THE ECONOMIC IMPACT OF CRISIS ON MILK MARKET IN SELECTED DAIRY FARMS IN EUROPE

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Abstract. The article is devoted to the discussion of changes that took place on farms specialized in milk production in the period before and after the milk market reform in Europe. 124 farms were selected for the study, all having participated in the analysis of milk production costs in the European Dairy Farmers (EDF) from 2012 to 2016. The work examined selected changes in the organization of production and economic effects on farms. The results indicate a clear increase in production, resulting both from the increase in the size of cow herds, and from the improvement of milk productivity in all groups of farms. The largest differences between groups in the costs incurred in milk production were in alternative costs and depreciation. The unfavourable price situation on the market in 2016 meant that the total costs of milk production were lower than milk prices in only 12 % of the analysed farms.

Key words: total costs, agricultural income, break-even in milk production.
JEL code: D24

Introduction

The survival of farms on the market requires constant adaptation of their activities to the changing environment. Most often, to meet the market's challenges, farms deepen their specialization or diversify their activities (Bowler I., 1992, McNamara K. et al., 2005; Meerta, H. et al., 2005; Krammer M. et al., 2012). Such activities lead to the concentration of production and are manifested in increasing the volume of produce on farms (Brodzinska K., 2016). An example of progressing concentration processes is the Polish milk market. Data from the Polish Central Statistical Office (GUS) show that in 2016, compared to 2010, the number of farms raising cows decreased by 42 % (from 453.000 to 266.000), at the same time milk production increased nearly 8 % (with a smaller cow population by almost 11 %). The final effect of implemented farm strategies is influenced by many factors that may weaken or strengthen concentration activities. A large group of determinants affecting farms' behaviour are legal regulations on the milk market. Their diversity on the EU market, among others, in the level of support for milk production in individual Member States increases the inequality of competition conditions (Grochowska R., 2017). An example of this could be the governmental national programmes (e.g. in Germany) and financial incentives from the dairy processing sector that encourage farmers to reduce the amount of milk production. They have led to a slowdown of production growth in 18 from 28 countries in the EU, including a production drop in 12 countries (Hemme T. et al., 2017). Despite many studies on the impact of the abolition of milk quotas on production levels and prices of milk, it is extremely difficult to determine precisely these effects. Forecasts and real extent of the impact of regulatory changes remain very divergent (Short Term Outlook ..., 2014; EU Milk Market Observatory, 2017). The influence of these factors was additionally imposed by the global situation related to the introduction of an embargo in trade with Russia and an increase of production in countries belonging to the group of the largest milk producers (India, Pakistan, the United States etc.), which effectively limited the possibility of selling milk surplus on the global market. As a consequence of the impact of many factors, the average price of milk on farms on the world market in 2015 was lower by approximately 34 % compared to 2014 (Hemme T. et al., 2016). As a result, the economic situation of farms, which depends on the price and the costs of producing the product, deteriorated.
From the long-term development perspective of the farms, the advantage over market competitors should have its source in the specific configuration of the resources used in the production process but should not be the result of a short-term increase or decrease in prices on the market. Achieved competitive advantage is particularly important in periods of difficult market conditions. Considering the crisis in the European milk market in 2015-2016, the aim of the work was to determine the evolution of income in dairy farms and to present the basic directions of changes on farms that differ in the level of milk production profitability.

**Research methodology and material**

The empirical studies used the data on farms participating in the analysis of milk production costs by the European Dairy Framers (EDF). 124 farms were selected for the analysis, which provided data each year during the period of 2012-2016 and in which milk production was conventional. The population was divided into quartile groups due to increasing total costs of milk production incurred in 2012. The data indicate (Figure 1), that there is a full negative dependence between the total costs of milk production and the income from management obtained on farms (Pearson's correlation coefficient - 0.91). At the same time, no connection was observed between milk prices achieved on farms and the level of income taking into account the total milk production costs (Pearson correlation coefficient 0.07).

