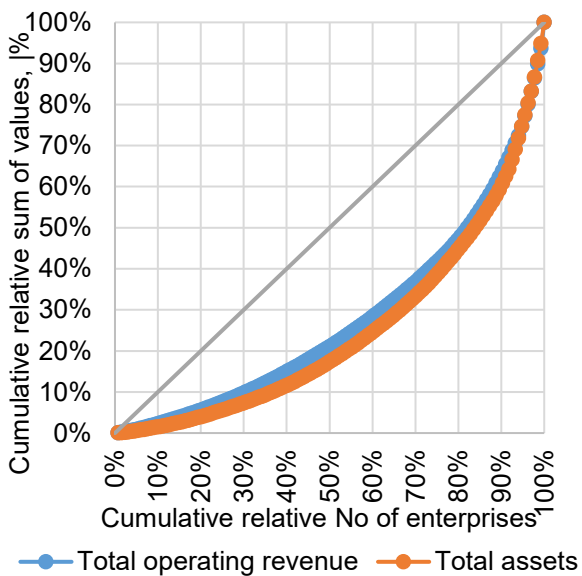
Ukraine, 2016



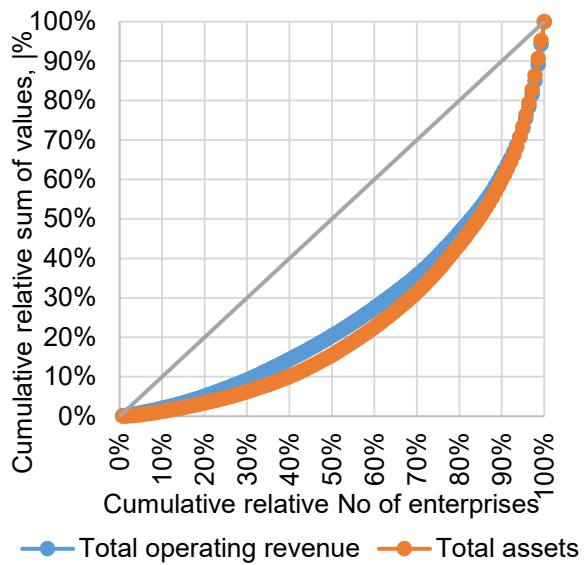
Poland, 2020



Poland, 2016



Hungary, 2020



Hungary, 2016

Figure 5. Lorenz curve in the dairy industry by countries, 2016-2020

Source: own calculations based on EMIS sample

In 2016, the Hungarian dairy market was the most monopolised, while the Polish market was the least monopolised. However, while in Hungary and Ukraine, market concentration indicators have remained relatively stable over the past five years, in Poland, the Gini coefficient has exhibited a marked increase, despite a substantial growth in the number of enterprises. In 2020, Poland's national market exhibited the highest degree of monopolisation, with a Gini index of 60%. In contrast, Ukraine and Hungary demonstrated a comparable level of concentration, with indices of 44.7 and 45.3%, respectively (Table 3).

Table 3. The distribution of dairy enterprises by sizes, 2016-2020

Year	2020				2019				2018				2017				2016			
Indicator	TOR		TA		TOR		TA		TOR		TA		TOR		TA		TOR		TA	
Units	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Hungary																				
Micro	47	35.1	26	19.4	52	36.6	27	19.0	42	33.3	24	19.0	40	31.7	25	19.8	52	37.7	35	25.2
Small	79	59.0	88	65.7	81	57.0	89	62.7	74	58.7	78	61.9	78	61.9	75	59.5	77	55.8	81	58.3
Medium	8	6.0	19	14.2	9	6.3	25	17.6	10	7.9	23	18.3	8	6.3	25	19.8	9	6.5	21	15.1
Large	0	0.0	1	0.7	0	0.0	1	0.7	0	0.0	1	0.8	0	0.0	1	0.8	0	0.0	2	1.4
TOTAL	134	100	134	100	142	100	142	100	126	100	126	100	126	100	126	100	138	100	139	100
Poland																				
Micro	56	62.2	52	51.5	52	60.5	52	51.5	53	60.9	51	51.5	30	56.6	37	55.2	4	28.6	1	7.1
Small	31	34.4	40	39.6	33	38.4	38	37.6	33	37.9	36	36.4	22	41.5	21	31.3	9	64.3	8	57.1
Medium	3	3.3	9	8.9	1	1.2	11	10.9	1	1.1	12	12.1	1	1.9	9	13.4	1	7.1	5	35.7
Large	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
TOTAL	90	100	101	100	86	100	101	100	87	100	99	100	53	100	67	100	14	100	14	100
Ukraine																				
Micro	8	25.8	1	3.3	8	23.5	3	9.1	9	27.3	3	9.4	8	23.5	3	9.1	6	28.6	4	18.2
Small	17	54.8	16	53.3	19	55.9	17	51.5	20	60.6	20	62.5	23	67.6	22	66.7	13	61.9	12	54.5
Medium	6	19.4	13	43.3	7	20.6	13	39.4	4	12.1	9	28.1	3	8.8	8	24.2	2	9.5	6	27.3
Large	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
TOTAL	31	100	30	100	34	100	33	100	33	100	32	100	34	100	33	100	21	100	22	100

*TOR – total operating revenue

**TA – total assets

***n – number of enterprises

Source: own calculations based on EMIS sample

The structural distribution of dairy enterprises in all three countries is characterised by a predominance of micro and small enterprises (according to the European Commission methodology). Large enterprises, if present, are represented by 1-2 units (Figure 6-8).

The alterations in the quantity of micro, small, medium, and large enterprises in Hungary from 2016 to 2020 demonstrate discernible trends across diverse enterprise sizes (Figure 7). It is evident that micro enterprises, which are typically characterised by their small-scale

operations, have demonstrated fluctuations in their representation based on total operating revenue (TOR) and total assets (TA).

