Income Situation of Dairy Farms in European Union Countries: A Synthetic Approach

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Abstract:

Purpose: *The purpose of this paper is to determine the market position of Polish milk producers based on a synthetic assessment of the profitability of dairy farms compared to their business partners in the European Union in 2013–2017.*
Design/Methodology/Approach: *Source materials used in this analysis was 2013–2017 data for the "dairy cows" type of farming, as retrieved from the FADN. A synthetic characteristic was used to carry out a summary assessment of dairy farms' income situation; its value was determined without making a reference to an ideal solution.*
Findings: *This study revealed the large complexity and heterogeneity of income situation of Union's milk producers. Only some farms engaged in milk production have enough income to be able to continue or develop milk production in the coming years. At the same time, a significant part of dairy farms find themselves in a poor income situation, as confirmed by a negative production profitability ratio. These farms will face considerable development challenges in the future. It follows from this study that some of the Polish dairy farms face major restructuring and modernization challenges. Also, a part of them are likely to discontinue milk production in the future.*
Practical implications: *Findings from this study can be used by the Union's agricultural policymakers and by agricultural producers and their associations. The results identify the countries where dairy farms are likely to be competitive in the future and those where dairy farms face major development challenges.*
Originality/value: *The results of this comparative analysis supplement previous research on the profitability of dairy farms. This paper proposes the use of linear ordering in assessing the profitability of dairy farms.*

Keywords: *Dairy farms, FADN, synthetic characteristic, EU, income situation.*

JEL Classification: *O52, Q12, Q14.*

Paper Type: *Research study.*

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1. Introduction

Under market economy conditions, the purpose of production processes is to manufacture and sell goods in a way that enables making profits (in enterprises that rely on an employed workforce) or earning incomes (in operators which make predominant use of their own labor). The output of an enterprise is reflected in the amount of goods produced whereas incomes derived from production activity are a proxy for its economic performance (Manteuffel, 1984). The relationships between output and economic performance can differ in nature, and can even be negative. If this is the case, increasing the volume of unprofitable production will have a deteriorating effect on the operator's economic performance. Under market economy conditions, supply often exceeds demand; as a consequence, the farmers' economic performance (especially incomes) is poor, which restricts their development capabilities and undermines their competitive position in the market.

As noted by Niezgoda (2009), considering the agricultural production processes and the diverse range of agricultural produce, in a situation where supply is greater than demand, it is of key importance for the farmers to demonstrate economic performance at a level which allows them to at least maintain their market competitiveness. However, this is known to be generally a challenge for a considerable part of farms because the agricultural market's structure is characterized by near-perfect competition on the supply side whereas the demand side often operates in quasi-monopolistic competition conditions. Or, the least that can be said is that the buyers of agricultural raw materials have an important market and contract advantage over the suppliers (Molle, 2000; Fałkowski and Milczarek-Andrzejewska, 2011; Milczarek-Andrzejewska, 2012; Malak-Rawlikowska and Milczarek-Andrzejewska, 2016).

As the basic metric used in assessing the financial situation of farms and the standards of living of the farming population, the profitability of agricultural production is analyzed in order to assess the farms' efficiency and market competitiveness (Domagalska-Grędys, 2009; Podstawka *et al.,* 2017). The purpose of analyzing the changes in farm incomes is to determine the current development trends, while having in mind that the level of incomes earned by a farm co-determines its competitiveness.

In accordance with the FADN methodology, family farm income is the category that represents the payment for engaging the farm's own productive inputs in farming operations and the payment for the risk taken by the farmer during the financial year (Goraj *et al.,* 2005). The importance of farm incomes is due to the fact that – under market economy conditions – the economic goal is to make them grow, whereas their level and growth ratio can be used in assessing competitiveness in a regional context (Domagalska-Grędys, 2009). The level of farm incomes is determined by a number of factors. The production line, the degree of specialization, the degree of production concentration, qualifications and skills of agricultural producers, environmental

conditions reflected by the strength and scope of impact of external factors, as well as the scope and pace of technological changes and the farmers' openness to innovation are aspects that have a considerable effect on it (Gołębiewska, 2010).

A fragmented structure of both land ownership and farms can be found in most countries around the world (Villanueva and Colombo, 2017). Geographic location conditions and the farm inheritance regime are aspects that significantly affect the degree of agricultural fragmentation in each country (Bentley, 1987; Graefen, 2002; Pietrzykowski, 1990; Klank, 2006; Popa and Dinu, 2015; Marciniuk, 2017; Ntihinyurwa and de Vries, 2021). Usually, in European Union countries, small farms are the predominant agricultural model (European Parliament, 2014; Guiomar *et al.,* 2018). This is particularly noticeable in Central and Eastern European countries (Czyżewski and Stępień, 2013; European Parliament, 2015; Hartvigsen, 2016; European Commission, 2021).