![Graph showing Connections between total milk production costs and prices and the amount of management income on farms in 2012 (euro/100 kg ECM)](source: author's calculations based on EDF data 2013)

This paper presents average results for the whole group of farms and for two extreme quartile groups: q1 with the lowest and q4 with the highest total milk production costs. The groups were of...
permanent character, which means that the farms classified as quartile in 2012 remained such throughout the analysis period.

The analysed groups of farms, apart from production costs, differed in the production potential and in the use of production factors in production process (Table 1). The farms from the q1 group were characterized by a greater amount of milk produced, which resulted mainly from a larger average herd of cows. The average milk yield of cows was lower than in the whole population by almost 0.5 t ECM per cow per year. The average share of the forage area rented and labour input per cow was similar in the extreme quartile groups. An important parameter differentiating farms was the average value of capital per cow. On average, capital expenditures in the q4 group were about 2.2 times higher than in the q1 group.

### Table 1

**Basic parameters of the analysed farms in 2012**

<table>
<thead>
<tr>
<th>No</th>
<th>Parameters</th>
<th>Unit of measure</th>
<th>Groups of farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Number of farms</td>
<td>unit</td>
<td>q1</td>
</tr>
<tr>
<td>2</td>
<td>Total costs of milk production</td>
<td>euro/100 kg ECM*</td>
<td>28.1</td>
</tr>
<tr>
<td>3</td>
<td>Size of cows herd</td>
<td>no/farm</td>
<td>275</td>
</tr>
<tr>
<td>4</td>
<td>Milk yield</td>
<td>kg ECM/cow</td>
<td>8404</td>
</tr>
<tr>
<td>5</td>
<td>Milk production</td>
<td>t ECM/year</td>
<td>2473</td>
</tr>
<tr>
<td>6</td>
<td>Stocking rate</td>
<td>LU/1 ha forage area</td>
<td>1.71</td>
</tr>
<tr>
<td>7</td>
<td>Share of forage area rented</td>
<td>%</td>
<td>57.6</td>
</tr>
<tr>
<td>8</td>
<td>Labor input</td>
<td>h/cow</td>
<td>44.6</td>
</tr>
<tr>
<td>9</td>
<td>Capital input</td>
<td>1000 euro/LU</td>
<td>4323</td>
</tr>
</tbody>
</table>

* ECM (Energy Corrected Milk) means milk with adjusted energy content: 3.3 % protein and 4.0 % fat.

**Source:** author’s calculations based on EDF data 2013

The economic performance of farms was determined in accordance with the methodology used by EDF, which is slightly different from the FADN (Farm Accountancy Data Network) methodologies at the intermediate stages of agricultural income calculation. Direct costs of milk production \((D_c)\) in the EDF methodology include costs of animal purchase, costs related to raising heifer for sale, insemination, veterinary services and medicines, other direct costs in animal production and costs related to purchase of feed and production of own feed (seed material, fertilizers, plant protection products and other costs related to the production of feed) intended for animal feed in the milk production industry. The overheads costs and costs of production factors are determined in the same way as in FADN.

In order to assess the economic condition of family farms, management income \((EP)\) was used, considering the alternative costs of own production factors: land, capital and labour. It was calculated in accordance with the formula:

\[
EP = FI - OppC
\]  
(1)

Where:

- \(EP\) – entrepreneurs profit;
- \(FI\) - agricultural income;
- \(OppC\) - opportunity costs of own production factors: land, capital and labour.

Farm income in milk production was calculated according to the formula:

\[
FI = R - D_c - O_c - Dep - Pf_c
\]  
(2)

Where:
FFI - family farm income;
R - revenues (sales of milk, cattle in the milk production industry and other revenues, e.g. subsidies related to milk production, VAT balance, etc.);
$D_c$ - direct costs in the milk production industry;
$O_c$ - overheads costs in the milk production industry;
Dep - depreciation of: machinery, equipment and buildings involved in milk production;
$Pf_c$ - costs of production factors (land rent, capital costs, including interest and hired labour costs involved in milk production).

