Market Power in the European Dairy Industry

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Anotace

Článek je zaměřen na analýzu tržní síly na trhu mléčných výrobků. Konkrétně článek identifikuje tržní sílu zpracovatelského trhu mléka ve 24 zemích Evropské unie. Analýza tržní síly je založena na tzv. mark-up modelu a aplikaci přístupu stochastické hraniční funkce. Výsledky prokazují tržní selhání na zpracovatelském trhu mléka v Evropské unii. Zmíněné zneužití oligopolní tržní síly není v průměru velké. Mezi analyzovanými zeměmi však existují významné rozdíly. Rozdělení tržní síly je sešikmené směrem k nižším hodnotám, což znamená, že většina společností disponuje nízkou nebo téměř žádnou tržní silou. Na druhou stranu zde však existují i společnosti (okolo 10 %) se značně vysokou tržní silou.

Klíčová slova

Mléko, tržní síla, oligopol, SFA, Evropská unie.

Abstract

The paper presents an analysis of market power in the output milk-processing market. In particular, the paper identifies market failures in the output milk-processing market in 24 EU member states. The analysis is based on a mark-up model and the application of stochastic frontier methodology. The results show that market failures are pronounced on the EU output milk-processing market. However, the abuse of oligopoly market power is not large on average, despite the fact that we can find significant differences among the countries. The mark-up distribution is skewed toward lower values. That is, the majority of companies are characterized by only a small or almost no degree of market power; however, there are companies (about 10 %) with considerably high oligopoly market power.

Keywords:

Milk, market power, oligopoly, SFA, European Union.

Introduction

Market power is defined as the ability of a firm or group of firms to raise the price of a good or service above the competitive level (Kutlu and Sickles, 2012). Morrison Paul (2001) added that evaluating market power involves modelling and measuring the difference between market price and marginal factor cost for inputs (mark-down), or price and marginal cost for outputs (mark-up). Since 1980 there have been numerous studies based on a New Empirical Industrial Organization theoretical background focused on detecting market power or, in general, market imperfections in the agricultural or food-processing market, as the case may be. Most of these studies are based on the Lerner index (Lerner, 1934). Nevertheless, Kumbhakar et al. (2012) point out several weaknesses of this approach, namely the optimization errors, possibility of negative market power, assumption of constant returns to scale and price data requirement. Another approach for measuring market power is to estimate a conduct parameter rather than use the Lerner index (Kutlu and Sickles, 2012, Muth and Wohlgenant, 1999). This approach uses a conjectural variations

approach and treats the conduct as a parameter to be estimated. Finally, Kumbhakar et al. (2012) introduced an approach based on stochastic frontier analysis.

The results of previous studies mostly found that food processors have oligopsony market power (e.g. Morrison Paul, 2000), but there are also studies which failed to find any evidence of oligopsony power (e.g. Muth and Wohlgenant, 1999, Perekhozhuk and Grings, 2006) or found only weak oligopsony power (Scalco and Brage, 2014). Moreover, McCorriston (2002) concluded that food markets are now more typically oligopolistic. Studies using firm-level data are not so numerous and include, for example, Hockmann and Vöneki (2009), Bakucs et al. (2009), Perekhozhuk et al. (2013) and Acharya et al. (2011).

This paper extends the above-mentioned studies on the analysis of market imperfections. The aim is to conduct a comparative analysis among the EU member countries and identify the degree of market imperfections in the output milk-processing market. In particular, the paper addresses the following research questions. The first question concerns market imperfections in the output milk-processing market. The aim is to identify the degree of oligopoly market power. The second question relates to the country specifics, especially whether output milk-processing markets differ significantly among EU countries, and what the development is in the analysed period.

The paper is organized as follows: the Materials and methods section presents the estimation strategy and describes the data set; the Results and discussion section presents the results of the mark-up model and the relative mark-up in EU member states; and the Conclusions section contains concluding remarks.

Materials and methods

The research questions will be addressed by estimating a mark-up model and employing stochastic frontier methodology. The mark-up model is derived from the standard profit maximization problem. The solution of the optimization problem results in product price equalling marginal costs for a competitive market, and price exceeding marginal costs for a non-competitive (oligopolistic) market:

$$p \geq \frac{\partial C(\mathbf{w}, y_i, t)}{\partial y_i}, \tag{1}$$

where p is a price of output (product), Y is an output,

and C stands for total costs.

