Joanna Baran

Warsaw University of Life Sciences – SGGW, Poland

THE PRODUCTION SCALE OF POLISH DAIRY COMPANIES AND THEIR ECONOMIC AND FINANCIAL RESULTS

SKALA PRODUKCJI POLSKICH PRZEDSIĘBIORSTW PRZETWÓRSTWA MLEKA A ICH WYNIKI EKONOMICZNO-FINANSOWE

Key words: production scale, economic performance, financial performance, dairy cooperative

Słowa kluczowe: skala produkcji, wyniki ekonomiczno-finansowe, spółdzielnie mleczarskie

Abstract. This article presents assessment of relation between the scale of dairy cooperatives and their economic and financial performance. The analysis, based on 578 observations, shows that the scale of dairy cooperative is correlated with most of efficiency measures.

Introduction

Dairy industry is one of the most important branches of the Polish food industry. However, it belongs to business lines dominated on average by relatively small-sized companies. Despite the fact that recently the concentration processes in the sector have gathered momentum, the average size of Polish companies is much smaller than the size of the world leaders. In the sector literature authors stress positive scale effects on efficiency of dairy companies:

- Pijanowski and Gaweł based on the experience of developed countries, in particular the United States, stress remarkable reduction of costs of cheese production in large plants [Pijanowski, Gaweł 1986];
- Guba identifies increasing returns to scale at the stage of processing and decreasing returns to scale in milk supply; he believes that the production volume of a dairy, for which diseconomies of scale with regard to milk supply arise, depends on the degree of dispersion and scale of suppliers; he refers to evaluations of the scale effects prepared by German and Polish researchers, which indicate savings at the level of 26-43% with regard to consumption of the labour factor, capital savings at the level of 18-19% and 0-23% savings of material, with doubled production volume [Guba 2000];
- Wiendlmeier shows the potential for savings with regard to unit costs to be achieved by increasing the scale of dairy production [Wiendlmeier 2001];
- Thiele presents curves of unit costs for selected dairy product ranges (pasteurized milk, butter, ripening cheeses and crud-style chesses) depending on the production volume; the curves take on the L-shape known in the economics literature signaling observable increasing return to scale [Thiele 2005];
- Pietrzak shows the positive impact of the size of the dairy cooperative scale on the indices of economic work output and of the Cooperative Additional Value on a liter of purchased milk and of the Abnormal Cooperative Additional Value on a liter of purchased milk [Pietrzak 2006];
- Pietrzak using the Cobb-Douglas production function confirms that Polish dairy cooperatives experience increasing returns to scale; however, the author states that the scope of potential benefits achievable due to economies of scale is smaller than expected on the basis of review of results of other authors [Pietrzak 2007];
- Baran using the non-parametric approach to evaluate scale efficiency (basing on the DEA method), the author concludes that dairy companies (both cooperatives and other legal forms) in years 1997-2005 experienced improvement of efficiency of the scale of production [Baran 2007];
- Pietrzak and Chojnowska stress statistically significant differences among cooperatives with diversified dynamics of scale growth with regard to such indices as: liquidity ratio, and quick ratio, debt ratio and debt-equity ratio and profitability ratios; the authors conclude that fast growth of scale (measured with the dynamics of the assets value) leads to higher profitability, but it involves temporary increase of risk connected with deterioration of liquidity ratios [Pietrzak, Chojnowska 2008];

– Pietrzak, Baran, Chojnowska proved that dairy cooperatives which increase the production scale in the most dynamic manner are more efficient with respect to most indices than cooperatives with lower growth dynamics; what is more, the analysis applying the DEA method proved that slightly poorer productivity of assets in fast-growing cooperatives is compensated by considerably higher work output [Pietrzak, Baran, Chojnowska 2008].

The aim of this article is also to evaluate the impact of the scale of dairy companies on their economic and financial results.

For the purposes of the studies the following research hypothesis was formulated: Increase of the production scale of dairy companies leads to the improvement of their efficiency.