Valuation of the use of one’s own factors in production is very important in the case of comparisons of production and economic results of farms that differ in the structure of resource ownership (land, capital and labour). In the literature, approaches to the valuation of involved resources are slightly different (El Ostra H. et al. 1996; MacDonald J. et al. 2017; Goraj L. and Manko S., 2011; Skarżynska A., 2011). The costs of so-called lost benefits in this analysis were determined according to the same method in each individual country participating in the study. Opportunity costs of own land used in milk production were determined on the basis of land rent in the area of the farm’s operation. The opportunity cost of capital (without land) was determined on the basis of interest on bank deposits with a maturity over 2 years for non-financial corporations. The alternative costs of the family labour force were estimated on the basis of the product of the annual workload of family members and remuneration rates (hourly rates were calculated on the basis of annual gross wages and salaries in the national economy without bonuses and rewards).

In determining the farm income and entrepreneurs profit in the milk production sector, only the costs, revenues and subcharges assigned to this production were taken into account. The research also determined the break-even points in milk production. They were set on two levels. The first break-even point was determined on the basis of the general costs (the sum of direct costs, overheads costs, external factors and depreciation). The second break-even point is determined by the total costs of milk production (excluding milk quota costs). The calculation of break-even points of milk production is based on the simplification assuming that the revenues obtained in the milk production sector, other than milk sales, have their source in non-core activities and their amount is equal to the production costs of the sold products. The break-even points in this case inform about the minimum milk price required to cover general costs or total costs.

Research results and discussion

The production of milk on farms throughout the analysis period increased. On average, about 6 % more milk was produced each year in the whole population, which in consequence led to an increase in production by about ¼ in comparison to 2012 (Figure 2). This increase was mainly due to the increased number of cows in herds (in the whole population, the growth of an average herd was 19 %). The dynamics of increase in cow herd size was comparable between the extreme quartile groups (increase by 17 % in the q1 group and 19 % in the q4 group in 2016 as compared to 2012). However, the increase expressed in the number of cows in the herd was higher in the group q1 (46 cows), in which in 2016 an average herd had 321 cows and in the q4 group - 207 cows (an increase of 34). The increase in cow herd observed in the surveyed population confirms the results of other studies - the abolition of milk quotas in the EU will lead to an increase in the size of cow herds on farms, especially large ones (Groenvelda A. et al. 2011; Kempena M. et al. 2016 Zenga S. et al., 2016). The increase in the number of animals progressed systematically
throughout the analysis period and no abrupt increase was observed after the liquidation of milk quotas, as it was expected in other studies (Huettel S. et al., 2011, Louhichi K. et al., 2010).

Milk yield increased by about 5% until 2016 in the population. This increase was particularly visible in the last year of the analysis, in which it amounted to 2% compared to 2015. Slightly higher increase of productivity of milk was observed in the q4 group, by about 6%. As a result of changes in the size of the herd and milk productivity, the average milk production on farms in 2016 was nearly 2.5 thousand and the difference between the production of the q1 and q4 groups was nearly 1000 t ECM per year.

![Graph showing herd size, milk yield, and milk production in groups of farms from 2012 to 2016](image)

**Source:** author’s calculations based on EDF data

Fig. 2. The average herd size, milk yield of milk and milk production in groups of farms in 2012-2016

Changes in production volume on farms were related to the impact of many market factors and the need to adapt to new legal conditions (e.g. the abolition of milk quotas in the EU). The declining income of farms from 2015 on resulted mainly from the decline in prices of milk and cattle. On average, milk sales accounted for no less than 85% of the total revenue in the milk production sector. A similar level of income in separate groups of farms resulted from similar milk prices, which in the first quartile were on average 2% lower and in the fourth quartile by about 1% higher than the average prices in the EDF group. Total revenues varied analogously in groups - the differences were 1-2 euros per 100 kg of milk. The lowest total revenues in all groups of farms occurred in 2016, they ranged from 33 euros in the group q1 to 35 euros in the fourth quartile. The average decline in total revenues between 2014 and 2016 was 23%.