If we multiply relation (1) by the share of output on total costs, we can write:

$$\frac{p \cdot y}{C} \geq \frac{\partial C(\mathbf{w}, y_i, t)}{\partial y_i} \cdot \frac{y}{C} = \frac{\partial \ln C}{\partial \ln y}, \tag{2}$$

The inequality can be transformed to an equality by adding a non-negative, one-sided error term (u), i.e. u represents a measure of market failures – relation (3). Then, relation (3) can be estimated using stochastic frontier methodology. The stochastic frontier approach for detecting the degree of monopoly power was first introduced by Kumbhakar et al. (2012).

$$\frac{p \cdot y}{C} = \frac{\partial \ln C}{\partial \ln y} + u, u \geq 0, \tag{3}$$

Relation (3) asks for estimation of the first derivative of the cost function. If the database does not contain prices, the duality theorem can be employed, and the first derivative of the input distance function can be estimated instead (Kumbhakar et al., 2012):

$$\frac{p \cdot y}{C} = \frac{\partial \ln C}{\partial \ln y} + u = \frac{\partial \ln D^I}{\partial \ln y} + u, u \geq 0, \tag{4}$$

Assuming that the input distance function has a translog form:

$$\ln D^I = \alpha_0 + \alpha_t t + \frac{1}{2}\alpha_{tt}t^2 + \alpha_y \ln y + \alpha_{yt} \ln yt + \frac{1}{2}\alpha_{yy}(\ln y)^2$$
$$+ \boldsymbol{\alpha}_x' \ln \tilde{\mathbf{x}} + \boldsymbol{\alpha}_{xt}' \ln \tilde{\mathbf{x}}t + \frac{1}{2}\ln \tilde{\mathbf{x}}' \mathbf{A}_{xx} \ln \tilde{\mathbf{x}} + \ln \tilde{\mathbf{x}}' \mathbf{A}_{xy} \ln y \tag{5}$$

where $\tilde{x}_j = {x_j}/{x_J}$ for $j=1,...,J-1,$ are normalized input quantities and T is a time variable, then adding a variable capturing the statistical noise (v), we get:

$$\frac{\partial \ln D^I}{\partial \ln y} = \alpha_y + \alpha_{yt}t + \alpha_{yy}\ln y + \boldsymbol{\alpha}_{xy}' \ln \tilde{\mathbf{x}} + u + v, \tag{6}$$

That is, the model estimated in the empirical part has the form:

$$\frac{p \cdot y}{C} = \alpha_y + \alpha_{yt}t + \alpha_{yy}\ln y + \boldsymbol{\alpha}_{xy}' \ln \tilde{\mathbf{x}} + u + v, \tag{7}$$

Defining the relative mark-up (φ) as $\varphi = \frac{p - MC}{MC}$ we get the estimate of relative mark-up as:

$$\hat{\varphi} = \frac{\hat{u}}{\alpha_y + \alpha_{yt}t + \alpha_{yy}\ln y + \boldsymbol{\alpha}_{yx}' \ln \mathbf{x}} \tag{8}$$

Moreover, since we respect the heterogeneity in production structures we employ the extended version of the random parameter model (Tsionas, 2002) and the fixed management model (Alvarez et al., 2003 and 2004); that is, relation (7) becomes:

$$\frac{p \cdot y}{C} = \alpha_y + \alpha_{yt}t + \alpha_{yy}\ln y_{it} + \boldsymbol{\alpha}_{xy}'\ln \widetilde{\mathbf{x}}_{it}$$

$$+ \alpha_m m_i^* + \frac{1}{2}\alpha_{mm}m_i^{*2} + \alpha_{tm}m_i^* t + \alpha_{ym}m_i^* y_{it} + \boldsymbol{\alpha}_{xm}m_i^*'\ln \widetilde{\mathbf{x}}_{it} + u_{it} + v_{it},$$

(9)

where $m_i^* \sim \bullet(0,1)$ represents unobservable heterogeneity (the symbol represents that m_i^* could possess any distribution with zero mean and unit variance). Subscripts i and t stand for the i-th producer at time t. Model (9) is fitted by maximum simulated likelihood with the software NLOGIT 5.0. u_{it} is estimated according to Jondrow et al. (1982).