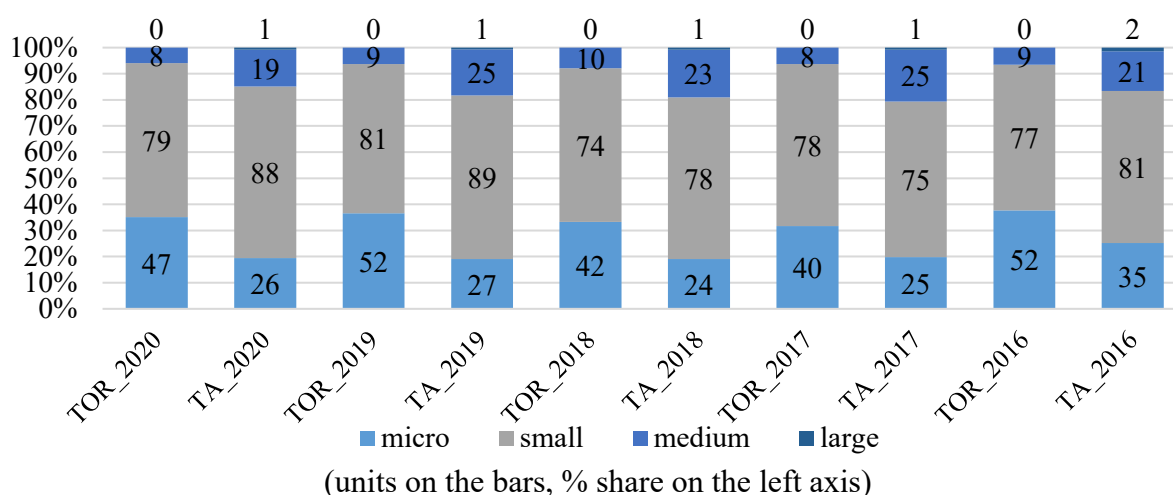


Figure 6. The dynamics of the number of enterprises in Hungary, units

Source: own calculations based on EMIS sample

In 2016, 52 micro enterprises accounted for 37.7% of TOR and 32 enterprises – for 25.2% of TA, but by 2020, their number and share had decreased to 35.1% of TOR and 19.4% of TA. This decline indicates a reduction in their relative contribution to Hungary’s economy over time. Small enterprises exhibited a more stable presence during this period. In 2016, they represented 55.8% of TOR and 58.3% of TA. By 2020, their share had slightly increased to 59% of TOR and 65.7% of TA. This growth indicates that small enterprises maintained and slightly expanded their role in the economy, particularly in terms of asset utilisation.

Medium-sized enterprises experienced modest changes. In 2016, these two categories accounted for 6.5% and 15.1% of TOR and TA, respectively. By 2020, the company’s share had decreased to 6% of TOR but increased to 14% of TA. This mixed trend suggests a slight decline in revenue generation but a stable or growing asset base.

Large enterprises, which typically dominate in terms of scale and resources, showed minimal representation throughout the period. In 2016, the company did not contribute to a significant value of total operating revenue, but made at least 1.4% of TA. By 2020, its share had decreased to 0.7% of TA, indicating a decline in their relative economic impact.

It is important to note that these changes underscore a shifting dynamic amongst different enterprise sizes in Hungary. Specifically, micro enterprises have experienced a decline, small enterprises have demonstrated stability and growth, medium enterprises have

exhibited mixed trends, and large enterprises have evidenced a reduction in their economic presence.

An analysis of the changes in the number of micro, small, and medium enterprises in Poland from 2016 to 2020 reveals distinct trends. The data presented in the form of bars in the chart represents the total count of enterprises, while the percentage scale illustrates the share of total operating revenue (TOR) and total assets (TA) contributed by these enterprises (Figure 8).

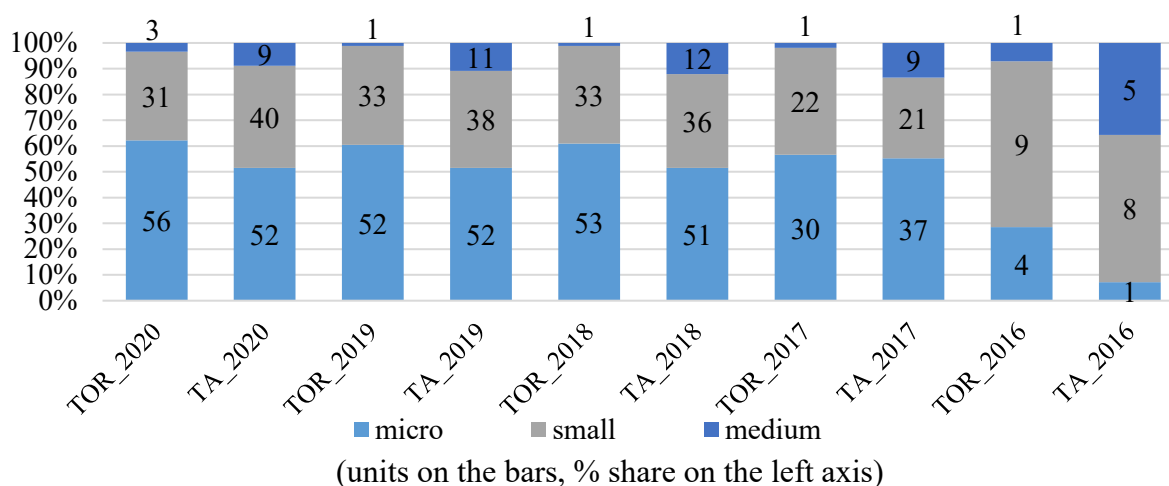


Figure 7. The dynamics of the number of enterprises in Poland, units

Source: own calculations based on EMIS sample

For micro enterprises, the number remained relatively stable over time. In 2017, micro enterprises accounted for 56.6% of TOR and 55.2% of TA, and these proportions remained consistent through to 2020, thereby highlighting the stability in their economic role. The number of micro enterprises remained consistently high during this period, thereby reflecting their considerable presence in Poland's economy.

