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Economic Competitiveness of Dairy Farms from the Top Milk-Producing Countries in the EU: Assessment in 2014–2021

Andrzej Parzonko [1], Anna Justyna Parzonko [2,*] and Piotr Bórawski [3]

[1] Department of Economics and Organization of Enterprises, Faculty of Economics, Institute of Economics and Finance, Warsaw University of Life Science SGGW-Warsaw, 02-787 Warszawa, Poland; andrzej_parzonko@sggw.edu.pl
[2] Department of Tourism, Social Communication and Consulting, Faculty of Economics, Institute of Economics and Finance, Warsaw University of Life Science SGGW-Warsaw, 02-787 Warszawa, Poland
[3] Department of Agrotechnology and Agribusiness, Faculty Agriculture and Forestry, University of Warmia and Mazury in Olsztyn, 10-719 Olsztyn, Poland; pboraw@uwm.edu.pl
* Correspondence: anna_parzonko@sggw.edu.pl; Tel.: +48-22-59-34-162

Abstract: This study aims to present changes in the competitive positions of the dairy farms from EU countries with the highest milk production in 2020. The assessment was based on data from the FADN system for the years 2014–2021 and covered average and large dairy farms from five EU countries: Germany, France, The Netherlands, Italy, and Poland. To assess the competitive positions of dairy farms from the selected EU countries, we developed the Synthetic Measure of Competitive Position based on the resource-based theory of enterprises. The conducted research showed that: (1) average dairy farms in Poland had the lowest production potential resulting from their possessed resources. (2) The highest value of the Synthetic Measure of Competitive Position for 2014–2021 was achieved by average dairy farms from Germany and their position in the ranking strengthened throughout the analyzed period. (3) The same analysis conducted on the group of large dairy farms showed that the competitive position, measured with the Synthetic Measure of Competitive Position, was the highest in the case of Polish dairy farms.

Keywords: dairy farms; economic competitiveness; EU countries

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1. Introduction

An important feature of a free-market economy is competition between market actors. The essence of this phenomenon is well-captured in the definition proposed by Stankiewicz [1], who stated that "competition is a scenario where participants are in contention with each other striving for similar goals, which means that the actions taken by some to achieve particular goals make it difficult (and sometimes even impossible) for others to achieve the same goals". The phenomenon of competition in economic sciences is most often described from the perspective of the competitiveness of enterprises. The review of the literature on this subject by Siudek and Zawojska [2] shows that the competitiveness of enterprises is defined differently depending on the research subject and objectives; however, most authors agree that competitiveness is a relative concept and can only be discussed in a comparative context, and that this concept needs to be operationalized. The competitiveness of enterprises is widely considered to be a complex system consisting of three elements: (1) competitive potential, understood as the total resources of the enterprise along with the competences and abilities of its employees; (2) competitive strategy, understood as an integrated and coordinated set of actions and commitments that the company undertakes in order to gain a competitive advantage in a particular market; (3) competitive position, understood as the result of competing in a given area achieved by the company, considered against the background of the results achieved by its competitors [3–5].

Nowadays, European dairy farms, even though they are most often family-run, have the nature of enterprises, and farmers have become entrepreneurs. Their goal is to derive financial benefits from their activities, which leads to competition for limited resources, mainly land and capital [6,7]. Dairy farms which are located in geographical proximity to one another and sell milk to the same dairy compete directly. However, indirect competition also takes place between dairy farms operating in different EU countries. This is, inter alia, caused by the fact that one of the key assumptions of the European Union is the principle of the free movement of goods between the member states [8]. Consequently, dairy products, and even raw milk, can be freely distributed across the EU. This situation may result in shifting milk production from countries (regions) with less favorable conditions to countries where these conditions are better. Thus, to some extent, dairy farms from individual EU countries compete with each other.

An important argument for considering the issue of the competitiveness of dairy farms in the EU is the fact that there is a great diversity of these entities in terms of the scale and technology of milk production. In 2020, there were over 467,000 dairy farms operating in EU countries. The largest number of them was in Romania (134,070), and these were entities with the smallest scale of milk production. Countries such as Bulgaria, Poland, Lithuania, Latvia, and Slovenia were characterized by a significant number of dairy farms with a relatively small production scale. At the other extreme of the farm spectrum, classified in terms of the scale of milk production, there are holdings from Czech Republic, Denmark, Estonia, and The Netherlands. The largest shares of dairy farms with an average annual production value above EUR 500,000 in 2020 were in Denmark and Cyprus, amounting to 76% and 74%, respectively [9].

This study aims to present changes in the competitive positions of dairy farms from the EU countries with the highest milk production recorded in 2020 over the period of 2014–2021. The studied period was purposefully selected to overlap the EU common agricultural policy (CAP) set for the years 2014–2020 with a transitional period in 2021–2022. The assessment used data from the Farm Accountancy Data Network (FADN) system and covered average dairy farms (representing, in the FADN, the most relevant part of the agricultural activity in each EU member state, i.e., at least 90% of the Standard Output) and large dairy farms (with a Standard Output from EUR 100.000 to 500,000) from the five EU countries with the highest milk production (Germany, France, The Netherlands, Italy and Poland). In 2020, the milk production from these five EU states accounted for 64.96% of the milk produced in all EU countries.

2. Materials and Methods

To achieve the research goal, we gathered data from the Farm Accountancy Data Network (FADN). It is a European system for collecting accounting data from farms, dating back to 1965. FADN is one of the tools that help in programming and implementing the EU common agricultural policy. Data collected within this system are used primarily to annually determine the incomes of farms operating in EU countries and to assess the effects of the EU CAP. The FADN survey covers commercial farms that produce approximately 90% of the value of Standard Output in a region or country. Farms are classified according to their type of farming based on the share of revenues from a given activity in the structure of total revenues. Our analysis covered dairy farms (type of farming—dairy farms) which, according to the FADN methodology, are entities that have a minimum share of milk sales of 66% in the structure of total farm revenues. Due to the need for transparency and relevance of the analyses, the sample of EU dairy farms for this study has been limited to the five countries with the highest milk production in 2020 in the EU: Germany, France, The Netherlands, Poland, and Italy.

The analysis has covered a group of average and large dairy farms from the five selected countries. The parameters of an average dairy farm were determined in accordance with the FADN methodology. To calculate them, the sum of individual measures (e.g., SE026—Arable land (ha)) from all dairy farms, constituting the sample of farms, is divided by the number of farms in the sample (arithmetic mean). According to the FADN methodology, large dairy farms are defined as entities with a Standard Output (SO) from EUR 100,000 to 500,000.

In the economic and agricultural literature, in order to assess the competitive position of an agricultural holding, the Werner Kleinhanss competitiveness index is used, which is the ratio of income from an agricultural farm to the costs of using the farm's own production factors [10]. The presented measure has many advantages, and one of them is the relatively simple way of determining it. One of the significant drawbacks is its failure to recognize the quality (value) of resources (mainly land and other fixed assets) compared to other farms. The analyzed indicator is blind to whether the assessed farm has a modern barn or an outdated facility requiring major renovation, only the static relationship between the generated income and the costs of the farm's own (unpaid) production factors count. It may turn out that a farm keeping cows in a depreciated building does not bear the costs of the capital employed and is more competitive than an entity keeping cows in a new (well-equipped) barn. The question arises: How long can one operate in such conditions and is it indicative of greater competitiveness?