The data we use in the analysis is drawn from the Amadeus database, which contains financial information for public and private companies across Europe. The database provides detailed information about (standardised) annual accounts, financial ratios, sectoral activities and ownership information. The panel data set that we use in our analysis contains companies whose main activity is milk processing, according to the NACE classification. It is an unbalanced panel data set, which represents the period from 2003 to 2012 and contains 6,367 observations of milk-processing companies from 24 EU countries (only Croatia, Cyprus, Luxembourg and Malta are missing).

The following variables were used in the analysis:

Revenue share = Revenue/Costs, Output, normalized Material and Labour. Revenue is represented by the operating revenue (Turnover) of the company. Costs are the sum of Labour costs, Material costs and Capital costs. Labour costs are represented by the cost of employees, Material costs are the total costs of materials and energy consumption per company, and Capital costs are calculated as the book value of fixed assets multiplied by the interest rate according to convergence criteria. Output is represented by operating

revenue (Turnover) of the company and is deflated by the sectoral index of milk-processing prices (EU-level – 27 countries or country-level if it was disposable, respectively; 2010 = 100). Material and Labour are normalized by Capital. Material is the total costs of materials and energy deflated by the index of producer prices in the milk industry (country-level; 2010 = 100). Labour is represented by the total number of employees and Capital is the book value of fixed assets deflated by the index of producer prices in the industry (country-level; 2010 = 100).

Moreover, we rejected producers with fewer than three observations (on average) to decrease the problem associated with the entry and exit of producers from the database. The country sample descriptive statistics are provided in the Appendix – Table A1.

Results and discussion

Table 1 provides a parameter estimate of the mark-up model for the milk output processing market in the 24 EU member states. As expected, almost all parameters are highly significant. The only exceptions are the time variable and material in interaction with the heterogeneity component. Moreover, the high significance of most of the coefficients of the unobservable heterogeneity component (fixed management) confirms that the chosen specification approximates well the estimated relationship. That is, the heterogeneity among firms is an important characteristic of the milk food-processing sector.

The estimates show the positive impact of the output and labour inputs on revenue share in the milk food-processing sector. On the other hand, material inputs determine negatively the revenue share. This is in line with our expectations. Higher labour inputs are connected

Means for random parameters				Coefficient on unobservable fixed management			
Variable	Coeff.	SE	P [|z|>Z*]	Variable	Coeff.	SE	P [|z|>Z*]
Const.	1.1384	0.0069	0.0000	Alpha_m	0.9056	0.0081	0.0000
Time	0.0001	0.0003	0.6680	Time	-0.0025	0.0003	0.0000
Output	0.0122	0.0007	0.0000	Output	-0.0832	0.0008	0.0000
Labour	0.0454	0.0009	0.0000	Labour	-0.0167	0.0009	0.0000
Material	-0.0490	0.0009	0.0000	Material	0.0006	0.0009	0.5184
				Alpha_mm	0.2986	0.0018	0.0000
Sigma	0.1252	0.0005	0.0000	Lambda	1.8631	0.0213	0.0000

Source: own calculation

Table 1: Parameter estimates.

with a production characterized by higher value added. The opposite can be expected for material inputs, ceteris paribus. Finally, the firms with higher output have a higher revenue share. This could also be connected with higher market power.

The unobservable heterogeneity component (management) contributes positively to the revenue share. Moreover, this positive impact is accelerating. As far as the relation between management and the mark-up component is concerned, we can conclude that an increase in the heterogeneity component (management) leads to a decrease in the mark-up component. Moreover, higher output leads to a smaller mark-up component for a given level of management. Labour determines negatively the mark-up component, and the material inputs are not statistically significant. The impact of time on market imperfections is negative, although very low. These results may suggest slightly increasing competitiveness in the EU food-processing output market in the dairy sector.

Finally, the parameter λ is highly significant, and greater than one. That is, the estimate indicates that non-competitive behaviour can be found in the EU output milk-processing market. Moreover, the variation in the mark-up component u_{it} is more pronounced than the variation in the random component (statistical noise) v_{it}, which suggests significant differences in the market behaviour among milk processors.