The Polish agricultural sector demonstrates considerable agrarian fragmentation, which means many farms have insufficient resources of their fundamental productive input, namely agricultural land. This, in turn, generally implies a low concentration level of agricultural production and, often, a negligible degree of specialized production. According to data of the Central Statistical Office (CSO, 2021), structural transformation accelerated when Poland joined the European Union (EU). This is manifested by a reduction in the total number of farms, including a declining number of small ones.

However, the development gap between Poland and many Union countries in the structure, specialization, output, economic performance and development potential continues to be noticeable. The structural transformation of the Polish agriculture accelerated largely as a consequence of the agricultural policy, especially the Union's agricultural policy encouraging farmers and other operators to increase their production scale. This resulted in making production both more concentrated and more specialized which ultimately allows farms to improve their competitiveness in the Union and global markets. In some Union countries, on-farm milk production developed for more than three decades in specific conditions, i.e. under the milk quota regime which significantly determined the production capacity of, and the volumes of raw materials delivered to, the dairy industry.

At the same time, for the consumers this meant balancing the supply of and demand for dairy products; in other words, the regime contributed to stabilizing the market in this production sector while guaranteeing decent incomes to milk producers (Boulanger and Philippidis, 2015; Alpmann and Bitsch, 2017). Compared to their partners (and competitors, at the same time) from western EU countries, Polish producers could not reap the benefits of market regulations under the milk quota regime in such a long period. However, they were much in favor of maintaining milk production quotas also after 2015 because they perceived it as a guarantee of market stabilization in both the production and price dimensions.

Without having regard to negative feedback from representatives of milk producers on abolishing milk production quotas and to foreseen consequences it would carry for the producers (Bascou, 2008; Requillart *et al.,* 2008; Binfield *et al.,* 2008, Britz and Wieck, 2008; Lehtonen, 2008; European Commission, 2010; Baer-Nawrocka and Kiryluk-Dryjska, 2010; Evaluation of CAP…, 2011), the European Commission decided to discontinue the quota regime for milk production at the end of the 2014 marketing year.

In 2013, Mansel Raymond, chairman of the Copa-Cogeca's "Milk and Milk Products" working group, stated that "due to abolition of milk quotas, 2015 will witness the emergence of new opportunities but also of new challenges, such as adverse weather conditions, extreme market fluctuations and high production costs" (KRiR, 2013). The European Union's decision to abolish milk production quotas became crucial from the perspective of future development opportunities and conditions for dairy farms as it involved shifting from a production-oriented to a market-oriented development paradigm for the milk market. That situation dramatically changed the milk producers' market position. Indeed, in the production-oriented paradigm, they could count on high prices in the internal market which allowed them to earn relatively stable incomes and develop their farms.

Conversely, in the market-oriented paradigm, they need to struggle with a much stronger fluctuation in market prices and with evolving consumer preferences. Usually, this exposes the milk production sector to a higher economic risk than before while also restricting the development capabilities of weaker farms (Baer-Nawrocka *et al.,* 2012). However, the last decade saw an increase in milk product prices at the global level and in many local markets. High prices of milk products encouraged and will continue to encourage raw material producers to invest and modernize their farms in order to gain a competitive edge. In Poland, the modernization of the milk sector must be focused on continued improvements in production efficiency but also on bridging the organizational and technological gap between Poland and other milk producers in European Union countries which are market competitors in the regional economic grouping.

Compared to the pre-transformation period, Polish dairy farms made considerable progress in terms of output and economic performance. Also, compared to what they were before the accession to the EU, they improved their standing against many partners which, at the same time, are their business competitors. However, what needs to be borne in mind is that a large development gap still exists between Poland and leading milk producing countries and farms, and that it seems rather impossible to bridge it even within the decades to come.

The purpose of this paper is to determine the market position of Polish milk producers based on a synthetic assessment of the profitability of dairy farms compared to their business partners in the European Union in 2013–2017. The assessment of the dairy

farms' profitability reflects their economic standing which, in the long run, is decisive for their development capabilities in given production and market conditions. The period of 2013–2017 was selected purposefully as it was a breakthrough moment for the Union's milk sector. The reason behind it is the abolition of the quota regime for milk production in Union countries after 31 years of it being in force in some of them (or after 11 years in the case of "new" countries which became EU members in 2004, including Poland). For both producer groups in Union countries, the abolition of the milk quota regime was a breakthrough from the perspective of the future of the milk sector at a global, regional and local level.

2. Materials and Methods

Source materials used in this analysis was 2013–2017 data for the "dairy cows" type of farming, as stored in the Farm Accountancy Data Network (FADN). FADN data is collected from a representative sample of farms with a defined type of farming, economic size and location. The data was retrieved from the official website of the European Commission. Five-year average values were used in order to eliminate the impact of random fluctuations in prices, output, costs etc. which are characteristic of farmers.