In a similar fashion, small enterprises exhibited stability in their contributions. In 2017, the representation of TOR and TA was 41.5% and 31.3%, respectively, and these figures remained constant by 2020. The number of small enterprises has exhibited only slight variations over the years, thereby maintaining their importance in generating revenue and utilizing assets effectively.

Medium-sized enterprises, however, exhibited a subtle shift in their approach. The proportion of TOR accounted for by the subject decreased from 7.1% in 2016 to 3.3% in 2020, thus indicating a decline in their role in revenue generation. Conversely, the proportion of TAs decreased marginally, from 35.7% in 2016 to 8.9% in 2020. Despite the

relatively stable number of medium enterprises over time, the observed decrease in their contribution to total assets may signal alterations in their operational strategies or the scaling up of their enterprises.

In summary, micro and small enterprises demonstrated consistent stability in their contributions to TOR and TA, thus playing a significant role in Poland's economy. Medium-sized enterprises demonstrated an inconclusive pattern, with a decline in their share of TOR and of TA, suggesting an evolving dynamic in their economic impact. These patterns are indicative of the overall structure and behaviour of enterprise sizes in Poland during the specified period.

The alterations in the quantity of micro, small, and medium enterprises in Ukraine from 2016 to 2020 disclose significant tendencies in their contributions to total operating revenue and total assets (Figure 9).

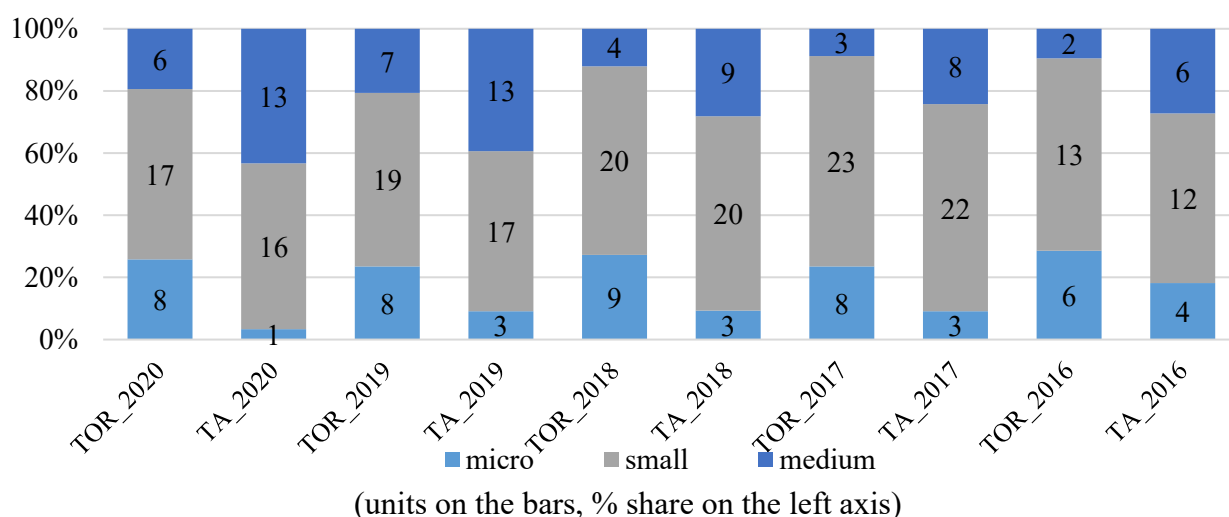


Figure 8. The dynamics of the number of enterprises in Ukraine, units

Source: own calculations based on EMIS sample

Micro enterprises demonstrated a relatively stable presence over the years. In 2016, these enterprises accounted for 4 enterprises contributing to 28.6% of TOR and 18.2% of TA. By 2020, the number of micro enterprises had increased to eight, with their share of TOR rising to 25.8%, while their share of TA decreased to 3.3%. This suggests an increasing role in revenue generation, but a reduced contribution to asset utilisation.

In terms of numerical representation, small enterprises consistently constitute the predominant proportion of entities analysed. In 2016, 13 small enterprises were responsible for 61.9% of TOR and 54.5% of TA. By 2020, the number of small enterprises had increased

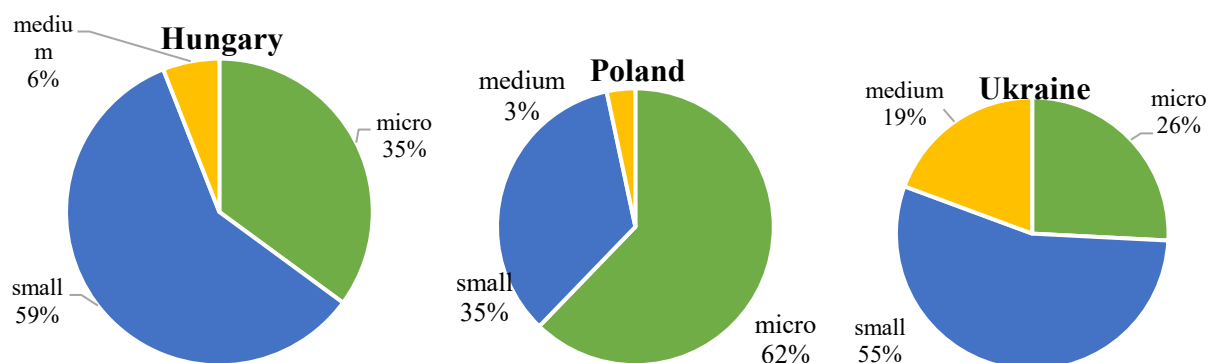
to 17, with their share of TOR decreasing slightly to 54.8%, while their share of TA remained stable at 53-65%. This stability underscores their substantial and enduring contribution to the Ukrainian economy.