Materials and methods

The scope of studies covers Polish milk processing companies. Research objects were selected taking into consideration the pre-defined criteria. The selection criterion involved fulfilling at least two of the following three conditions:

– average annual employment specified as the number of FTEs included at least 50 people;
– the total of balance sheet assets at the end of a financial year equaled at east EUR 2.5 mln converted into the Polish currency;
– net revenues earned from sales of goods and products and financial operations for a financial year equaled at east EUR 5 m converted into the Polish currency.
– and the share of the sale of goods and material of this cooperatives does not exceed 30% of the total sales[1].

The studies were conducted using the analysis of variance and the Kruskal-Wallis non-parametric test. Calculations were performed using the MS EXCEL 2007 and STATISTICA 7.1 packages.

Results

The scale of production is defined as the volume of input production factors used by a company [Samuelson, Marks 1998]. For the purpose of the studies the scale of dairy companies was measured by means of three variables reflecting production factors: labour costs (in PLN thous.), costs of consumed material and energy (in PLN thous.) and value of fixed assets (in PLN thous.).

In order to verify whether dairy companies with a large scale of production are more efficient than companies with a small and medium scale of production, the examined companies were divided into 3 size categories taking at the same time into account three variables representing measures of production factors determining the scale of production. For this purpose percentiles for the variables were defined and the companies were divided into 3 groups:

A – companies up to the 33rd percentile,
B – companies between the 34th and 67th percentile,
C – companies above the 67th percentile.

Table 1. The key indicators by group selected on the basis of scale*
Tabela 1. Charakterystyka grup wyodrębnionych według wielkości skali*

Specification/*Wyszczególnienie*	**Measure/ *Miara***	**Group/*Grupa***		
		1	**2**	**3**
		small/*małe*	**medium/*średnie***	**large/*duże***
Size/*Liczebność*	mean/*średnia*	191	197	190
Fixed assets [thous. PLN]/ *Majątek trwały [tys. zł]*	median/*mediana*	4,179	8,755	24,599
	mean/*średnia*	4,922	10,826	50,436
Costs of materials and energy [thous. PLN]/ *Koszty materiałów i energii [tys. zł]*	median/*mediana*	17,230	34,432	101,837
	mean/*średnia*	16,402	35,927	153,239
Labour costs [thous PLN]/ *Koszty pracy [tys. zł]*	median/*mediana*	3,007	5,374	11,728
	mean/*średnia*	3,159	5,683	16,176

* mean for the period 1999-2006 (based on deflated data)/*średnia z lata 1999-2006 (dane urealniono o odpowiednie wskaźniki inflacji)*
Source: own study based on *Monitor Spółdzielczy – B* and *Monitor Polski – B*
Źródło: opracowanie własne na podstawie Monitora Spółdzielczego – B i Monitora Polski – B

[1] Including companies earning at least 30% of their revenues from the commercial activity would disturb the actual relations regarding milk processing.

In the next step companies which were classified to group A based on at least 2 out of 3 above-mentioned variables – were deemed to be companies with a small scale of production (group 1). Companies which were assigned to group B based on at least 2 out of 3 above-mentioned variables – were regarded as companies with a medium scale of production (group 2). Companies with a large scale of production (group 3) included such companies which were classified to group C based on at least 2 out 3 analyzed variables. Description of companies categorized to group 1, 2 and 3 is presented in table 1.

The comparison of financial and economic ratios of respective groups proves that the growth of the scale of production of dairy companies involves a drop of asset productivity and productivity of consumed material and energy, but at the same time the efficiency of wages and work output improve significantly (Tab. 2). It can be attributed to differences in production methods among companies of different sizes. Smaller companies use production methods involving lower capital intensity and material consumption, but on the other hand they are more labour-consuming in relation to large companies which apply labour-saving methods requiring higher capital intensity and material consumption. Large dairy companies in comparison to other entities achieve higher milk "capitalization", which in turn leads to higher profitability on three analyzed levels and offering more benefits to their suppliers, such as higher milk purchase prices (Tab. 2).