A synthetic characteristic was designed to enable a more in-depth assessment and a summary description of the farms' income situation. This is a multidimensional analysis method which allows to classify and order different units. The synthetic characteristic was built based on a method that does not make a reference to an ideal solution. It consists in using normalized characteristics of the input set (Kaczmarczyk, 2017). The taxonomic method which includes calculating the synthetic development indicator allowed to assess the profitability of dairy farms in European Union countries between 2013 and 2017, to order them and rank the objects being compared. The synthetic characteristic was developed in the following stages (Wysocki and Lira, 2005):

Stage 1. Selecting a set of simple characteristics which co-determine the complex process covered by this study, and determining their values.

Stage 2. Normalizing the values of simple characteristics.

Stage 3. Determining the value of the synthetic characteristic (indicator) based on the following formula:

$$q_i = \frac{\sum_{j=1}^{m} z_{ij}}{m}, \qquad (i=1,2,\ldots,n) \tag{1}$$

Stage 4. Linear ordering and classification of objects by type.

The set of simple characteristics necessary to determine the synthetic indicator of the

income situation consisted of income amounts and profitability ratios, including:
- gross value added (EUR),
- family farm income (EUR),
- land profitability (EUR/ha),
- family farm income per full-time family employee (EUR/FWU[1]),
- net value added per full time-employee (FTE) (EUR/AWU[2]),
- production profitability ratio (%)[3],
- milk production profitability (EUR/kg),
- income per dairy cow.

All simple characteristics were calculated as average values for 2013-2017. Cyprus and Greece were the only countries with no FADN entries due to them having an insufficient number of dairy farms in the FADN sample. Hence, they were excluded from further stages of the analysis. First, this study analyzed the coefficient of variation, which was over 20% for each of the selected characteristics. This means the characteristics demonstrate sufficient variation and, thus, have enough discriminative capacity. The next step consisted in creating the correlation matrix and the inverse matrix, and in analyzing the diagonal entries of the latter. One of the characteristics (family farm income per full-time family employee) was removed from further analysis due to it being excessively correlated with other ones. The diagonal entries of the restructured inverse matrix did not exceed 10, which means that the wrong condition number of the correlation matrix was eliminated and that the selected simple characteristics are deemed well chosen.

The next step was the specification of the nature of simple characteristics; all of them were identified as having a stimulating effect. Then, the values of simple characteristics were normalized using the unitarization procedure. The maximum and minimum values were determined in the respective sets for each characteristic. For the sake of comparability, the values of the variables with a stimulating effect were transformed as per the following formula (Wysocki and Lira, 2005):

$$z_{ij} = \frac{x_{ij} - min\{x_{ij}\}}{max\{x_{ij}\} - min\{x_{ij}\}}, \qquad z_{ij} = <0,1> \tag{2}$$

The value of the synthetic characteristic was determined without making a reference to an ideal solution, i.e. by averaging the normalized values of simple characteristics. The results fell into the interval of 0 to 1. They were distributed into four typological classes based on arithmetic mean and standard deviation of the indicator's characteristic.

3. Results

The number of dairy farms differs between European Union countries due to natural, climate and structural conditions and historical reasons. Other factors that contribute

to this diversity are the farmers' capabilities and the ever-growing number of new legal regulations. The annual average total number of European Union dairy farms participating in the FADN in 2013–2017 was nearly 600,000 (Farm Accountancy…, accessed on August 6, 2021). Figure 1 shows the distribution of dairy farms covered by the survey between different countries.

**Figure 1.** *Distribution of European Union dairy farms covered by the survey in 2013-2017*
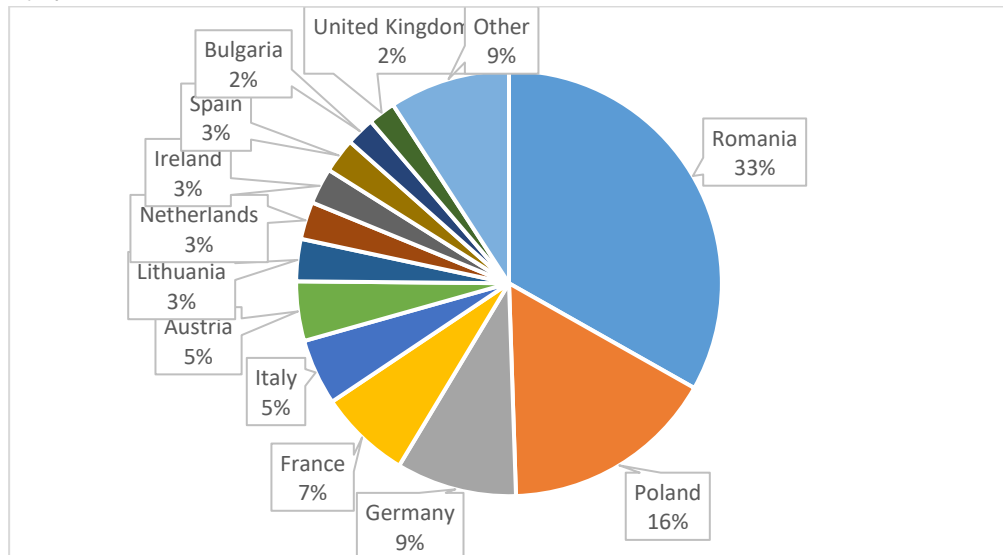
Source: *Own study based on Farm Accountancy…, accessed on August 6, 2021.*