Medium-sized enterprises experienced fluctuations in both their numbers and economic contributions. In 2016, two medium enterprises contributed 9.5% of TOR and six to 27.3% of TA. By 2020, the number of medium enterprises had increased to 6, but their share of TOR decreased to 19.4%, while the share of 13 medium companies in TA rose to 43.3%. This suggests a shift in focus, with medium enterprises becoming more asset-intensive while generating a smaller proportion of revenue.

The data presented herein indicates an evolution in the dynamics between enterprise sizes in Ukraine. Recent studies have indicated an increase in the number of micro enterprises, as well as an increase in the revenue that they contribute to the economy. However, these studies have also shown a decrease in the asset share of micro enterprises. It is evident that small enterprises have sustained their predominant position in both TOR and TA. Conversely, medium enterprises have exhibited growth in terms of both numbers and asset contributions. However, this growth has been accompanied by a decline in revenue share. These trends are indicative of the evolving organisational structure and economic behaviour of enterprises in Ukraine during the specified period.

At the same time, the market structure differs significantly depending on which indicator is chosen for classification – according to total operating value, in 2016-2020, no large enterprises were registered (at least in the EMIS database) in any country (Figure 9). In terms of total assets, only one large enterprise was permanently operating in Hungary – Tedej Zrt. (Hajdunanas, Hajdu-Bihar region) with an average book value of EUR 46.8 million (and the assets of this enterprise gradually increased in 2016-2018 - from 43.876 million to 49.1 million, and then decreased to 46.3 million in 2020), and in 2016 Batortrade Kft. (Nyirbator, Szabolcs-Szatmar-Bereg region) had a book value of 45.487 million euros. However, in 2017, the assets of Batortrade Kft. decreased by 1.8 times (to 25.3 million), and by 2020, they were growing slowly – only to 31 million euros. Therefore, according to both criteria, this company now belongs to the medium-sized group.

Distribution of units by total operating revenue



Distribution of units by total assets

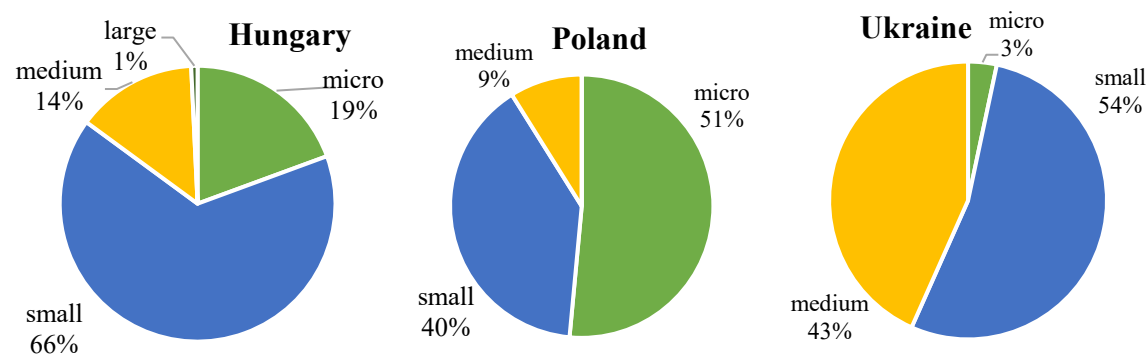


Figure 9. Comparing enterprises by sizes, 2020

Source: own calculations based on EMIS sample

The structural distribution by number of companies is extremely heterogeneous. For example, in Hungary, small enterprises accounted for 60-65% of the total in 2020, both in terms of sales and assets; in Ukraine, it was 55%, and in Poland, 35-40%. The distribution of other groups is already different. In terms of assets, microenterprises in Hungary accounted for 35% of all registered enterprises, but only 19% had a total operating value of more than EUR 2 million; in Ukraine, only 3% of companies could be classified as microenterprises in terms of assets, but this group already accounted for 26% in terms of sales; in Poland, the share of microenterprises was the largest – 51% in terms of assets and 62% in terms of sales. The largest share of medium-sized enterprises in terms of both total operating value and total assets was in Ukraine – 43% and 19% respectively, in Hungary – 16% and 6%, and the smallest in Poland – 9% and 6%.

Over the 2016-2020, the structure of the distribution of enterprises in Hungary has hardly changed, while in Poland, in 2017, the share of microenterprises increased sharply, and the market presence of small and medium-sized companies decreased accordingly. In 2017-2020, the microenterprise group was the largest, accounting for approximately 60% of total

operating income and 50% of total assets, with the share of small companies at 35-40% by both criteria. In Ukraine, the number of microenterprises remained almost unchanged in terms of market size (25-28%), but at the same time fell sharply in terms of assets - from 18% in 2016 to 3% in 2020 (although in reality it was a decrease from 4 to 1 unit); the share of medium-sized enterprises grew from 27% to 43% in terms of assets and from 9.5% to 43% in terms of sales, with an increase in assets of more than 10% in 2019 compared to 2018, which should have led to an increase in revenue, but the onset of the crisis in 2020 levelled these expectations – in 2019-2020, only 20% of enterprises had an average annual revenue of more than €10 million. Finally, the largest group of small enterprises accounted for almost the same share by both criteria – 50-60%, although in 2017 it rose to 67-68%. Thus, small enterprises predominate in Hungary (60-66%), followed by Ukraine (55-56%), and Poland has the smallest number of them, although it is a fairly large group – 35-40% of the total number of enterprises. In terms of total operating value, micro-enterprises are in second place in Hungary, while in Ukraine micro- and medium-sized enterprises are represented in approximately the same proportion, and in Poland there are very few medium-sized enterprises compared to the number of micro- and small enterprises. However, according to the Gini index, Poland has the most concentrated market (60% by revenue), while in Hungary the figure is 46.5% and in Ukraine it is 44.7%. In Poland, the level of concentration increased sharply in 2017 (from 37% to 60%), while the market structure in Ukraine and Hungary remained almost unchanged. We will use total operating value as a criterion for grouping companies by size, as the market share that a company has managed to occupy is the best measure of the efficiency of using available resources.