To assess the competitive position of dairy farms from individual EU countries, we constructed the Synthetic Measure of Competitive Position. Since, nowadays, as a result of the social division of labor (after World War II), the activities of agricultural farms have been reduced to the production of mass raw materials of biological origin, the theoretical basis for the construction of this measure was the resource-based theory of enterprises. According to the resource-based theory, the source of an enterprise's success lies in the possession and appropriate use of both tangible and intangible resources, including the knowledge and competences (capabilities) gathered in human resources. This theory has been gradually developed for many years. Its author, E.H. Chamberlin, studied the impact of diverse resources on competitive position and achieving economic effects. In the mid-1980s the resource-based theory of enterprises was further developed by B. Wernerfelt, and later by such authors as: J.B. Barney and M.A. Peteraf. Representatives of the resource-based theory of enterprises focus on explaining which of the resources possessed by enterprises have the potential to build a sustainable competitive advantage and, consequently, enable them to achieve better economic results [11–14].

The literature proposes various company asset models. Itami and Roehl [15] differentiate physical, human, monetary, and invisible assets, such as: managerial skills, technologies, customer trust, and organizational culture. Barney et al. [13] distinguishes physical assets, capabilities, organizational processes, information, and knowledge. These are controlled by the company and enable the implementation of a strategy which aims to increase efficiency and effectiveness. Romanowska [16] divides resources into visible ones—a company's tangible assets, and invisible ones—related to people and culture. Even though the division of farm assets into material (visible) ones and immaterial (invisible) ones, i.e., those related to people's behavior and culture, seems appropriate, it is very difficult to identify the intangible resources on family farms.

In the case of milk production, the tangible resources that determine the competitive position of a dairy farm include: (1) area of own agricultural land (ha), (2) area of leased agricultural land (ha), (3) value of farm buildings (EUR/farm), (4) value of tractors, agricultural machinery, and equipment (EUR/farm), (5) number of cows (average), and (6) milk yield of cows (kg/year). Additionally, when assessing the competitive position of dairy farms through the prism of tangible resources, we also considered the possibilities of increasing them, i.e., (1) agricultural land lease prices (EUR/ha), (2) interest rates on bank loans, (3) remuneration for the work of hired workers (EUR/hour), and (4) the initial level of financing for the owned assets (assets) with liabilities (%). Obviously, dairy farm owners compare the effects of their work to the economic results of other community members, and similarly, an important component of the Synthetic Measure of Competitive Position is the income from farmers' own work on the farm in relation to the income of people working outside agriculture. The smaller the disparity in income, or the advantage in income from farm work compared to the potential wage outside agriculture, the stronger the arguments are for running and developing agricultural farms (including dairy farms). This study used the average gross annual wages in the national economy of a given country published by the OECD as reference values.

Since several variables (indicators) related to resources and income parity were used to assess the competitive positions of dairy farms, it was justified to use a method from the group of multidimensional analyses. Among the methods from this group, the use of Hellwig's development pattern method seemed rational. The Hellwig method makes it possible to rank studied objects according to the level of phenomena that cannot be measured by a single variable. Hellwig's method synthesizes information from a series of diagnostic variables and assigns one synthetic measure to the analyzed phenomenon [17]. This method determines the taxonomic distances (the Euclidean distance) from the evaluated objects to the reference object, which is the object with the most favorable values for each feature.

The first stage in applying Hellwig's development pattern method is normalization. As a result, indicators (variables) become unnominated quantities, i.e., without units of measurement, and the variables are unified in terms of their location and variability.

Variables may be stimulant, destimulant, nominant, or neutral. A stimulant is characterized by the fact that an increase in its value indicates an increase in the level of a complex phenomenon; destimulant—an increase in its value indicates a decrease in the level of the complex phenomenon; nominant—a variable has a specific, most favorable value called the nominal value. An increase in a variable's value to the nominal value causes an increase in the level of the complex phenomenon, while an increase above the nominal value causes a decrease in the level of the complex phenomenon. In assessing the competitive positions of dairy farms from EU countries, stimulating and destimulating indicators were used (Table 1).

Table 1. Indicators used to assess the competitive positions of dairy farms from EU countries, divided into stimulants and destimulants.

Stimulants		**Destimulants**	
Area of own agricultural land (ha)	X1	Agricultural land lease price (EUR/ha)	X7
Area of leased agricultural land (ha)	X2	Employee rental price (EUR/hour)	X8
Value of farm buildings (EUR/farm)	X3	Output rate in financing assets with liabilities (%)	X9
Value of tractors, agricultural machinery, and equipment (EUR/farm)	X4	Disparity in income from work on a dairy farm in relation to the potential wage outside agriculture (%)	X10
Number of cows (average)	X5		
Milk yield of cows (kg/year)	X6		

Source: own study.

After normalization, destimulant variables must be transformed into stimulants. This is done by subtracting the destimulant value from one (for unified data). Then, a pattern is defined, i.e., an abstract object with the best values of each feature (indicator), as well as an anti-pattern consisting of the weakest values of each indicator. In the next step, the similarity of each object to the resulting pattern is measured using Euclidean distances (d_{i0}). The lower the value of the distance d_{i0}, the more favorable its position is in relation to the phenomenon under study. In the case of the analyzed problem, it is the higher competitive position of a dairy farm.

The final stage is to determine a synthetic measure that allows for a linear ordering of the objects. In the Hellwig development pattern method, this measure (m_i) is expressed by the formula:

$$m_i = 1 - \frac{d_{i0}}{d_0}, (i = 1, 2, \ldots, n)$$

This measure usually takes values in the range [0; 1]. These values are higher the closer the object is to the pattern. The denominator of the fraction (d_0) is the distance between the designated pattern (exemplary company) and the anti-pattern, and is calculated based on the formula:

$$d_0 = \overline{d_0} + 2\,S_d$$

where $\overline{d_0} - mean,$ and $S_d - standard\ deviation.$

The factor determining the economic efficiency of dairy farms is the scale of production. Therefore, we found it reasonable to take into account the economic size of the dairy business when assessing the competitive position of this type of entity.

3. Results

3.1. Competitive Position of Average Dairy Farms from the Studied EU Countries

The values of component indicators included in the Synthetic Measure of Competitive Position differed quite significantly between average dairy farms from the EU countries selected for this analysis (Tables 2 and 3). The average number of cows per farm in 2020 ranged from 20.85 in Poland to 105.76 in The Netherlands. Variation in the number of animals generated considerable differences in the production potential. In 2020, the average dairy farm in Poland used more than four times less agricultural land than in France, and the value of tangible fixed assets (excluding land) on Dutch farms was almost five times higher than that on Polish farms (Table 2). Despite significant differences between the average dairy farms from the countries selected for analysis, their common feature was the tendency to gradually increase the scale of milk production in 2014–2020. The number of dairy cows and their milk yield gradually increased.

The indicators defined as destimulants differed significantly across dairy farms from the analyzed EU countries (Table 3). The average price of agricultural land lease in The Netherlands in 2020 was almost seven times higher than that in Poland, more than five times higher than that in France, and almost four times higher than those in Italy and Germany. Remuneration for work was also the highest in The Netherlands and the lowest in Poland.