The largest number of dairy farms was found in Romania. Each year, an average of nearly 200,000 Romanian farms were covered by FADN surveys, accounting for ca. 1/3 of the total number of dairy farms in the EU. Poland was the country with the second largest number of dairy farms (16% of the total number). Germany, one of the leaders in milk production, was home to 9% of the total number of EU farms. Ranked below, other countries with a considerable share in the number of dairy farms are France (7%), Italy, Austria (5% each), Spain, Ireland, Lithuania, the Netherlands (3% each), the UK and Bulgaria (2% each). Other countries, with up to 8,000 dairy farms, accounted jointly for 9% of the total number.

However, it is worthwhile to compare the number of dairy farms with the production volume. Note that the main milk producers in the EU are Germany, France, UK, Poland, the Netherlands and Italy which together account for ca. 70% of the total milk production volume in the EU (European Commission, 2019). It is therefore reasonable to say that the market situation in the EU is driven by only a few countries with a huge production potential. The largest milk producers are mostly EU-15 members; of the countries who joined the EU after 2004, only Poland is part of that group (Skarżyńska, 2017).

Figure 2 presents average levels of family farm income earned in 2013–2017 by an average dairy farm in each of the countries analyzed compared to incomes of an average farm.

Figure 2. *Average family farm income of farms and dairy farms in the European Union in 2013–2017 (EUR thousand)*
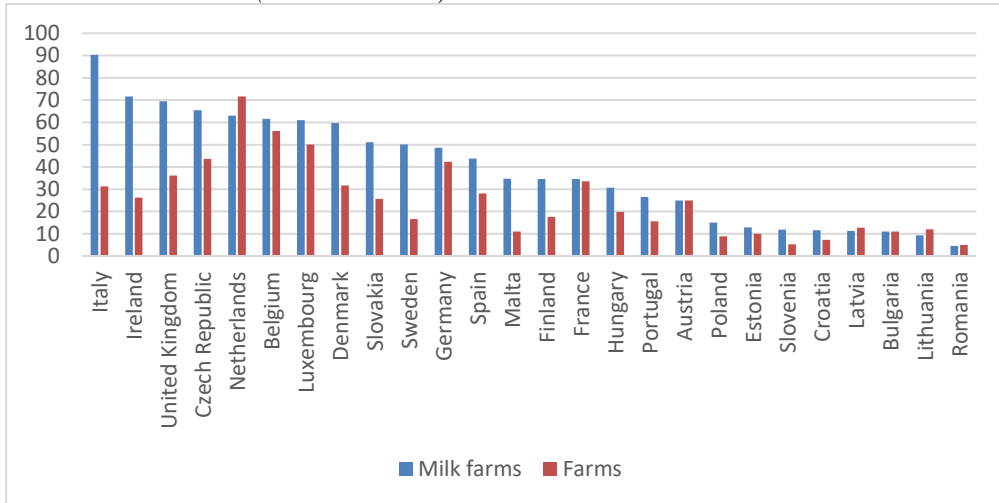
Source: *Own study based on Farm Accountancy…, accessed on May 31, 2020 and August 6, 2021.*

In all countries surveyed except for the Netherlands, Latvia, Bulgaria, Lithuania and Romania, dairy farms earned higher family farm incomes than the total group of farms. In the study period, the highest incomes were reported by Italian dairy farms (ca. EUR 90,000), followed by milk producers from Ireland and the UK (ca. EUR 70,000). Specialized dairy farms from Romania and Lithuania ranked at the bottom of that list (below EUR 10,000). In that period, the average annual family farm income earned by Polish dairy farms was ca. EUR 15,000. The largest income gap between dairy farms and the general farm population was recorded in Italy, Ireland, Sweden and Malta where dairy farm incomes were on average three times as high as those earned in the total group of farms. Note also that from the perspective of agricultural producers, the payment for their labor seems no less important than farm-level incomes. In turn, when it comes to assessing farm economics, it may be of key importance to calculate the profitability ratios (per dairy cows, per kg of milk etc.). Hence, this study was supplemented with these aspects and took them into account in structuring the synthetic characteristic.

Dairy farms covered by the survey were classified based on characteristics of their income situation. However, in order to provide a fuller picture of their economic and production situation, Table 1 presents the differences in their selected characteristics.