Table 2 presents the estimates of relative mark-up for European milk processors. The relative mark-up takes values in the interval from zero to one. Zero indicates competitive behaviour on the output market, as the case may be, i.e. the situation where marginal cost equals the price of the output. Then, a relative mark-up value higher than zero represents non-competitive behaviour. In particular, an increasing relative mark-up is associated with increasing market failures or the oligopolistic power of milk processors, respectively. The results show that the estimated

	Mean	Std.Dev	Min.	Max.	1st decile	9th decile	1st quartile	3rd quartile	Cases
EU	0.121	0.074	0.004	0.875	0.047	0.210	0.073	0.151	6287
Austria	0.152	0.046	0.076	0.291	0.106	0.211	0.117	0.176	37
Belgium	0.134	0.056	0.014	0.323	0.074	0.226	0.103	0.158	274
Bulgaria	0.088	0.082	0.017	0.441	0.025	0.214	0.033	0.101	79
Czech Republic	0.103	0.062	0.007	0.443	0.044	0.181	0.061	0.129	278
Germany	0.127	0.056	0.009	0.328	0.056	0.199	0.092	0.157	404
Denmark	0.120	0.044	0.067	0.255	0.077	0.153	0.095	0.134	15
Estonia	0.105	0.048	0.027	0.231	0.048	0.165	0.062	0.138	43
Spain	0.126	0.077	0.008	0.552	0.046	0.225	0.074	0.163	569
Finland	0.150	0.053	0.068	0.300	0.096	0.234	0.106	0.185	84
France	0.138	0.069	0.004	0.463	0.054	0.226	0.095	0.176	619
United Kingdom	0.077	0.044	0.008	0.308	0.034	0.128	0.046	0.098	447
Greece	0.112	0.059	0.013	0.332	0.052	0.192	0.074	0.144	203
Hungary	0.162	0.115	0.050	0.544	0.076	0.304	0.087	0.193	64
Italy	0.136	0.077	0.007	0.646	0.055	0.228	0.088	0.166	1656
Ireland	0.076	0.025	0.044	0.121	0.047	0.114	0.055	0.090	17
Latvia	0.108	0.050	0.012	0.277	0.061	0.165	0.073	0.131	70
Lithuania	0.086	0.044	0.021	0.206	0.041	0.162	0.050	0.112	99
Netherlands	0.182	0.080	0.041	0.496	0.112	0.269	0.132	0.227	60
Poland	0.097	0.056	0.009	0.427	0.051	0.154	0.067	0.108	749
Portugal	0.157	0.072	0.005	0.334	0.078	0.259	0.103	0.206	75
Romania	0.119	0.123	0.010	0.875	0.024	0.238	0.048	0.141	305
Sweden	0.084	0.045	0.014	0.217	0.036	0.140	0.046	0.105	27
Slovenia	0.125	0.040	0.067	0.210	0.080	0.182	0.098	0.149	27
Slovakia	0.100	0.044	0.032	0.263	0.049	0.151	0.067	0.121	86

Source: own calculation

Table 2: Relative mark-up estimates.

overall mean of the relative mark-up is 0.12. That is, the European milk-processing output market is characterized by some degree of market failure or abuse of market power, as the case may be. Since the distribution of the mark-up is relatively narrow, with a standard deviation of 0.07, and skewed toward smaller values, the majority of milk processors are characterized by only a small or almost no degree of market power. However, significant differences between the 1st and 9th deciles can be found. The first decile indicates that 10 % of producers are very close to competitive behaviour (mark-up lower than 0.05). On the other hand, the last 10 % of producers reach a relative mark-up higher than 0.21. That is, the results indicate a considerable degree of non-competitive behaviour on the dairy output market for these producers.

The overall means of the relative mark-up differ among the individual member states. The means of the relative mark-up can be found in the interval 0.08 to 0.18, and their standard deviations take values from 0.025 to 0.123. Producers in Bulgaria (0.09), the United Kingdom (0.08), Ireland (0.076), Lithuania (0.09) and Sweden (0.08) exercise a lower degree of non-competitive behaviour, on average, as compared to producers in Austria (0.15), Finland (0.15), Hungary (0.16) and Portugal (0.16). Moreover, the distribution of relative mark-up is narrower in the countries with the lowest means of the mark-up indicating rather small market imperfections in these countries. On the other hand, the highest differences among producers can be found in Hungary and Romania, where the standard deviation is 0.115 and 0.123, respectively. Hungary and Romania are characterized by large differences between the first and ninth deciles of the relative

mark-up. This suggests that Hungarian milk processors with the highest mark-up could have considerable power to determine the market price and market environment, which could have a negative impact on companies with a small relative mark-up. A similar situation can also be found in Romania, Bulgaria, Spain, Portugal, Italy and France. In addition, the first decile for Romania and Bulgaria is very close to zero, suggesting that many companies are price takers in these countries.