In order to verify statistical significance of the above-mentioned differences analysis of variance was considered for variables illustrating economic and financial results denoted as dependent variables with the variable type of returns to scale identified as the grouping variable. At the first stage of analysis

Table 2. Values of economic and financial ratios for respective groups of companies
Tabela 2. Wartości wskaźników ekonomiczno-finansowych dla poszczególnych grup przedsiębiorstw

Variables/*Zmienne*	**Measure/*Miara***	**Group/*Grupa***		
		1	**2**	**3**
		small/*małe*	**medium/*średnie***	**large/*duże***
Fixed asset productivity/ *Produktywność aktywów trwałych*	median/*mediana*	5.73	5.53	5.43
	mean/*średnia*	6.78	6.39	6.14
Current asset productivity/ *Produktywność aktywów obrotowych*	median/*mediana*	6.38	6.79	5.58
	mean/*średnia*	6.59	6.84	5.91
Total asset productivity/ *Produktywność aktywów ogółem*	median/*mediana*	2.95	3.07	2.57
	mean/*średnia*	3.10	3.09	2.86
Productivity of consumed inputs and energy/ *Produktywność zużytych materiałów i energii*	median/*mediana*	1.53	1.42	1.32
	mean/*średnia*	1.60	1.46	1.41
Efficiency of wages/ *Efektywność płacy*	median/*mediana*	8.08	9.06	12.69
	mean/*średnia*	8.76	10.09	14.63
Technical productivity[a)] [l/person]/ *Techniczna wydajność pracy [l/os.]*	median/*mediana*	163	157	243
	mean/*średnia*	164	184	261
Labor productivity[b)] [PLN/person]/ *Ekonomiczna wydajność pracy [zł/os.]*	median/*mediana*	211	238	369
	mean/*średnia*	219	252	378
ROS/*ROS [%]*	median/*mediana*	0.34	0.19	0.65
	mean/*średnia*	0.37	0.08	0.95
ROA/*ROA [%]*	median/*mediana*	2.06	1.11	3.69
	mean/*średnia*	5.04	1.46	4.69
ROE/*ROE [%]*	median/*mediana*	2.09	1.42	4.14
	mean/*średnia*	2.94	-2.12	6.01
Milk capitalization[c)] [PLN/l]/ *Spieniężenie mleka [zł/l]*	median/*mediana*	1.28	1.36	1.50
	mean/*średnia*	1.33	1.39	1.47
Milk purchase price [PLN/l]/ *Cena skupu mleka [zł/l]*	median/*mediana*	0.73	0.80	0.88
	mean/*średnia*	0.72	0.82	1.21

[a)] technical work output was calculated as output per each employed person, [b)] economic work output was calculated as revenues earned per each employed person, [c)] milk capitalization was calculated as revenues to volume of milk processed/
[a)] *techniczna wydajność pracy została obliczona jako produkcja przypadająca na każdego pracownika, [b)] ekonomiczna wydajność pracy została obliczona jako przychody uzyskane przez każdego pracownika, [c)] spieniężenie mleka zostało obliczone jako przychody do objętości mleka przetworzonego*
Source: own study
Źródło: opracowanie własne

Table 3. Results of the Kruskal-Wallis test
Tabela 3. Wyniki testu Kruskala-Wallisa

Variables/*Zmienne*	**Kruskal-Wallis test (confirmation of significance of differences)/*Test Kruskala-Wallisa (potwierdzenie istotności różnic)***		**Multiple comparisons between groups/ *Porównania wielokrotne między grupami***		
	H	**p-value**	**group 2 > group 1/ *grupa 2 > grupa 1***	**group 3 > group 1/ *grupa 3 > grupa 1***	**group 3 > group 2/ *grupa 3 > grupa 2***
Fixed asset productivity/ *Produktywność aktywów trwałych*	2.30	0.317	no/*nie*	no/*nie*	no/*nie*
Current asset productivity/ *Produktywność aktywów obrotowych*	22.92	0.000	yes/*tak*	no/*nie**	no/*nie**
Productivity of total assets/ *Produktywność aktywów ogółem*	9.42	0.009	no/*nie*	no/*nie**	no/*nie**
Productivity of consumed inputs and energy/ *Produktywność zużytych materiałów i energii*	85.36	0.000	no/*nie**	no/*nie**	no/*nie**
Wage efficiency/*Efektywność płacy*	166.25	0.000	yes/*tak**	yes/*tak**	yes/*tak**
Technical work output/*Techniczna wydajność pracy*	45.53	0.000	yes/*tak*	yes/*tak**	yes/*tak**
Economic work output/*Ekonomiczna wydajność pracy*	51.90	0.000	yes/*tak*	yes/*tak**	yes/*tak**
ROS/*ROS*	17.00	0.000	no/*nie*	yes/*tak*	yes/*tak**
ROA/*ROA*	14.93	0.001	no/*nie*	no/*nie*	yes/*tak**
ROE/*ROE*	19.31	0.000	no/*nie*	yes/*tak**	yes/*tak**
Milk capitalization/*Spieniężenie mleka*	11.73	0.003	no/*nie*	yes/*tak**	yes/*tak**
Milk procurement price/*Cena skupu mleka*	30.45	0.000	yes/*tak**	yes/*tak**	yes/*tak**