Table 1. *Selected production and economic characteristics of dairy farms in European Union countries in 2013–2017*

Specification	Minimum	1st quartile	Average	Median	3rd quartile	Maximum	Coefficient of variation (%)
Agricultural land area (ha)	4.0	22.5	102.1	53.0	95.6	915.8	175.4
Labor inputs (AWU)	1.0	1.8	3.4	2.0	2.5	26.0	147.5
Number of dairy cows	4.0	17.5	60.1	57.0	74.0	199.4	81.1
Total output (EUR thousand)	8.3	57.8	241.9	193.1	298.3	996.6	101.1
Milk yield (kg per cow)	2871.2	5725.8	6676.9	6822.0	7454.4	9374.4	24.1
Operating subsidies (EUR thousand)	1.3	14.0	44.3	22.2	44.9	322.1	148.0
Family farm income (EUR thousand)	4.5	13.4	38.8	34.6	60.7	90.3	62.2
Farm income less subsidies (EUR thousand)	-271.1	-8.7	-5.5	3.4	16.1	73.2	1133.3
Gross value added (EUR thousand)	5.8	28.6	111.1	90.4	142.9	525.2	103.5
Land profitability (EUR/ha)	58.0	374.7	1065.7	682.6	1109.7	8751.3	156.7
Family farm income per full-time family employee (EUR thousand/FWU)	4.5	8.2	23.7	20.3	34.7	58.6	66.6
Net value added per FTE (EUR thousand/AWU)	4.7	10.4	27.8	19.9	43.5	84.1	74.4
Production profitability ratio (%)	-27.2	-4.9	5.5	6.7	15.8	38.0	287.8
Milk production profitability (EUR/kg)	0.02	0.09	0.13	0.11	0.17	0.32	56.0
Income per dairy cow (EUR)	172.0	603.6	791.8	777.0	943.6	1639.2	40.3

Source: *Own study based on Farm Accountancy…, accessed on May 31, 2020.*

As regards production resources, note that the greatest variation was found in the area of agricultural land and the smallest in the average number of dairy cows per farm (the coefficient of variation was 175% and 81%, respectively). In the years covered by this study, dairy farms in the EU had an average of 100 ha of agricultural land but half of them had no more than 50 ha. The physically smallest farms were located in Malta and Romania (ca. 4 ha) and the largest in Slovakia (over 915 ha). The gap in labor inputs, with an average of 3.4 AWU, was smaller. Note however that it was no more than 2 AWU in half of the operators surveyed and more than 2.5 AWU in 75% of the whole group.

The highest values were recorded in the Czech Republic (over 10 AWU) and Slovakia (26 AWU). The operators covered by the survey owned from 4 cows (in Romania) to nearly 200 cows (in Slovakia). The upper quartile also included Denmark, the UK, the Czech Republic, the Netherlands, Sweden and Estonia. At that time, an average Polish

dairy farm had ca. 21 ha of agricultural land, used 1.8 AWU of labor and had barely 16 dairy cows (Farm Accountancy…, accessed on May 31, 2020). Of all the categories presented in Table 1, the smallest variation (slightly above 24%) was in the milk yield which ranged from 2,870 kg per cow (in Bulgaria) to 9,374 kg per cow (in Denmark). The average value was ca. 6,680 kg per cow and was very close to the median (Farm Accountancy…, accessed on May 31, 2020).

Subsidies, especially operating subsidies, considerably contribute to the farms' economic performance. In half of the farms surveyed, they did not exceed EUR 22,000 per year, and accounted for no more than EUR 44,000 per year in 75% of the whole group. While the variation in family farm incomes was rather small, it became extremely high upon deduction of operating subsidies, with a gap of over EUR 344,000. Without subsidies, no less than 25% of the whole group would generate a loss, and the average income would be negative, too.

One of the elements that laid foundations for the classification of EU dairy farms was the efficiency of using productive inputs in the form of land and labor. The former varied in the range of EUR 58 per ha to EUR 8,750 per ha. In half of the operators surveyed, it did not exceed EUR 680 per ha. Also, it demonstrated a high level of variation (with a coefficient of variation of nearly 157%). The figures for labor efficiency, with respect to both own labor and total labor inputs, were much less dispersed (ca. 66% and 74%, respectively). In turn, net value added per FTE varied in a slightly wider range. The greatest difference between own labor efficiency and total labor efficiency can only be seen in the third and fourth quartile. The highest payment for labor (over EUR 50,000 per FTE) was recorded in Danish, Dutch, Italian and Irish farms. At the same time, in Poland, it was barely EUR 8,900 per AWU; this means an average Polish dairy farm was ranked in the first quartile (Farm Accountancy…, accessed on May 31, 2020).

What also needs to be mentioned is the production profitability ratio which demonstrated a high level of dispersion. It was negative for first-quartile (i.e. Slovakian, Finnish, Czech, Estonian, Hungarian, Latvian and Swedish) farms which means they would generate a loss without production subsidies. The dispersion was much smaller for milk production profitability and for income per dairy cow. In the population surveyed, the average values of these ratios were EUR 0.13 per kg and ca. EUR 792 per cow, respectively. In Poland, milk production profitability was positive and quite high (22%), resulting in an average Polish dairy farm being ranked in the fourth quartile. Income per kg of milk and per dairy cow also reached a high level (fourth and third quartile, respectively) (Farm Accountancy…, accessed on May 31, 2020).