In Hungary, the largest share of total revenue was contributed by small enterprises (60.2%), medium-sized enterprises (27.5%) and micro-enterprises (12.2%). A similar structure was observed in Poland, with small enterprises accounting for 66.3% of the total revenue of the dairy industry. The shares of medium-sized enterprises (16.6%) and micro-enterprises (17.1%) were almost equal (Figure 10).

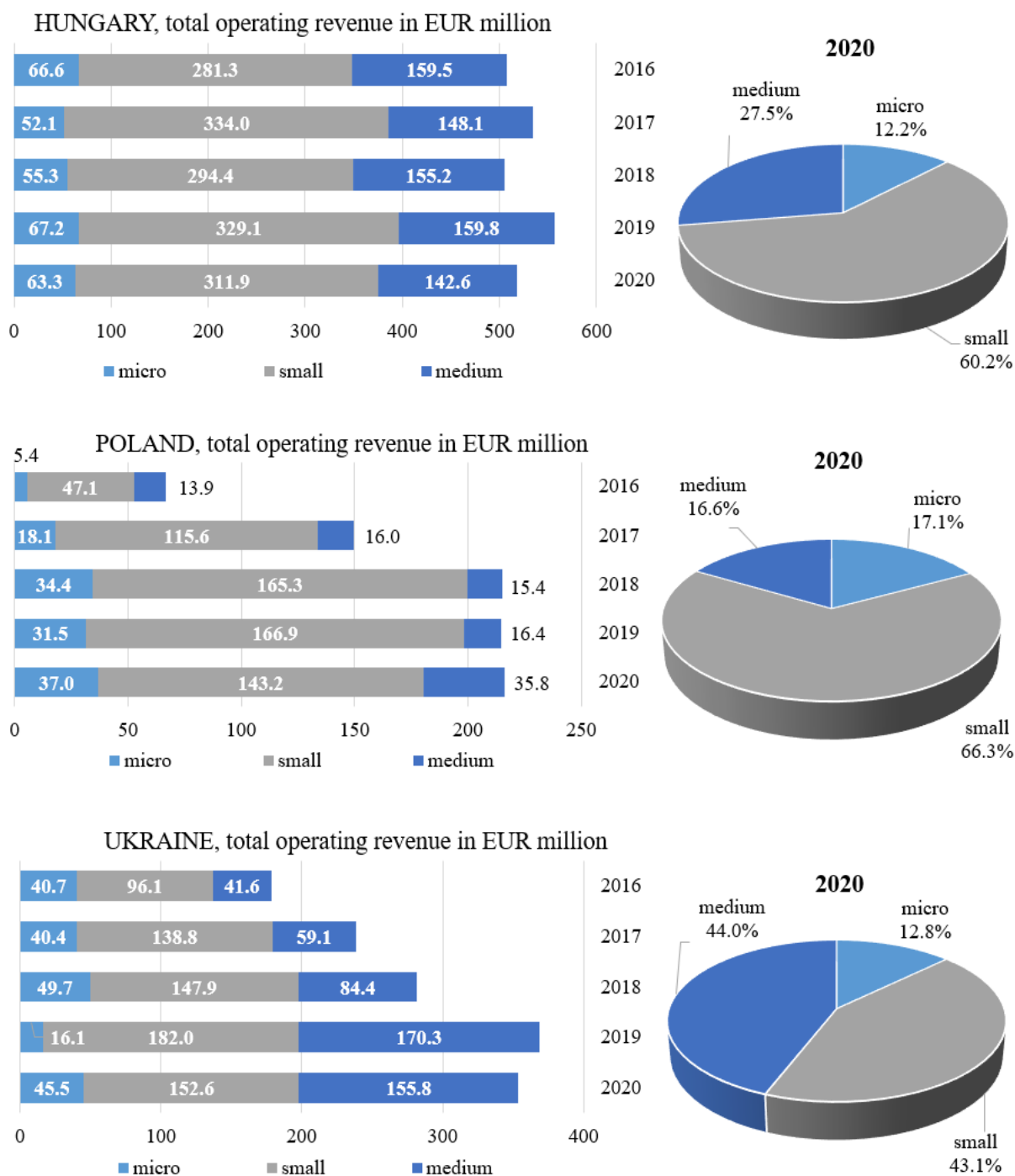


Figure 10. Total operating revenue by groups of enterprises, 2016-2020

Source: own calculations based on EMIS sample

In Ukraine, the industry's total revenue structure differs in its composition. While the share of microenterprises is the smallest compared to other groups (12.8%), medium and small enterprises share the remainder of the market equally (44.0% and 43.1%, respectively) in 2020. However, the structural changes in Ukraine in terms of total operating turnover, both in absolute and relative terms, were the most significant. In 2016, compared to 2017, there was an absolute increase in total revenue of €60 million per year. In 2018, the annual increase was €43.6 million. Concurrently, the share of medium-sized enterprises in total

revenue exhibited an upward trajectory, attaining a twofold increase over a five-year period (from 23% to 44%), while the share of microenterprises underwent a nearly proportional decline (from 22.8% to 12.8%), and the share of small enterprises exhibited a slightly more modest decrease (from 53.9% to 43.1%). The Hungarian dairy market is the largest in terms of total capacity. In 2020, revenues totalled more than €517.8 million. By comparison, the industry's total operating revenue in Ukraine was almost €353.8 million, and in Poland, almost €216 million (if to group the enterprises by the criteria suggested by European Commission). Furthermore, Hungary and Ukraine both experienced a marginal decrease in sales during 2020, with losses amounting to EUR 51.3 million and EUR 14.6 million, respectively. Notably, Poland incurred the least substantial losses since the onset of the crisis, with a total operating revenue loss of only EUR 265 thousand (Figure 11).