![Graph showing revenues, total costs, and entrepreneur's profit in milk production from 2012 to 2016](image)

**Source:** author’s calculations based on EDF data

Fig. 3. Revenues, total costs and entrepreneur's profit in milk production on farm groups in 2012-2016 (euro/100 kg ECM)

The evolution and level of total costs and their components was definitely more diversified than in the case of revenues in milk production (Figure 4). The average total costs of production in the milk production sector in 2016 in the whole population amounted to 40 euro and were lower by
8% than in 2012. In the first quartile of the population, in 2016 these costs were lower than in the q4 group by over 9 euros. However, the difference in costs between these groups in comparison with 2012 decreased by 8 euros per 100 kg of ECM (in 2012 the difference to the disadvantage of the q4 group was 16 euros). The decrease resulted mainly from the reduction of direct costs, initiated in most farms in 2013, but was most visible in 2016. The farms mainly reduced the costs incurred for the purchase feed and production of own feed (e.g. fertilizer costs). Other costs of milk and feed production have also been reduced. The biggest differences in particular cost categories between groups were observed in depreciation and opportunity costs. It was connected with very large differences in capital expenditures, located mainly in machines and buildings involved in milk production. In 2016, in the q4 group, the sum of these two cost categories was 50% higher than in the farms from the q1 group. The level of real costs (direct, overheads and production factors costs) in individual groups differed significantly less. The range of their value was 2.8 euros, in favour of the q1 group (lower real costs than average in the population).

Source: author’s calculations based on EDF data

Fig. 4. Development of the level of various cost categories in the milk production sector in the groups of farms in the years 2012-2016 (euro/100 kg ECM)

The income situation on farm groups was very diverse (Figure 3). The farms in 2016, i.e. at the time of the largest drop in revenues, were not able to cover the alternative costs of their own production factors. The income from management in all groups of farms was negative, which means that using their own production factors in an alternative way would allow them to avoid or reduce losses. In the q1 group, entrepreneurs profit was achieved by 2015, only in 2016 it reached negative values and amounted to -3 euros per 100 kilograms ECM (the losses per farm amounted to approximately 9,5 thousand euros and after taking into account subsidies the loss has decreased to the level of 2,000 euros). In the q4 group, the management losses were significantly higher. From the beginning of the analysis, management revenues were not obtained even after including non-production subsidies.

Taking into account only the costs of milk production in the analysis and their comparison with the obtained prices for the product give the opportunity to assess the profitability of milk production (Figure 5). In the analysed period, the first break-even point was reached in all groups. This means that direct costs, overheads costs, external factors and depreciation (in Figure 5 termed as general costs) related to milk production were covered by the milk price obtained on farms. At the same time, the difference between the price of milk and the total costs of its production did not allow them to cover the costs of using their own production factors in most farms and for most of the years. Such a situation occurred in all groups of farms in 2016. Out of the entire population, only in 15 farms the second break-even point was reached (with 7 farms
from the first quartile group). The loss ranged from about 3 euros in the group q1, to about 9 euros in the q4 group for every 100 kg of ECM. Farms from the first population quartile maintained their advantage in terms of total milk production costs. Compared to the q4 group, these costs were lower by more than ¼ (26%), which, considering the prices of milk at similar levels, allowed those entities to achieve the highest profitability in 2012-2015 and the smallest loss in 2016.

Conclusions
1) The studies carried out indicate that 25% of farms from the sample, with the lowest total costs of milk production, were characterized by far bigger herd size of cows with simultaneously lower milk yield in the sample. In the last five years, the analysed farms aimed at increasing production, both during the periods of growth and price decrease.
2) The increase in milk production with quite unstable level of milk prices translated into the profitability of its production. In the context of this profitability, the costs of milk production played a key role. Such a claim results from the lack of a clear differentiation in the level of prices between groups of analysed farms. In the formation of costs in all groups, there is a tendency to reduce them, especially in the situation of a deep price drop in 2016. The results clearly show that the differences in the level of costs incurred decreased, especially in the area of direct costs.
3) Based on general costs, it can be concluded that milk production in 2012-2016 was profitable (except for 2016 in the q4 group). However, in the vast majority of farms, the farm income did not reach the level sufficient to cover opportunity costs in milk production, especially in 2016. It should be emphasized that the group of farms with the lowest total production costs maintained its advantage in profitability over farms from other groups, the gap in the level of costs between the groups was reduced.

Bibliography