The next step of this study was to determine the income situation of dairy farms grouped into four typological classes, as shown in Table 2. The first typological group was formed by countries whose synthetic characteristic went above the sum of

arithmetic mean and standard deviation for the metric concerned. The typological group with a good income situation included dairy farms based in countries such as Ireland and Italy. The income situation was found to be better in Italian dairy farms. One of the major characteristics that made the first typological group stand apart was that the income from own labor exceeded the income from total labor. In other groups, it was the opposite. A very good income situation of Irish and Italian dairy farms was the consequence of a high production profitability ratio (of nearly 30%) which, in turn, resulted from high farm incomes without subsidies.

In other countries, farms made large use of support in the form of operating subsidies, which was manifested by an operating loss in farms without subsidies. In Irish and Italian dairy farms, average incomes without subsidies were ca. EUR 60,000. The average income per kg of milk and per dairy cow reported by milk farms in countries ranked in the first typological group was EUR 0.22 and over EUR 1,300, respectively. However, in the first typological group, gross value added presented in Table 2 was smaller than in the second and third group.

Table 2. *Income situation of dairy farms in European Union countries grouped by type in 2013–2017*

Specification	Income situation			
	I	II	III	IV
	good	medium-good	medium-poor	poor
	Ireland, Italy	Belgium, Denmark, Austria, Germany, Spain, Luxembourg, Malta, Netherlands, Romania, UK	Bulgaria, Czech Republic, France, Croatia, Hungary, Lithuania, Poland, Sweden, Portugal, Finland, Slovakia	Estonia, Latvia, Slovenia
Gross value added (EUR thousand)	106.1	118.6	120.4	55.2
Family farm income (EUR thousand)	81.0	47.1	30.9	12.0
Land profitability (EUR/ha)	2035.4	1676.2	534.8	330.2
Family farm income per full-time family employee (EUR thousand/FWU)	55.0	30.4	16.5	7.4
Net value added per FTE (EUR thousand/AWU)	52.7	38.6	18.0	11.1
Production profitability ratio (%)	29.9	11.2	-1.1	-5.3
Milk production profitability (EUR/kg)	0.22	0.13	0.13	0.09
Income per dairy cow (EUR)	1323.5	805.0	755.2	527.9

Source: *Own study based on Farm Accountancy…, accessed on May 31, 2020.*

The second typological group was composed of dairy farms in a medium-good income situation. The value of the synthetic characteristics was between the synthetic metric's arithmetic mean and the sum of its mean and standard deviation. This group includes

dairy farms from Western European countries (Belgium, Austria, Germany, the Netherlands, Luxembourg, UK) and Denmark, Spain, Malta and Romania. These countries had remarkably high levels of, profitability of land (with an income of nearly EUR 1,700 per hectare of agricultural land), incomes from own and total labor (at an average level of EUR 34,000), and a positive production profitability ratio of over 11%.

There was a considerable difference between the farms' income from own labor and total labor (the latter was more than EUR 8,000 greater). Gross value added per dairy farm was close to EUR 120,000. The average income derived from 1 kg of milk and one dairy cow was EUR 0.13 and EUR 805, respectively. In turn, the average family farm income in these countries was EUR 47,000 per year. Milk farms from these countries formed a heterogeneous group because some of them demonstrated low levels of costs per farm while others reported a high production value which entails important costs. For instance, despite having the highest production profitability ratio and the highest incomes per kg of milk and per dairy cow, Romanian dairy farms reported an average family farm income of only EUR 4,500 (with incomes from total and own labor being at a comparable level).

Also, they had a remarkably low milk yield, a small number of dairy cows (4 animals per farm), and the smallest costs (EUR 5,000) of all EU countries (which contributed to them being ranked in the second typological group). Such differences between dairy farms of counties ranked in the second typological group reflect their medium-good income situation, their potential and some opportunities which have not been fully seized by dairy farms in some of these countries.

The largest number of EU countries were classified into the third typological group. They were characterized by a medium-poor income situation, and included the Czech Republic, Poland, Croatia, France, Bulgaria, Hungary, Lithuania, Portugal, Finland, Sweden and Slovakia. They differed in the amount of gross value added, ranging from EUR 15,000 in Bulgaria and Lithuania to over EUR 500,000 in Slovakia. Characteristically, Slovakian farms had an extremely large area of agricultural land which went beyond 1,000 ha per dairy farm in 2014.