Moreover, we can also find countries where non-competitive behaviour is significant for all dairy producers – Austria and the Netherlands. In these countries, the companies gathered in the first decile exercise significantly higher mark-up power than in the rest of the countries.

Figure 1 provides the development of relative mark-up in the EU output milk-processing market. We can observe a slight increase in the years 2007 and 2009, when the average value of mark-up increased similarly by 0.009. Then, the mean value of mark-up decreased in 2010 and stabilized around the value 0.015. Moreover, Figure 1 shows that the spread between the first and ninth decile was pretty low in the year 2006. Then it significantly increased in 2007 and 2008 and became narrower over the next two years. The last year (2011) is characterized by another change. In particular, the mark-up differences among the companies started to increase again. This development suggests that the time of economic crises decreased the differences among the companies as far as relative mark-up is concerned. Specifically, we can observe a decrease in relative mark-up for companies with higher market power (ninth decile). The opposite is true for companies
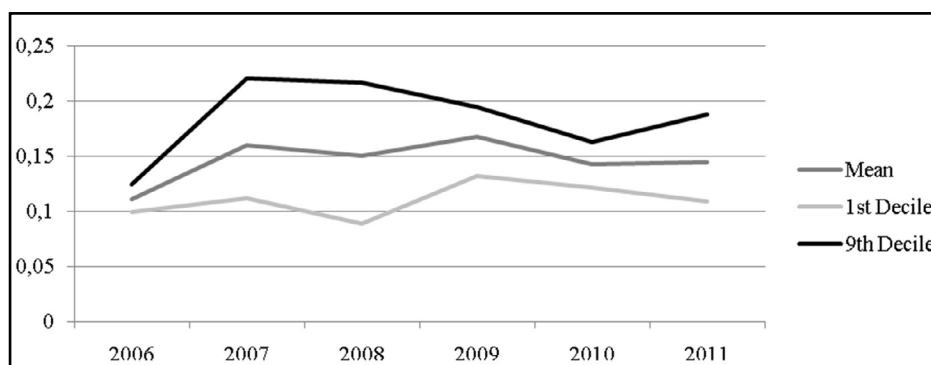
Note: Figure 1 presents the development of mark-up in the time period 2006-2011, for which there is a sufficient number of observations for each year.

Source: own calculation

Figure 1: Development of relative mark-up.

in the first decile, i.e. companies with low relative mark-up.

The development of relative mark-up can also be analysed with respect to technical efficiency development, as provided in Kutlu and Sickles (2012). To analyse this relationship in the EU dairy sector, we can use the results of Cechura et al. (2014), who analysed the development of technical efficiency in European milk-processing companies. The results show that the technical efficiency of European milk processors decreased in 2007, 2008 and 2010 and increased in 2009 and 2011. That is, we can observe some similarities in the development of technical efficiency and relative mark-up, except for 2007. Since technical efficiency can be associated with the use of capacities, and taking into account the dairy market situation in the analysed period, the results suggest that the value of relative mark-up could be connected with the use of milk processors' capacities. On the other hand, the opposite development of technical efficiency and relative mark-up in 2007 could be associated with the role of management, in particular, "…firms may use their market power to allow inefficient allocation of resources." Kutlu and Sickles (2007, page 2).

Table 3 presents the mark-up development in the analysed countries. We can observe that the majority of EU member states have an almost identical development of the relative mark-up. The mark-up increased in 2007 and 2009 and decreased in 2010 and 2011. However, some exceptions can be found. The mark-up in the Netherlands, in particular, had an opposite development. It decreased in 2009 and increased in 2010 and 2011.

As far as the new member states are concerned, we can conclude that the relative mark-up mainly increased the year after the accession. Only the Czech Republic and Lithuania are exceptions. This could be the result of milk quotas, which strongly affected the situation in the milk market. This conclusion is supported by the increase in mark-up in the years of strong release of the quota (e.g. 2008 for the Czech Republic).