Note: average values of dependent variables broken down by size groups are presented in table 3, yes/no – means that the ratio of a particular group is/is not higher than the ratio of a compared group, ratios marked with (*) are statistically significant with $p < 0.05$/*średnie wartości zmiennych zależnych w przekroju grup wielkościowych przedstawia tabela 3, tak/nie – oznacza, że wskaźnik danej grupy jest/nie jest większy od wskaźnika grupy porównywanej, oznaczone (*) współczynniki są istotne statystycznie z $p < 0,05$*
Source: own study
Źródło: opracowanie własne

assumptions of normal distribution were verified and the second stage entailed verifying the assumption of homogeneity of variance of dependent variables in groups. Based on the analysis of normality plots it was concluded that distributions of some variables diverge significantly from normal distribution, and that in case of some variables assumptions of equality of variances in groups are not fulfilled. Thus, a conclusion was formulated that the results of the analysis of variance might be considered as rather unreliable. In order to eliminate the mentioned formal imperfections of the analysis of variance, a non-parametric method (not requiring compliance with the assumptions of distribution normality and homogeneity of variance) was applied. As a non-parametric alternative for the analysis of variance in the intergroup arrangement the Kruskal-Wallis sum rank test[2] was applied. In the Kruskal-Wallis test the null hypothesis saying that all groups (samples) were taken from the population with the same distribution (or distributions of the same median) was verified.

The results obtained in the Kruskal-Wallis test (Tab. 3) confirmed the statistically significant higher efficiency of wages, higher economic and technical work output, higher return on equity, milk capitalization and milk purchase price in large companies in comparison to small and medium-sized companies.

It should be also stressed that productivity of total assets and current assets and productivity of consumer materials and energy of the smallest and medium-sized companies was confirmed to be significantly statistically higher in comparison to large-scale companies.

[2] Verification of the hypothesis in the Kruskal-Wallis test is based on the H-statistics defined with the formula [Stanisz 2006]:
$$H = \frac{12}{n(n+1)} \sum_{i=1}^{k} \frac{T_i^2}{n_i} - 3(n+1)$$ where:
T_i *– means a rank sum in each separate sample,*
n *– total number of all samples,*
n_i *– size of i-th sample.*

Conclusions

The performed studies confirm in part the formulated research hypothesis about the positive impact of the growth of the scale of production of dairy companies on their efficiency. The studies proved that large-scale milk processing companies achieve higher work output, higher profitability, higher milk capitalization and higher benefits for farmers expressed as higher milk purchase prices in comparison to small and medium-sized companies. The hypothesis was not confirmed only with regard to asset productivity ratio and productivity of consumed material and energy. Probably it can be attributed to differences in production methods among companies of a different size. Smaller companies use methods involving lower capital intensity and material consumption but on the other hand they are more labour-consuming in relation to large companies which apply labour-saving methods requiring higher capital intensity and material consumption.

Based on the performed studies it can be assumed that further consolidation of milk processing companies should lead to the improvement of efficiency of these entities.

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Streszczenie

Dokonano oceny wpływu skali spółdzielni mleczarskich na ich wyniki ekonomiczno-finansowe. Przeprowadzone badania na próbie 578 obiektów wskazują, że wraz ze wzrostem skali mleczarni poprawie ulegają takie miary efektywności, jak: wydajność pracy, rentowność, spieniężenie i ceny skupu mleka.

Correspondence address:

Dr Joanna Baran
Warsaw University of Life Sciences – SGGW
Nowoursynowska Str. 166
02-787 Warsaw, Poland
phone: +48 22 593 42 60
e-mail: joanna_baran@sggw.pl