An important indicator that demonstrates the economic attractiveness of running a dairy farm is the ratio of income from farm work compared to the potential wage outside agriculture. The only country that recorded a higher income from work on a dairy farm than the average wage in the economy throughout the analyzed period was Italy (Table 3). In turn, dairy farms in France, despite a relatively high economic potential and large scale of milk production, achieved a lower income from farm work in 2014–2021 than the average remuneration for work in the French economy. The labor income disparity ranged from 12.88% in 2021 to 58.37% in 2016. An interesting situation regarding the income disparity occurred in The Netherlands, with the disparity experiencing considerable fluctuations. In 2016, Dutch farmers running dairy farms achieved significantly lower income from farm work compared to the average wage in the Dutch economy, while in 2017 the situation was the opposite. The main reason for the fluctuations was the changes in the prices of dairy products on the global market, which resulted in changes in milk purchase prices on the local market [18]. These data show a high sensitivity of Dutch farms to changes in the market prices of dairy products in the world.

There were also differences between the analyzed farms from the selected five EU countries in the way that they financed their assets. The most indebted dairy farms were holdings from France and The Netherlands. The share of liabilities in the sources of asset financing on dairy farms in France in 2018–2021 exceeded 50%. In turn, the least indebted farms in the analyzed years were dairy farms from Poland and Italy.

Table 2. Selected indicators from average dairy farms in selected EU countries used in the construction of the Synthetic Measure of Competitive Position (stimulants).

Country	Year	Indicators (Stimulants)					
		X1	X2	X3	X4	X5	X6
(DE) Germany	2014	26.84	45.41	127,374.00	122,113.00	62.29	7448.27
	2015	27.54	49.21	142,424.00	126,472.00	67.43	7678.47
	2016	28.01	49.62	141,119.00	126,329.00	69.19	7586.93
	2017	28.21	49.40	141,323.00	133,145.00	70.10	7836.31
	2018	30.76	58.39	166,402.00	159,182.00	78.59	8031.55
	2019	31.37	59.07	173,232.00	168,263.00	78.71	8278.38
	2020	31.47	60.57	174,238.00	173,921.00	79.11	8317.47
	2021	31.22	60.99	177,146.00	183,582.00	80.02	8273.72
(FE) France	2014	11.68	78.74	108,488.00	86,426.00	58.36	6929.01
	2015	11.04	87.31	116,649.00	94,044.00	63.69	7019.03
	2016	11.41	86.11	114,673.00	90,960.00	63.65	6871.51
	2017	12.03	84.74	111,577.00	90,884.00	64.46	6926.47
	2018	12.05	98.34	136,915.00	108,096.00	72.25	7045.36
	2019	10.58	98.30	137,596.00	108,216.00	72.61	7077.45
	2020	11.23	99.10	150,989.00	118,464.00	73.02	7237.76
	2021	11.47	99.28	158,676.00	124,778.00	74.19	7255.09
(IT) Italy	2014	9.79	19.14	67,351.00	42,230.00	53.95	6057.36
	2015	10.30	21.78	70,263.00	40,385.00	51.40	6284.93
	2016	10.99	21.48	63,961.00	40,462.00	54.11	6017.46
	2017	11.78	21.24	73,639.00	40,310.00	55.96	5752.05
	2018	13.07	27.92	82,184.00	48,008.00	68.30	6058.55
	2019	13.34	25.86	85,483.00	51,654.00	67.86	6281.41
	2020	12.73	28.08	91,602.00	59,380.00	69.44	6352.70
	2021	12.66	29.79	92,874.00	62,150.00	70.06	6602.94
(NL) The Netherlands	2014	34.03	19.39	298,092.00	134,014.00	94.16	8033.12
	2015	34.84	20.85	339,257.00	139,861.00	101.65	8238.08
	2016	34.48	21.88	329,957.00	131,312.00	104.02	8323.49
	2017	36.17	21.36	340,047.00	139,612.00	104.12	8711.56
	2018	37.92	22.22	349,464.00	148,539.00	105.24	8873.58
	2019	35.94	24.14	324,741.00	156,469.00	104.25	8825.15
	2020	37.42	23.90	322,875.00	166,732.00	106.07	8877.16
	2021	35.12	26.47	311,141.00	168,358.00	105.76	8764.25
(PL) Poland	2014	15.89	5.55	46,714.00	42,214.00	16.10	5349.95
	2015	16.79	6.11	48,650.00	45,195.00	17.74	5465.39
	2016	16.34	5.74	45,351.00	39,811.00	16.92	5630.18
	2017	17.14	6.37	49,811.00	45,172.00	18.47	5868.14
	2018	17.90	8.59	54,656.00	49,988.00	20.38	6190.33
	2019	18.22	8.42	55,446.00	50,542.00	20.91	6324.16
	2020	17.77	8.07	52,889.00	50,494.00	20.86	6422.44
	2021	17.46	7.38	50,963.00	51,496.00	20.85	6291.11

X1—own land (ha); X2—leased land (ha); X3—value of farm buildings (EUR); X4—value of tractors, agricultural machinery, and equipment (EUR); X5—number of cows (average); X6—milk yield of cows (kg/year). Source: own study.

Table 3. Selected indicators from average dairy farms in selected EU countries used in the construction of the Synthetic Measure of Competitive Position (destimulants).

Country	Year	Indicators (Stimulants)			
		X7	X8	X9	X10
(DE) Germany	2014	280.16	14.12	22.4	25.26
	2015	284.05	14.04	24.8	42.66
	2016	293.57	13.91	25.4	22.12
	2017	307.23	14.66	24.6	−22.20
	2018	312.01	15.56	26.4	11.70
	2019	317.84	15.91	27.5	26.22
	2020	314.28	16.38	27.6	25.19
	2021	323.04	16.97	27.3	−22.96
(FE) France	2014	149.28	12.99	45.45	33.08
	2015	150.93	12.61	49.04	47.33
	2016	147.66	12.37	49.88	58.37
	2017	144.28	12.52	47.86	23.26
	2018	142.68	12.88	52.06	34.00
	2019	142.81	12.91	51.27	22.83
	2020	145.57	13.21	52.61	28.14
	2021	149.74	13.31	51.81	12.88
(IT) Italy	2014	277.01	11.38	3.39	−140.92
	2015	226.77	11.74	1.92	−85.28
	2016	234.17	11.99	1.23	−90.92
	2017	234.65	11.38	1.61	−97.56
	2018	224.89	12.37	1.77	−142.38
	2019	249.73	12.37	1.39	−124.11
	2020	217.20	12.44	1.47	−152.60
	2021	223.13	12.83	1.80	−148.26
(NL) The Netherlands	2014	865.24	15.24	33.12	5.04
	2015	602.45	14.90	35.40	37.21
	2016	699.50	15.77	36.72	60.31
	2017	784.55	16.44	34.21	−34.48
	2018	892.93	17.48	25.92	10.68
	2019	761.10	17.81	27.21	−6.54
	2020	778.16	18.47	27.48	32.40
	2021	783.87	19.26	25.24	11.53
(PL) Poland	2014	87.93	2.76	5.19	18.80
	2015	87.23	2.94	5.26	32.56
	2016	89.55	2.70	4.85	24.89
	2017	94.03	2.94	5.22	−4.60
	2018	93.95	5.76	6.26	0.51
	2019	97.39	6.64	5.84	3.97
	2020	98.27	6.04	5.16	5.12
	2021	103.93	5.40	4.65	−10.20

X7—lease price of agricultural land (EUR/ha); X8—price of hired labor (EUR/hour); X9—initial level in financing assets with liabilities (%); X10—disparity in income from work on the farm compared to the average wage outside agriculture (%). Source: own study.