Therefore, gross value added in that group was the highest of all typological groups (over EUR 120,000). Also, family farm income in that group of countries was ca. EUR 17,000 smaller than in the second one. Most dairy farms located in countries with a medium-poor income situation had large resources of agricultural land, which translated into a low land profitability ratio. Indeed, the average income per hectare of agricultural land earned by farms in this group was EUR 535. Income from total labor (nearly EUR 18,000) was only slightly greater than income from own labor. This group's income situation is described as medium-poor as it has a negative production profitability ratio. It means that most dairy farms in this group reached extremely low levels of production profitability. Dairy farms from three countries – Czech Republic,

Finland and Slovakia – stood apart from this group because their production profitability ratio was negative and varied in the range of -18% to -27%. This was due to losses that would be generated by farms in the absence of subsidies. However, thanks to support provided to them in the form of subsidies, their income was positive. The average income per kg of milk was EUR 0.13 which is the same as in the second typological group. In turn, the average income per dairy cow in this group of farms was EUR 755, i.e. half of what was earned in the group with a good income situation (Farm Accountancy…, accessed on May 31, 2020).

The last typological group had a poor income situation and consisted of two Baltic states (Estonia and Latvia) and Slovenia. They demonstrated less favorable economic conditions than other European Union countries. In this group, gross value added (EUR 55,000 on average) was half that recorded in countries from the first group (which enjoyed a good income situation). Also, dairy farms from these countries reported extremely low annual incomes (EUR 12,000). An average income of EUR 330 per hectare of agricultural land is yet another proof of low land productivity in that group.

The profitability of labor inputs in dairy farms of the fourth typological group was very low. Incomes from total labor inputs in Estonian, Latvian and Slovenian farms were by ca. EUR 4,000 higher than incomes from own labor of farmers or their family members. The income situation categorized as poor had a remarkably high negative production profitability ratio (at an average level of -5%). This is equivalent to a business loss being suffered by non-subsidized farms. The average levels of milk production income per kg and per dairy cow were low, too, at EUR 0.09 and EUR 528, respectively. The income situation was particularly bad in Estonian dairy farms. In that country, the number of farms is small and the area of agricultural land per farm exceeds 200 ha. As farmers produce milk primarily for their own needs, the average income per kg of milk was EUR 0.02. Generally, the reason behind the poor income condition of countries of the fourth typological group were unfavorable farming conditions and, as a consequence, high production costs (Farm Accountancy…, accessed on May 31, 2020).

4. Discussion and Conclusions

One of the primary goals sought by economic operators, including farms, should be (and usually is) to attain a level of economic performance which allows them to continue their activity in the following years. A benchmark of economic results presented synthetically (especially including the profitability of dairy farms in European Union countries) demonstrates that they differ between the countries. This also means that dairy farms' market position differs considerably depending on their profitability which, from an economic perspective, determines their future development capacity and thus translates into market competitiveness. Based on these findings, it can be concluded that a good and a poor income situation of dairy farms are a relatively rare occurrence in the Union's agricultural sector; indeed, in the

context of the results of this study, it was the case for two and three Union countries, respectively.

Compared to the whole farm population surveyed, only Italian and Irish dairy farms demonstrated a good income situation (first group). Conversely, a poor income situation was characteristic of Estonian, Slovenian and Latvian dairy farms (fourth group). In the study period, there was a significant difference in gross value added between these two extreme categories of income situation of dairy farms in Union countries. In the first group, it was almost twice that recorded in the fourth one (ca. EUR 106,000 vs. EUR 55,00).

In these two groups of dairy farms, specific relationships were formed between family farm income and gross value added. In the first group, production processes resulted in a situation where farming income derived from gross value added accounted for more than 76% of it. Conversely, in the fourth group, barely 25% of gross value added was left as the farming income. Moreover, dairy farms from the two groups considerably differed in the profitability of production processes, i.e. in income per dairy cow. It can be demonstrated that, defined as such, profitability of the best farms (first group) was two and a half times that recorded in the worst ones (fourth group). Note that in her analysis of competitiveness of dairy farms in European Union countries based on 2013–2015 FADN data, Nowak (2018) came to similar conclusions in that respect. Indeed, she used an economic metric in the form of average farm income in assessing the competitiveness of specialized milk producers, and found that the highest values were recorded in Italian farms (among others).

At the same time, countries such as Estonia, Latvia and Slovenia demonstrated low levels of farm income and ranked at the bottom. Czakowska and Sass (2008) indicated that in Ireland, the dairy sector is generally viewed as the most profitable farming activity. The results of this study confirm that this situation persisted between 2013 and 2017 because Irish dairy farms were classified into the first group; this reflects their good income condition as per the evaluation criteria. The dairy farms' income situation differed considerably between the first and the fourth group in that the production profitability ratio was negative in the fourth group and was positive and extremely high (nearly 30%) in the first one. The significant differences result from the nature of production processes run by dairy farms in these countries and from the natural conditions for dairy production. It has to be borne in mind that dairy farming is strictly related to vegetable production (Ziętara 2002; 2007).