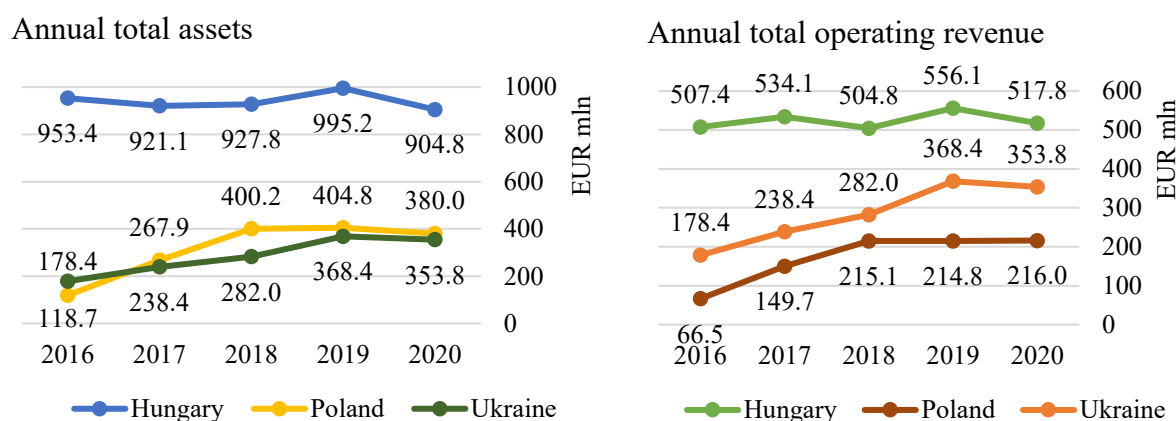


Figure 11. Total dairy industry dynamics, 2016-2020

Source: own calculations based on EMIS sample

In Hungary, the growth of companies' assets was predominantly negative (from EUR 953.4 million in 2016 to EUR 904.8 million in 2020), and total income exhibited fluctuations, though overall, there was a marginal increase. In contrast, there was an increase in both assets and market capacity in Ukraine and Poland (with a slowdown only in 2020).

FINANCIAL EFFICIENCY ANALYSIS

Comparative analysis of the profitability indicators reveals striking differences in profitability across the three countries. In 2020, Poland's net profit margin exhibited extreme volatility (-17.0% mean, ranging from -2602.1% to 1857.4%), primarily due to a significant proportion of loss-making enterprises (23.5%). Ukraine maintained more stable performance with a 9.5% mean NPM, with only 13.3% of companies reporting losses.

Hungary demonstrated the most balanced performance with an 8.6% mean NPM and the lowest proportion of loss-making enterprises at 9.7%.

The standard deviation provides insight into the variability or consistency of financial ratios. Poland appears to have the largest dispersion, with financial ratios, including net profit margin and return on equity, indicating high standard deviations, showcasing significant annual variability.

Hungary and Ukraine demonstrated more stable ranges. The standard deviation values for Hungary are relatively moderate across all metrics, indicating a stable financial environment with limited fluctuations. For instance, net profit margin demonstrates variations ranging from 12.9% to 19.4%, while the return on assets fluctuates between 4.9% and 9.6%. The analysis revealed that Poland's micro enterprises maintained the highest profitability levels among the three countries, peaking at an NPM of 15.9% in 2016. Hungary's micro firms demonstrated greater fluctuations. Ukraine's micro and small businesses experienced a marked deterioration, characterized by declining asset returns and profit margins.

Medium-sized enterprises in Poland demonstrated the most substantial financial enhancement, exhibiting an improvement in profitability from 2016 to 2020. Conversely, Hungary and Ukraine demonstrated a decline in performance, particularly with regard to ROA and ROE, suggesting challenges in achieving optimal asset efficiency.

A comprehensive examination of the data reveals that Poland exhibited the most stable profitability dynamics. In contrast, Hungary and Ukraine demonstrated increasing volatility and declining returns, a trend that was particularly evident among medium-sized businesses.

The most significant differences were observed in how different countries' enterprises performed across various size categories:

- Ukraine showed a strong correlation between enterprise size and performance.
- Hungary demonstrated a non-linear relationship with diminishing returns.
- Poland exhibited minimal influence of enterprise size on profitability.

CORRELATION ANALYSIS

The research explored the hypothesis that larger companies are more profitable by examining the relationship between enterprise size and financial performance across different contexts.

In Ukraine, the analysis revealed a strong relationship between company size and financial performance. After controlling for outliers, up to 86.93% of net profit values in 2020 could be predicted by total assets. The dependency was most pronounced in 2019, with 78.99% of total operating income correlating with total assets across the entire set of enterprises.

The tracking of dynamics between book value and net profit showed significant variations. In 2020, a negligible correlation was observed for Hungarian enterprises, with only 20% of enterprises demonstrating a direct proportional relationship. For Ukrainian companies, the correlation was much stronger, with R^2 reaching 43.24% in 2020 and potentially up to 77.65% after excluding outliers.