The value of the Synthetic Measure of Competitive Position calculated for the analyzed period was the lowest for Polish dairy farms (Figure 1). The small scale of milk production, which was closely related to relatively small land and capital resources, translated into the lowest position in the ranking. Despite favorable conditions in terms of agricultural land lease prices and low prices for hired labor, the position of Polish farms throughout the studied period was the worst, and the value of the Synthetic Measure of Competitive Position for Polish dairy farms compared to Italian dairy farms, occupying the penultimate position in the ranking, was almost four times lower.

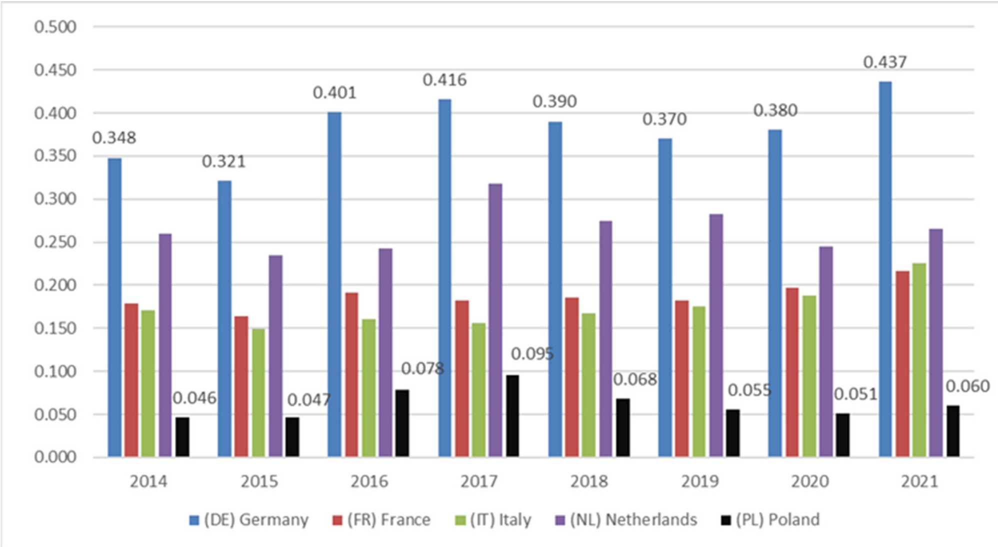

Figure 1. Synthetic Measure of Competitive Position of an average dairy farm from selected EU countries in the years 2014–2021.

The highest value of the Synthetic Measure of Competitive Position in the entire analyzed period was achieved by dairy farms from Germany. In the years 2014–2021, the position in the ranking of German dairy farms strengthened, and the value of the Synthetic Measure of Competitive Position was increased in 2021 by 25.5% compared to 2014. Dairy farms from The Netherlands, second in the ranking, achieved an increase in the calculated synthetic measure of only 2.4%. They were followed by farms from France and Italy, where the difference in the value of the Synthetic Measure of Competitive Position in 2021 was only 4% for both.

3.2. Competitive Position of Large Dairy Farms from the Studied EU Countries

The first problem in assessing the competitive positions of large dairy farms is defining this group. In the economic and agricultural literature, much more work is devoted to distinguishing small agricultural farms [19]. The most frequently used criterion for dividing farms according to size is land resources (utilized agricultural area) [20]. Economic size criteria defined as the European Size Unit (ESU) or Standard Output (SO) are also often used in the European Union countries. It should be noted that, in the case of dairy farms, there is a clear relationship between the area of land and the economic size. This is due to the fact that milk production is based on roughage (e.g., corn silage), which is difficult to purchase on the market, and is therefore most often produced on dairy farms.

In the EU, since 2010, the Standard Output (SO) has been used as an economic size measure. The European Size Unit (ESU) was abandoned as a result of a change in the method of calculating direct subsidies (separation of direct subsidies from the production). The Standard Output (SO) is calculated as the five-year average monetary value of the output of an agricultural product (crop or livestock) obtained per hectare or per head of livestock per year. The five-year reference period allows for limiting the impact of deviations resulting from variability in the production volume (e.g., resulting from harsh weather conditions or changes in the prices of agricultural products). Then, the unit value of Standard Output is related to the actual size of the business (number of cultivated hectares, number of livestock) and, thus, the Standard Output generated by a farm in a given year is determined.

The FADN survey covers commercial farms that produce at least 90% of the value of the Standard Output (SO) in a given EU country. The threshold for the economic size of farms included in the FADN survey is determined on the basis of summing the SO values of farms included in the national register of farms (starting from the largest to the smallest) until the size of the last farm is determined, which exhausts 90% of the SO value in the relevant administrative unit (region of a given EU country). The economic size thresholds determining the minimum size of agricultural holdings included in the FADN survey vary in individual member states (Figure 2), mainly due to existing differences in their agrarian structure.

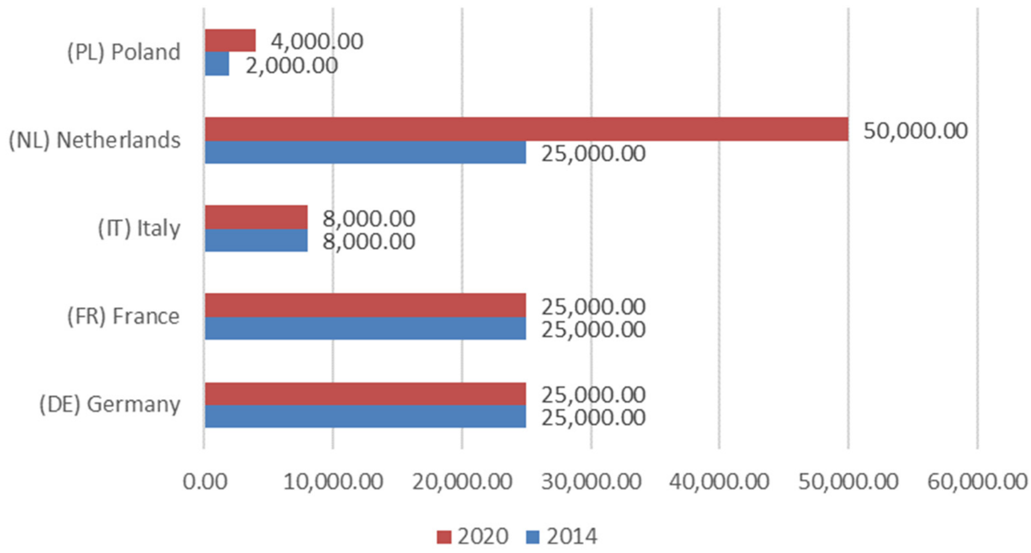

Figure 2. Minimum thresholds of the economic size of farms covered by FADN in years 2014 and 2020.