In Ireland, environmental conditions are favorable to milk production, milk yield is high, and adequate production technologies are deployed, especially as regards cow feeding, reproduction and welfare. All of these factors play a decisive role in making production economically viable, i.e. in ensuring a good income situation. A study by Skarżyńska (2012) clearly shows that the *"role of dairy cow yields play a crucial role in the milk production process. When at a higher level, it stimulates an increase in*

incomes and production profitability despite higher animal maintenance costs. Also, it results in a decline in unit costs of milk production and drives a more efficient use of workforce." In turn, based on research by Sompolska-Rzechuła and Świtłyk (2016), it can be demonstrated that the likelihood for a dairy farm to increase its income (and thus to improve its income situation) significantly depends on aspects such as: area of agricultural land; number of dairy cows, yield-boosting investments, purchased feedingstuffs, other direct costs of animal production; and depreciation costs.

The group of Union dairy farms is dominated by operators in a medium-good or medium-poor income situations. In the study period, these types of dairy farms were present in most Union countries, and formed two nearly equally sized sets of countries (10 and 11, respectively) (Table 2). Both typological groups of dairy farms reported very similar levels of gross value added (an average of ca. EUR 120,000 per farm). Conversely, when analyzing other indicators of dairy farms' income situation, considerable differences can generally be identified between the two typological groups.

First of all, there is a noticeable difference in family farm incomes. The value of family farm income in the third typological group (medium-poor farms) was 2/3 of that earned in the second group (medium-good farms). Such a relationship must result from a much greater cost intensity of milk production in farms from the third group compared to those ranked in the second one. The existence of this situation is corroborated by the levels of production profitability in both typological groups of farms. Significant differences between members of the two groups were identified in that respect, too. In the second typological group of dairy farms, operations which consisted mostly in milk production were profitable, as reflected by a positive production profitability ratio of over 10%. Conversely, in the third group of dairy farms, milk production operations were unviable, as confirmed by a negative production profitability ratio of -1.1%. The relationships identified above are of key importance to the functioning of the Union's milk sector, both in the macro (market) dimension and at the micro level, i.e. from the perspective of the farms' production economics.

In some of the key producers of the Union milk market, including France and Poland (Table 2), milk production results in a medium-poor income situation, and is characterized in particular by a negative production profitability ratio. Their poor economic performance, especially that of milk producers based in France – one of the Union's leading milk producing countries, is also confirmed in findings from other research. Skarżyńska (2017) demonstrated that the average incomes of a French non-subsidized farm in 2010–2013 was even lower than those of Polish farms (a total of EUR 5,500 vs. EUR 8,400). The amounts of income specified above are significantly different from what is recorded in countries such as the UK and the Netherlands (ca. EUR 40,000) and Italy (over EUR 60,000). Meanwhile, the payment for labor in French dairy farms was lower than in Poland (with EUR 3,300 per FWU vs.

EUR 4,800 per FWU). In turn, instruments of the EU's Common Agricultural Policy, especially operating payments, had a significant impact on the increase in farm incomes. With payments included, incomes of French farms were 2.5 times higher than in their Polish peers but remained no less than twice smaller than those recorded in British and Italian farms.

Hence, the economic situation of French and Polish dairy farms being relatively worse than in other Union countries is quite a persistent phenomenon, as this is confirmed by up-to-date research results. One of the ways to improve the relatively poor economic performance of countries from the third typological group in the coming years will most probably consist in continued concentration of production in order to derive benefits from economies of scale.

However, if the future shows that the expected economies of production scale are not enough to improve the whole economics of production processes in dairy farms, reducing domestic milk production and replacing it with milk imports is a possible scenario to be considered. This situation provides potential opportunities for market expansion to producers based in countries from the first and second typological group whose good or medium-good income situation enables further development of milk production.

In summary, it may be concluded that this study revealed the large complexity and heterogeneity of income situation of Union's milk producers. Only some farms engaged in milk production have enough incomes to be able to continue or develop milk production in the coming years. At the same time, a significant part of milk farms (in nearly half of Union countries) find themselves in a poor income situation, as corroborated by a negative production profitability ratio (which means that the farms' operations were economically unviable). Such farms will face major development challenges in the future, some of them are likely to exit the market and discontinue milk production.

As shown by this study, these adverse events can also affect some dairy farms which currently operate in Poland. This is especially true for those that, based on their economic performance, can be viewed as being in a poor income situation which most probably will make them unable to undertake modernization and restructuring efforts in the future. At the same time, considering the competitive strategies of Polish dairy farms and having in mind their current production potential and competitive position and the economic performance of most farms, it seems more reasonable to expect that the agricultural sector and the farms will develop in accordance with the induced development strategy (Hayami and Ruttan 1971; Wilkin 1986), i.e., mainly based on resources external to the farm itself, with the use of support instruments available under the European Union's Common Agricultural Policy.

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Notes:

1 FWU (Family Work Unit) is equivalent to 2120 hours of family work within a year (Floriańczyk et al., 2017).

2 AWU (Annual Work Unit) is equivalent to 2120 hours of work within a year (Floriańczyk et al., 2017).

3 A ratio between the amount of income per farm (less operating subsidies) and total output (Skarżyńska, 2017, p. 28).