Interestingly, the relationship varied dramatically between countries:

- Ukraine demonstrated the strongest correlation between size and performance.
- Hungary showed a weak and inconsistent relationship.
- Poland exhibited the least predictable connection between enterprise size and financial outcomes.

The Polish market proved particularly challenging to analyse. Cluster analysis revealed that small enterprises with total assets of €2-3 million achieved the highest return on sales (12.32%), outperforming both microenterprises (4.91% ROS) and larger enterprises. These findings challenge conventional assumptions about economies of scale.

MILK PRICE ANALYSIS

The comparative analysis of European and Eastern European milk markets revealed profound market disparities:

The overall European milk market significantly surpasses the Eastern European market in terms of revenue and size. Europe is projected to generate US\$60.77 billion in 2025, while Eastern Europe accounts for US\$12.34 billion, just over 20% of the entire European market.

Per capita metrics highlight the market divide:

- European per capita milk revenue: US\$71.64.
- Eastern European per capita milk revenue: US\$51.90.
- European per capita milk consumption: 45.4 kg.

- Eastern European per capita milk consumption: 26.2 kg.

Milk price trends demonstrated remarkable variations:

- Hungary: Prices increased from €33.10 per 100 litres in 2014 to €43.57 in 2024.
- Poland: Prices rose from €32.87 to €50.15.
- Ukraine: Prices fluctuated dramatically, from €22.58 in 2014 to a peak of €68.04 in 2021, before declining.

Ukraine experienced the most extreme price volatility, with prices ranging from €22.58 per 100 litres in 2014 to €55.82 in 2019, before stabilizing at €46.90 in 2024. This volatility reflected the country's vulnerability to external economic and geopolitical shocks.

The EU average milk price increased from €37.73 in 2014 to €48.06 in 2024, influenced by market stabilization policies. However, 2024 saw regional inconsistencies, with some countries experiencing significant price fluctuations.

IMPACT OF WAR ON UKRAINIAN DAIRY SECTOR

The full-scale Russian invasion of Ukraine in February 2022 triggered profound disruptions in the dairy industry, fundamentally altering production landscapes and economic dynamics.

Production and population losses:

- Total cow population declined from 1.77 million in 2019 to 1.32 million in 2023.
- Milk production dropped from 9.3 million tonnes in 2019 to 7.0 million tonnes in 2023.
- Household milk production experienced the most dramatic decline, falling from 6.5 to 3.9 million tonnes.

Infrastructure and operational challenges:

- More than 100 commercial dairy farms were wholly or partially destroyed.
- Landmine contamination made pasture grazing dangerous.
- Power outages and infrastructure attacks disrupted processing capabilities.

Resilience and adaptation:

- Industrial farms demonstrated remarkable resilience.

- Commercial farms increased milk output by 7% in the first 10 months of 2023.
- Industrial farms' share of total production increased from 36.9% to a projected 44.9% by 2024.

The war triggered significant structural transformations:

- Shift towards more centralized and resilient production models.
- Increased emphasis on industrial farm operations.
- Development of adaptive strategies including:
 1. Spatial relocation of production.
 2. Vertical integration of supply chains.
 3. Technological innovations for energy autonomy.
 4. Cooperative resource management.

4. Trade and economic impact:

- Dairy exports focused on cheese, butter, and fermented products.
- Total dairy trade value significantly reduced.
- Increased dependence on regional markets, particularly Eastern European countries.

The Ukrainian dairy sector demonstrated remarkable adaptability, with industrial farms leading recovery efforts and developing innovative strategies to maintain production despite unprecedented challenges.

5. NEW AND NOVEL RESULTS OF THE DISSERTATION

This dissertation contributes several significant findings to the understanding of dairy sector dynamics in Eastern Europe:

- The comparative analysis of dairy enterprises in Ukraine, Hungary, and Poland revealed distinct patterns in the relationship between enterprise size and financial performance across the three countries.
- Identified a counter-intuitive development in Poland's dairy sector where market concentration increased (Gini index rising to 60% by 2020) despite substantial enterprise number growth (from 14 to 90 units), challenging conventional assumptions about market liberalisation.
- Established distinct patterns in the relationship between enterprise size and financial performance across three countries: Ukraine demonstrates strong correlation (R^2 reaching 86.93%), Hungary shows non-linear relationship with diminishing returns above €30 million in assets, and Poland exhibits minimal influence of enterprise size on profitability (R^2 of only 16.5%).
- Documented unprecedented milk price volatility in Ukraine (ranging from €22.58 to €68.04 per 100 litres) compared to EU markets, revealing vulnerability to external shocks and absence of stabilising policy mechanisms.
- Documented quantifiable resilience mechanisms during wartime, showing industrial farms maintained production levels while household producers experienced 18% decline, and cascade effects triggered compression of net margins from 17.4% to 3.1%.
- Established specific regional concentration patterns: Poland's western regions (Wielkopolskie generating €63.6 million), Hungary's eastern and western regions (Győr-Moson-Sopron with €62.7 million), and Ukraine's central-north-eastern region (Poltava with €40.0 million).
- Revealed structural shift in Ukrainian dairy sector during wartime, with industrial farms increasing their share of total production from 36.9% to projected 44.9% by 2024, demonstrating adaptation to crisis conditions.

The research documents four categories of adaptation strategies employed by Ukrainian dairy enterprises during wartime: spatial adaptation through operational relocation and distributed production systems; vertical integration via internalisation of supply chain components and on-farm processing; technological adaptation employing energy autonomy solutions and digital management systems; and cooperative arrangements including resource pooling and shared risk mechanisms. These findings extend agricultural resilience theory beyond climate and economic shocks to include war conditions, with quantified effectiveness metrics for each approach.