The great diversity of farms producing commercial products results in the need to separate smaller groups so that more relevant analyses can be carried out. The FADN methodology most often uses the division of farms into six size groups, where the main parameter determining the class boundaries is the Standard Output (SO). Large farms are defined as entities with a Standard Output from EUR 100,000 to EUR 500,000 a year (Table 4).

Table 4. Standard Output thresholds determining the classification of commercial farms according to size.

Ordinal Number	Size Group	Standard Output Thresholds [EUR]
1	Very small	2000 ≤ EUR < 8000
2	Small	8000 ≤ EUR < 25,000
3	Medium-small	25,000 ≤ EUR < 50,000
4	Medium-large	50,000 ≤ EUR < 100,000
5	Large	100,000 ≤ EUR < 500,000
6	Very large	EUR ≥ 500,000

Source: based on data from the EU FADN (2023).

The proposed approach to determining classes of agricultural farms in the FADN methodology was the basis in this study for separating the group of large dairy farms in the analyzed countries for the purpose of examining their competitive positions. According to this approach, a large dairy farm was defined as an entity achieving an annual Standard Output value of EUR 100,000–500,000.

The component indicators characterizing the average production potential of dairy farms, and classified as stimulants within the constructed Synthetic Measure of Competitive Position in the group of the large farms in all analyzed countries, were at a similar level (Table 5). The average number of cows in 2020 ranged from 55.83 on a Polish farm to 76.57 cows on a Dutch farm. The land resources (owned and leased) in 2020, in all studied countries apart from France (110.15 ha), were comparable and ranged from 47.3 to 75.81 ha of UAA. There was a clear difference between average farms from the studied countries regarding indicators defined as destimulants (Table 6). In the years 2014–2021, the prices for hired labor and lease rent were the lowest in Poland, and the profitability of own work on large farms in Poland clearly exceeded the level of wages in the rest of the economy.

The assessment of the competitive positions of large dairy farms using the Synthetic Measure of Competitive Position showed that, throughout the analyzed period, Polish farms achieved the highest value, but over time the competitive position of Polish dairy farms decreased compared to farms from other countries (Figure 3). The reasons for the successive decreases in the competitive advantage of Polish large dairy farms over time should be sought primarily in changes in the economic environment, in the increase in agricultural land lease prices and hired labor prices, and the decreasing profitability of the farmers' own work in relation to wages earned outside agriculture.

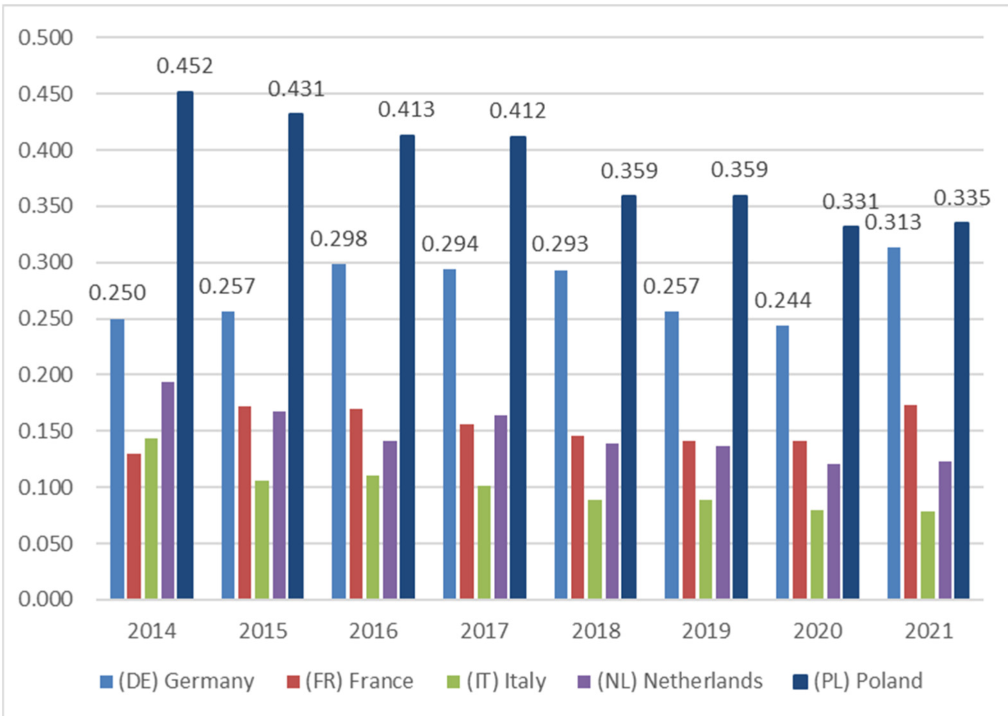

Figure 3. Synthetic Measure of Competitive Position of a large dairy farm from selected EU countries in the years 2014–2021.

Table 5. Selected indicators from large dairy farms in selected EU countries used in the construction of the Synthetic Measure of Competitive Position (stimulants).

Country	Year	Indicators (Stimulants)					
		X1	X2	X3	X4	X5	X6
(DE) Germany	2014	27.36	45.52	139,476.00	132,653.00	67.78	7338.36
	2015	26.30	44.41	138,265.00	123,985.00	65.35	7451.38
	2016	26.64	44.89	133,667.00	122,630.00	66.91	7324.65
	2017	26.93	44.62	134,045.00	128,632.00	67.73	7565.14
	2018	27.09	46.99	142,829.00	138,797.00	68.41	7616.03
	2019	27.38	47.15	149,301.00	149,273.00	68.74	7895.79
	2020	27.48	48.33	147,247.00	154,489.00	68.74	7883.33
	2021	26.84	49.06	150,511.00	162,214.00	68.98	7790.24
(FE) France	2014	10.17	92.65	125,804.00	100,242.00	67.06	7096.00
	2015	10.06	93.52	123,010.00	98,865.00	67.42	7088.77
	2016	10.29	92.77	122,140.00	97,069.00	67.94	6938.46
	2017	11.05	91.82	120,096.00	97,195.00	68.80	6976.50
	2018	11.44	97.53	126,572.00	103,946.00	70.88	6977.18
	2019	9.81	98.58	129,338.00	107,434.00	71.00	7025.16
	2020	10.31	99.84	144,293.00	117,999.00	71.35	7191.60
	2021	10.32	100.05	144,642.00	122,877.00	72.34	7144.46
(IT) Italy	2014	11.74	31.87	59,514.00	44,802.00	85.02	6073.83
	2015	11.29	30.40	60,224.00	34,227.00	73.01	5786.07
	2016	12.38	30.17	57,944.00	35,613.00	77.53	5483.80
	2017	14.13	28.76	65,198.00	34,002.00	79.58	5243.84
	2018	13.75	33.47	70,161.00	38,680.00	74.44	5709.36
	2019	14.26	31.15	74,331.00	42,861.00	76.95	5947.00
	2020	13.83	35.28	79,686.00	56,223.00	79.96	6171.90
	2021	14.00	36.53	70,783.00	55,559.00	77.31	6245.52
(NL) Netherlands	2014	28.53	17.88	241,660.00	110,118.00	79.37	7881.48
	2015	26.39	17.67	243,968.00	102,169.00	74.03	7974.89
	2016	26.19	18.45	238,966.00	94,885.00	75.56	7966.03
	2017	27.26	17.76	248,492.00	103,214.00	75.69	8422.32
	2018	28.02	17.91	246,578.00	110,568.00	74.16	8523.07
	2019	26.89	19.47	238,930.00	114,863.00	75.48	8539.60
	2020	28.01	19.29	232,303.00	120,866.00	76.57	8576.30
	2021	26.70	21.20	215,245.00	121,352.00	76.69	8479.98
(PL) Poland	2014	47.49	26.78	169,427.00	184,095.00	63.69	6875.42
	2015	41.43	23.48	152,905.00	166,054.00	57.75	7198.26
	2016	41.61	22.96	142,216.00	148,620.00	58.12	7281.12
	2017	41.10	24.45	145,053.00	151,869.00	58.61	7452.86
	2018	38.07	23.25	136,008.00	141,999.00	55.51	7426.32
	2019	37.92	23.27	135,249.00	140,951.00	56.44	7637.27
	2020	37.15	22.78	126,613.00	141,618.00	55.83	7720.85
	2021	36.17	22.28	124,866.00	148,967.00	56.61	7601.85