6. PRACTICAL APPLICABILITY OF THE RESULTS

The practical significance of these results lies in their application to investment decision-making, competition policy, reconstruction planning, and agricultural resilience building. The findings provide evidence-based guidance for dairy sector development in transition economies, particularly those aspiring to European integration.

For Policy Makers:

1. Implement context-specific strategies.
 - Ukraine: Encourage efficient consolidation, while supporting smaller farms in transition, as profitability strongly links to scale.
 - Hungary: Focus on optimising mid-sized enterprise efficiency, avoiding diminishing returns of very large farms. Introduce subsidy caps and management certification schemes.
 - Poland: Maintain diverse enterprise models by creating support schemes for small farms and strengthening regional dairy cooperatives.
2. Strengthen integration and infrastructure.
 - Support value chain integration through cooperatives and joint platforms.
 - Prioritise investment in rural transport, cold storage, and energy systems.
3. Align with EU standards.
 - For Ukraine, aim for full regulatory alignment within two years post-war.
 - Set measurable goals: 90% of processors EU-compliant, 50% reduction in border delays, and full traceability systems within three years.
4. Develop region-specific policies.
 - Ukraine: Support the central-north-eastern dairy belt, while stimulating western region growth.
 - Hungary: Tackle underutilised central regions while supporting east and west hubs.
 - Poland: Safeguard advantages of western regions while promoting balanced national expansion.

For Dairy Enterprises:

1. Strategically optimise scale and integration.
 - Ukraine: Expand into optimal herd size of 200–800 cows; invest €2,000–3,000 per cow with 4-5 year payback.

- Hungary: Target 150–400 cows, avoiding reduced efficiency at larger scales.
 - Poland: Pursue flexible scaling strategies suited to market conditions.
 - Across all three: explore vertical integration in feed, processing, and direct sales.
2. Invest in technology and resilience.
 - Adopt precision livestock systems, renewable energy, and low-emission technologies.
 - In Ukraine, prioritise distributed production and energy autonomy to reduce supply risks.
 3. Adapt financial strategies.
 - Ukraine: Build reserves equal to 6 months' costs and expand insurance coverage against volatility.
 - Hungary: Focus on operational optimisation to balance returns in mid-sized enterprises.
 - Poland: Strengthen financial risk management to protect small but high-performing firms.

For International Development Partners:

1. Coordinate comprehensive support.
 - In Ukraine, combine infrastructure, technology transfer, capacity building, and market access into five-year €1.2B support plans.
 - Allocate 40% to infrastructure, 30% to technology, 20% to training, 10% to market integration.
 - Prioritise climate-smart and renewable energy investment.
2. Facilitate knowledge transfer and human capital development.
 - Establish EU–Ukraine Dairy Excellence Centres within two years post-war.
 - Run professional exchanges (1,000 participants annually) and training schemes to reach 10,000 farmers in three years.
 - Target a 30% increase in youth engagement in dairy farming.

The implementation of these recommendations requires coordinated efforts across sectors, with the overarching aim of enhancing integration – horizontally among producers, vertically across value chains, and institutionally through coherent policy frameworks -- to support sustainable dairy development in all three countries.


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 Subject: PhD Publication List

 Candidate: Anna Gereles
 Doctoral School: Doctoral School of Management and Business
 MTMT ID: 10071652

List of publications related to the dissertation

Articles, studies (7)

1. **Gereles, A.**, Szöllősi, L.: A Study of Ukrainian Dairy Industry: Financial Performance and Trends. *SEA - Practical Application of Science*. 13 (38), 89-105, 2025. EISSN: 2360-2554.
DOI: <http://dx.doi.org/10.70147/s3889105>
2. **Gereles, A.**: Focus on Ukrainian agriculture and dairy industry: the risks and impacts of war. *Journal Association 1901 SEPIKE. Special Edition (Ukraine)*, 23-30, 2022. ISSN: 2196-9531.
3. **Gereles, A.**, Szöllősi, L.: Integrated approach in Ukrainian dairy industry: a case study from Poltava region. *Apstract*. 15 (3-4), 1-11, 2021. ISSN: 1789-221X.
DOI: <https://doi.org/10.19041/APSTRACT/2021/3-4/11>
4. **Gereles, A.**, Szöllősi, L.: Strategic Management And Modern Corporate Principles in Ukrainian Integrated Agribusiness. *Cross-Cultural Management Journal*. 22 (1), 47-51, 2020. ISSN: 2286-0452.
5. **Gereles, A.**, Szöllősi, L.: The current state and latest trends of the Ukrainian dairy sector. *Annals of the Polish Association of Agricultural and Agribusiness Economists*. 21 (2), 69-78, 2019. ISSN: 1508-3535.
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6. **Gereles, A.**: Analytical overview of dairy industry in the Poltava region, Ukraine. *Agrártudományi Közlemények = Acta agraria Debreceniensis*. 59, 47-51, 2014. ISSN: 1587-1282.
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Conference presentations (2)

8. **Gereles, A.:** Integration processes in the dairy industry of Ukraine as a major component of its development.

In: Tavasz Szél = Spring Wind. Szerk.: Keresztes Gábor, Eszterházi Károly Főiskola Líceum
Kiadó ; Budapest : Doktoranduszok Országos Szövetsége, Eger, 367-381, 2015. ISBN:
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9. **Gereles, A.:** Dairy industry in Ukraine: modern overview and trends.

In: Tavasz Szél 2014 Konferenciakötet. Szerk.: Csiszár Imre, Kőmíves Péter Miklós,
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The Candidate's publication data submitted to the Tudóstér have been validated by DEENK on the basis of the Journal Citation Report (Impact Factor) database.

31 July, 2025