X1—own land (ha); X2—leased land (ha); X3—value of farm buildings (EUR); X4—value of tractors, agricultural machinery, and equipment (EUR); X5—number of cows (average); X6—milk yield of cows (kg/year). Source: own study.

Table 6. Selected measures and indicators from a large dairy farm in selected EU countries used in the construction of the Synthetic Measure of Competitive Position (destimulants).

Country	Year	Indicators (Stimulants)			
		X7	X8	X9	X10
(DE) Germany	2014	182.09	13.58	22.0	18.0
	2015	175.05	12.68	22.3	37.1
	2016	182.33	12.73	22.1	16.6
	2017	186.76	13.56	21.1	−27.6
	2018	190.29	14.59	21.9	9.8
	2019	196.79	14.85	22.9	25.1
	2020	197.51	15.37	22.5	22.5
	2021	202.77	15.77	22.5	−15.4
(FE) France	2014	139.08	12.98	47.61	29.59
	2015	137.74	12.36	49.76	46.28
	2016	134.22	12.24	50.81	56.36
	2017	130.49	12.41	48.72	20.28
	2018	125.89	12.51	50.74	33.26
	2019	127.95	12.53	50.31	23.86
	2020	130.40	12.98	52.15	28.22
	2021	133.62	12.92	51.03	15.08
(IT) Italy	2014	197.71	11.08	5.33	−215.22
	2015	158.53	10.61	2.24	−111.60
	2016	142.07	10.72	1.30	−129.49
	2017	165.35	10.84	2.04	−126.35
	2018	142.27	11.16	2.40	−143.28
	2019	158.23	11.13	1.83	−123.36
	2020	141.97	10.85	1.90	−152.99
	2021	150.96	12.28	2.00	−132.61
(NL) The Netherlands	2014	301.94	13.64	30.34	21.12
	2015	224.94	13.33	31.72	51.46
	2016	254.26	14.98	33.16	64.56
	2017	280.21	16.05	29.90	0.24
	2018	322.95	17.08	22.84	37.69
	2019	286.32	17.45	23.92	25.67
	2020	277.04	16.83	23.09	50.26
	2021	304.03	19.12	21.20	39.38
(PL) Poland	2014	35.91	2.79	11.43	−211.13
	2015	38.99	2.76	10.99	−120.42
	2016	37.22	2.65	11.21	−130.69
	2017	41.97	3.01	11.74	−226.53
	2018	44.49	3.09	11.47	−160.61
	2019	46.56	3.44	10.76	−156.35
	2020	47.34	3.85	9.57	−143.85
	2021	47.46	3.83	8.47	−181.63

X7—lease price of agricultural land (EUR/ha); X8—price of hired labor (EUR/hour); X9—initial level in financing assets with liabilities (%); X10—disparity in income from work on the farm compared to the average wage outside agriculture (%). Source: own study.

4. Discussion

Dairy farms in EU countries, even though they operate in the single market, are quite diverse in terms of resources, which determines the scale of milk production and, to some extent, translates into economic results. The main factors responsible for the diversity of dairy farms in EU countries include: (1) historical conditions [19], (2) natural conditions for breeding dairy cattle [21–23], (3) the economic development of the country [24], (4) the implemented EU common agricultural policy with various administrative restrictions, and (5) the system for calculating direct payments [25,26].

It should be noted that changes in the EU agricultural policy in the milk market, introduced successively from 2007 to 2015, increased the degree of competition between dairy farms and dairies in the EU [27–29]. The main regulations contributing to this situation included: the abolition of subsidies for the export of dairy products outside the EU, the reduction in customs duties on dairy products imported from outside the EU, the limitation of subsidies for the private storage of dairy products, and the liquidation of the mechanism stabilizing milk production in individual EU countries, i.e., the milk quotas [30]. The agricultural policy in the years 2007–2015 regarding the EU milk market made the milk markets in EU countries dependent on the situation of world markets, which translated into changes in the prices of dairy products and milk procurement prices [31]. The abolition of milk production quotas in EU countries in 2015 encouraged farmers to increase milk production on their farms, which did not always result in an improvement in their income situation [32]. In 17 EU countries, milk production in 2021 was higher compared to 2015, and the largest increases were recorded in Ireland (2.62 million tons), Italy (1.78 million tons), Poland (1.65 million tons), and The Netherlands (0.70 million tons) [9]. The countries that increased milk production significantly included those with the best natural conditions for cattle breeding. Ireland is one of the cheapest milk producers in the world. The competitiveness of Irish dairying is based on favorable natural conditions, in which the milk production system is based on the pasture feeding of cows for most of the year. The result of this production system is that Ireland has one of the lowest milk yields per cow in the EU [33].

The established highly competitive position of dairy farms from Italy and The Netherlands contributed to the increase in total milk production in these countries. In Poland, the increase in milk production in 2015–2021 was one of the largest in EU countries, even though average Polish dairy farms were clearly inferior in terms of the calculated Synthetic Measure of Competitive Position to farms from Germany, Italy, and The Netherlands. The situation was different in the group of large dairy farms, where Polish farms had comparable assets to dairy farms from Germany, Italy, France, and The Netherlands but lower agricultural land lease prices and lower labor costs enabled them to gain competitive advantages over peer farms in the other studied countries. It can be assumed that the reason for the growth in milk production in Poland was a significant increase in the number of medium and large farms. This process was partly driven by the financial resources available for investment under the EU structural funds [34,35].

The conducted research confirmed the well-known and valid rule that one of the main factors determining the competitiveness of dairy farms is the scale of production [36,37]. When producing mass raw materials, farmers are forced to constantly increase the scale of production, which increases labor efficiency [38]. It is one of the main economic indicators in a free-market economy. Increasing the scale of production enables technical progress, but the main limitation here is the biological nature of production and the need to use a very specific resource—land (a limited resource that cannot be transferred to another location) [39]. The availability of land is determined by its price, which varies greatly in the analyzed EU countries. Very well-organized dairy farms in The Netherlands, with very intensive production, where one of the basic limitations is land resources, are very sensitive to price changes on the global milk market [32]. This was confirmed by the fluctuations in the calculated Synthetic Measure of Competitive Position. An important finding of our research is that Polish large dairy farms still have competitive advantages over dairy farms from other EU countries, and this is mainly due to a lower labor cost and lower land prices. However, these advantages are gradually decreasing.

An important factor determining the competitiveness of dairy farms in the EU countries is the implemented common agricultural policy (CAP). The next programming period of the EU CAP begins in 2023, and its goals include environmental care and climate change actions [40]. Also, the European Green Deal program is being implemented, which constitutes the basis for the concept of agricultural development in the EU. Undoubtedly, the pursuit of methane reduction (reduction by 30% in 2030 compared to the 1990s) will generate additional costs for dairy farms, which may contribute to the deterioration of their competitive position in relation to farms focused on plant production [41]. We hypothesize that the number of dairy farms in EU countries will continue to decrease.

The Limitations of the Study and Areas for Further Research

According to the resource-based theory of enterprises, the source of an enterprise's success is the possession and appropriate use of both tangible and intangible resources, including the knowledge and competences accumulated in human resources. To determine the competitive positions of dairy farms, this study focuses only on tangible resources. Even though intangible resources are nowadays considered very important, their identification is quite difficult. Since our study was based on data from the FADN system, we were not able to include parameters defining intangible resources in the constructed Synthetic Measure of Competitive Position of the studied dairy farms from five EU countries, because such data are not provided by this database. This is certainly an area for further research in this field. Additionally, a certain limitation in the conducted research is the changing common agricultural policy (CAP) of the EU. In 2023, a new CAP programming period started, where greater emphasis is placed on environmental protection and animal welfare. Undoubtedly, changes in this area may affect the competitive position of dairy farms in individual EU countries. The impact of the new regulations may be the subject of further research in this area.

5. Summary and Conclusions

The European Union member states as a group are among the top producers and exporters of milk and milk products. According to the OECD, in 2021, milk production in the EU accounted for 17.4% of world production, while cheese exports accounted for as much as 39.4% of global exports [38]. Dairy farms are the key component of the dairy sector, and their development directly impacts milk production. There is a great diversity of dairy farms in the EU countries in terms of the scale and technology of milk production. In 2020, there were over 467,000 dairy farms operating in EU countries. The largest number of them were in Romania (134,070), and these were entities with the smallest scale of milk production. Countries such as Bulgaria, Poland, Lithuania, Latvia, and Slovenia were characterized by a significant number of dairy farms with a relatively small production scale. At the other extreme of farms classified in terms of the scale of milk production were holdings from Czech Republic, Denmark, Estonia, and The Netherlands [42].

The EU common agricultural policy, implemented successively from 2007 to 2015, introduced changes in the milk market which resulted in increased competition between dairy farms and dairies in the EU. The abolition of milk production quotas in EU countries in 2015 encouraged farmers to increase milk production on their farms, which, however, did not always result in an improvement in their income situation. The progressive increase in the scale of milk production on dairy farms in the studied EU countries is reflected in the change in the minimum economic size qualifying for the group of commercial farms covered by the FADN system. In The Netherlands, the minimum Standard Output from a dairy farm (threshold) qualifying for the FADN survey was EUR 25,000 in 2014, and in 2020 it was already EUR 50,000. In Poland, this number increased from EUR 2000 up to EUR 4000.

The current study findings can be summed up as follows:

1. In the years 2014–2021, out of the five analyzed EU countries with the highest milk production in 2020 (Germany, France, The Netherlands, Italy, and Poland), average dairy farms in Poland had the smallest production potential resulting from their possessed resources. In 2020, the average dairy farm in Poland used more than four times less agricultural land than the average dairy farm in France, and the value of tangible fixed assets (excluding land) on Dutch farms was almost five times higher than that on Polish farms;
2. The highest value of the Synthetic Measure of Competitive Position in 2014–2021 was achieved by dairy farms from Germany. Throughout the analyzed period, the position in the rankings of German dairy farms was strengthening and the value of the Synthetic Measure of Competitive Position increased in 2021 by 25.5% compared to 2014. Dairy farms from The Netherlands, second in the ranking, achieved an increase in the synthetic measure of only 2.4%;
3. The same analysis conducted on the group of large dairy farms (holdings with the value of Standard Output from EUR 100,000 to EUR 500,000) showed that the competitive position, measured with the Synthetic Measure of Competitive Position, was the highest in the case of Polish dairy farms. It should also be noted that, over time, the competitive position of large Polish dairy farms decreased compared to peer dairy farms from other studied countries. The reasons for this situation should be seen primarily in changes in the economic environment, mainly the increase in prices of agricultural land lease, the increase in the prices of hired labor, and the decreasing profitability of the farmers' own work in relation to wages outside agriculture.

This study requires further, in-depth research, and it is certainly advisable to track changes in the competitiveness of dairy farms in individual EU countries after the introduction of the new guidelines under the common agricultural policy for 2023–2027. Further work should focus on adaptation costs related to environmental protection and improving animal welfare.

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References

1. Stankiewicz, M.J. Konkurencyjność przedsiębiorstwa. In *Budowanie Konkurencyjności Przedsiębiorstwa w Warunkach Globalizacji*; Wydawnictwo TNOiK "Dom Organizatora": Toruń, Poland, 2005; 463p.
2. Siudek, T.; Zawojska, A. Competitiveness in the economic concepts, theories and empirical research. *Acta Sci. Pol. Oecon.* **2014**, *13*, 91–108.
3. Johnson, G.; Scholes, K.; Whittington, R. *Exploring Corporate Strategy*, 8th ed.; Prentice Hall: Upper Saddle River, NJ, USA, 2008.
4. Golovchenko, O.; Saiensus, M.; Sorokoumov, G.; Onofriichuk, O.; Zubko, O.; Liu, L. *Management of Efficiency and Competitiveness of Enterprises*; Economic Affairs: New Delhi, India, 2022; Volume 67.
5. Dzikowska, M.; Gorynia, M. Theoretical Aspects of Enterprise Competitiveness: Toward an Eclectic Approach? *Gospod. Nar.* **2012**, *255*, 1–30. [CrossRef]
6. Poczta-Wajda, A. Economic viability of family farms in Europe—A literature review. *Ann. Polish Assoc. Agric. Agribus. Econ.* **2020**, *22*, 62–73. [CrossRef]
7. Smędzik-Ambroży, K.; Guth, M.; Majchrzak, A.; Muntean, A.C.; Maican, S.S. The socio-economics factors in family farms with different economic sustainability levels from central and eastern Europe. *Sustainability* **2021**, *13*, 8262. [CrossRef]

8. Varga, P. Fiscal Barriers to Trade within the EU Internal Market. *Teka Kom. Prawniczej PAN Oddział Lublin.* **2022**, *14*, 473–485. [CrossRef]
9. Eurostat. Agriculture. 2023. Available online: https://ec.europa.eu/eurostat/web/main/data/database (accessed on 20 November 2023).
10. Kleinhanss, W. Competitiveness of the major types of agricultural holdings in Germany. *Probl. Agric. Econ.* **2015**, *342*, 24–39. [CrossRef]
11. Skinner, A.S. Edward Chamberlin: The Theory of Monopolistic Competition: A Reorientation of the Theory of Value. *J. Econ. Stud.* **1986**, *13*, 27–44. [CrossRef]
12. Wright, P.M.; Mcmahan, G.C.; Mcwilliams, A. The International Journal of Human Resource Management Human resources and sustained competitive advantage: A resource-based perspective. *Int. J. Hum. Resour. Manag.* **1994**, *5*, 301–326. [CrossRef]
13. Barney, J.B.; Ketchen, D.J.; Wright, M. Resource-Based Theory and the Value Creation Framework. *J. Manag.* **2021**, *47*, 1936–1955. [CrossRef]
14. Peteraf, M.A. The cornerstones of competitive advantage: A resource-based view. *Strateg. Manag. J.* **1993**, *14*, 179–191. [CrossRef]
15. Itami, H.; Roehl, T.W. *Mobilizing Invisible Assets. Mobilizing Invisible Assets*; Harvard University Press: Cambridge, MA, USA, 1987.
16. Romanowska, M. Kształtowanie wartości firmy w oparciu o kapitał intelektualny. In *Wywiad Gospodarczy a Konkurencyjność Przedsiębiorstwa*; Difin: Warsaw, Poland, 2001.
17. Krakowiak-Bal, A. Wykorzystanie wybranych miar syntetycznych do budowy miary rozwoju infrastruktury technicznej. *Infrastrukt Ekol Teren. Wiej.* **2005**, *3*, 71–82.
18. Bełdycka-Bórawska, A.; Bórawski, P.; Guth, M.; Parzonko, A.; Rokicki, T.; Klepacki, B.; Wysokiński, M.; Maciąg, A.; Dunn, J.W. Price changes of dairy products in the european union. *Agric. Econ.* **2021**, *67*, 373–381. [CrossRef]
19. Hornowski, A.; Parzonko, A.; Kotyza, P.; Kondraszuk, T.; Bórawski, P.; Smutka, L. Factors determining the development of small farms in central and eastern Poland. *Sustainability* **2020**, *12*, 5095. [CrossRef]
20. Wojewodzic, T. *Procesy Dywestycji i Dezagraryzacji w Rolnictwie o Rozdrobnionej Strukturze Agrarnej*; The University of Agriculture in Krakow: Krakow, Poland, 2017; 287p.
21. Schmidt, N.M. The impact of climate change on European agricultural policy. *Eur. View.* **2019**, *18*, 171–177. [CrossRef]
22. Poczta, W.; Średzińska, J.; Chenczke, M. Economic situation of dairy farms in identified clusters of european union countries. *Agriculture* **2020**, *10*, 92. [CrossRef]
23. Chen, G. Agricultural Land Use Change Options and Climate Change. *Curr. Investig. Agric. Curr. Res.* **2019**, *7*, 1020–1022. [CrossRef]
24. O'Neill, A. Share of Economic Sectors in the Global Gross Domestic Product (GDP) from 2011 to 2021. Statista 2022. Available online: https://www.statista.com/statistics/256563/share-of-economic-sectors-in-the-global-gross-domestic-product/ (accessed on 23 November 2023).
25. Kiryluk-Dryjska, E.; Baer-Nawrocka, A.; Okereke, O. The Environmental and Climatic CAP Measures in Poland vs. Farmers' Expectations—Regional Analysis. *Energies* **2022**, *15*, 4529. [CrossRef]
26. Kim, J.-K. Features and Implications of the 2013 EU Common Agricultural Policy Reform. *J. Eur. Union Stud.* **2015**, *40*, 3–34. [CrossRef]
27. Bórawski, P.; Pawlewicz, A.; Parzonko, A.; Harper, J.K.; Holden, L. Factors shaping cow's milk production in the EU. *Sustainability* **2020**, *12*, 420. [CrossRef]
28. Ziętara, W.; Adamski, M. Competitiveness of the Polish dairy farms at the background of farms from selected European Union countries. *Probl. Agric. Econ.* **2018**, *354*, 56–79. [CrossRef]
29. Wilczyński, A.; Kołoszycz, E. Economic resilience of eu dairy farms: An evaluation of economic viability. *Agriculture* **2021**, *11*, 510. [CrossRef]
30. Parzonko, A.; Bórawski, P. Competitiveness of Polish dairy farms in the European Union. *Agric. Econ.* **2020**, *66*, 168–174. [CrossRef]
31. Perrot, C.; Caillaud, D.; Chatellier, V.; Ennifar, M.; You, G. Diversity seen in French dairy farms and production regions as the era of milk production quotas comes to an end. *Fourrages* **2015**, *2015*, 57–68.
32. Klopčič, M.; Kuipers, A.; Malak-Rawlikowska, A.; Stalgiene, A.; Ule, A.; Erjavec, K. Dairy farmers' strategies in four European countries before and after abolition of the milk quota. *Land Use Policy* **2019**, *88*, 104169. [CrossRef]
33. Palma-Molina, P.; Hennessy, T.; Dillon, E.; Onakuse, S.; Moran, B.; Shalloo, L. Evaluating the effects of grass management technologies on the physical, environmental, and financial performance of Irish pasture-based dairy farms. *J. Dairy Sci.* **2023**, *106*, 6249–6262. [CrossRef]
34. Czubak, W.; Pawłowski, K.P.; Sadowski, A. Outcomes of farm investment in Central and Eastern Europe: The role of financial public support and investment scale. *Land Use Policy* **2021**, *108*, 105655. [CrossRef]
35. Kusz, D. Level of investment expenditure versus changes in technical labour equipment and labour efficiency in agriculture in Poland. In Proceedings of the 2018 International Scientifi c Conference 'Economic Sciences for Agribusiness and Rural Economy' No 1, Warsaw, Poland, 7–8 June 2018; pp. 315–320. [CrossRef]
36. Wilson, P. Decomposing variation in dairy profitability: The impact of output, inputs, prices, labour and management. *J. Agric. Sci.* **2011**, *149*, 507–517. [CrossRef]
37. Krpalkova, L.; Cabrera, V.E.; Kvapilik, J.; Burdych, J. Dairy farm profit according to the herd size, milk yield, and number of cows per worker. *Agric. Econ.* **2016**, *62*, 225–234. [CrossRef]

38. Kusz, B.; Kusz, D.; Bąk, I.; Oesterreich, M.; Wicki, L.; Zimon, G. Selected Economic Determinants of Labor Profitability in Family Farms in Poland in Relation to Economic Size. *Sustainability* **2022**, *14*, 13819. [CrossRef]
39. Kryszak, Ł.; Guth, M.; Czyżewski, B. Determinants of farm profitability in the EU regions. Does farm size matter? *Agric. Econ.* **2021**, *67*, 90–100. [CrossRef]
40. Barral, S.; Detang-Dessendre, C. Reforming the Common Agricultural Policy (2023–2027): Multidisciplinary views. *Rev. Agric. Food Environ. Stud.* **2023**, *104*, 47–50. [CrossRef]
41. Adenaeuer, L.; Breen, J.; Hayden, A. Insights in overcoming the non-adoption of voluntary agricultural ghg mitigation measures in Ireland. *Econ. Agro-Alimentare.* **2020**, *22*, 1–26. [CrossRef]
42. OECD/FAO. Chapter 7. Dairy and Dairy Products. OECD-FAO Agric Outlook 2022–2031. 2022. Available online: https://www.fao.org/3/CC0308EN/Dairy.pdf (accessed on 23 November 2023).