Country	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Trend function	R^2
EU	0.118	0.115	0.115	0.118	0.127	0.126	0.135	0.12	0.113	0.115	y = 0.119 - 0.0002t	0.009
Austria	NA	NA	NA	0.112	0.16	0.151	0.168	0.144	0.145	NA	y = 0.133 - 0.004t	0.138
Belgium	0.127	0.134	0.133	0.133	0.125	0.14	0.156	0.131	0.124	NA	y = 0.131 + 0.001t	0.021
Bulgaria	0.143	0.051	0.127	0.108	0.06	0.076	0.11	0.084	0.052	NA	y = 0.118 - 0.006t	0.205
Czech Republic	0.092	0.098	0.075	0.1	0.123	0.101	0.127	0.104	0.108	0.094	y = 0.092 + 0.002t	0.128
Germany	0.137	0.122	0.108	0.117	0.12	0.126	0.142	0.137	0.125	0.132	y = 0.12 + 0.001t	0.132
Denmark	NA	NA	NA	NA	0.109	0.121	0.159	0.09	0.102	0.139	y = 0.117 + 0.001t	0.003
Estonia	0.102	0.06	0.087	0.147	0.128	0.127	0.155	0.091	0.082	0.148	y = 0.092 + 0.004t	0.117
Spain	0.123	0.126	0.128	0.133	0.114	0.119	0.146	0.129	0.112	0.046	y = 0.143 - 0.005t	0.256
Finland	0.129	0.145	0.149	0.158	0.133	0.159	0.161	0.149	0.159	NA	y = 0.136 + 0.003t	0.377
France	0.146	0.138	0.138	0.147	0.148	0.137	0.136	0.131	0.126	0.096	y = 0.155 - 0.004t	0.549
Great Britain	0.084	0.074	0.08	0.087	0.079	0.076	0.078	0.073	0.068	0.078	y = 0.083 - 0.001t	0.302
Greece	0.091	0.103	0.1	0.114	0.118	0.118	0.127	0.121	0.104	0.136	y = 0.095 + 0.003t	0.563
Hungary	0.094	0.099	0.149	0.119	0.159	0.152	0.199	0.169	0.143	NA	y = 0.098 + 0.009t	0.53
Italy	0.131	0.127	0.133	0.133	0.133	0.133	0.157	0.141	0.13	0.155	y = 0.126 + 0.002t	0.382
Ireland	NA	NA	0.069	0.07	0.073	0.068	0.075	0.07	0.098	NA	y = 0.062 + 0.003t	0.437
Latvia	0.097	0.078	0.091	0.106	0.126	0.126	0.139	0.085	0.107	0.157	y = 0.084 + 0.005t	0.347
Lithuania	0.096	0.103	0.094	0.08	0.109	0.064	0.081	0.078	0.069	0.103	y = 0.098 - 0.002t	0.123
Netherlands	0.175	0.18	0.19	0.144	0.164	0.202	0.175	0.191	0.244	0.143	y = 0.171 + 0.002t	0.208
Poland	0.1	0.097	0.094	0.085	0.098	0.093	0.113	0.102	0.087	NA	y = 0.095 + 0.0002t	0.007
Portugal	0.192	0.165	0.171	0.17	0.162	0.166	0.172	0.136	0.123	NA	y = 0.193 - 0.006t	0.662
Romania	0.111	0.096	0.072	0.064	0.219	0.242	0.107	0.083	0.081	NA	y = 0.112 + 0.002t	0.004
Sweden	0.035	0.046	0.056	0.089	0.1	0.102	0.109	0.102	0.114	NA	y = 0.034 + 0.01t	0.857
Slovenia	0.119	0.087	0.09	0.088	0.131	0.16	0.172	0.154	0.125	NA	y = 0.087 + 0.008t	0.419
Slovakia	0.07	0.081	0.086	0.083	0.106	0.1	0.14	0.111	0.115	NA	y = 0.067 + 0.007t	0.700

Source: own calculation

Table 3: Development of relative mark-up

From the development in individual countries we can observe that the most significant decrease was in Estonia. On the other hand, the mark-up increased in Austria, the Czech Republic, Germany, Finland, Hungary, the Netherlands, Poland, Romania, Sweden, Slovenia and Slovakia. The highest increase was achieved in Slovenia, followed by Austria and Slovakia.

As far as the decile distribution development is concerned, we can observe that the companies in the 9th decile in Estonia, France, Hungary, Romania and Slovenia significantly increased their market power in 2007 and then slightly decreased until 2010. This corresponds to the development on the EU level. Moreover, we can also find countries where the relative mark-up of the 9th decile significantly increased during the analysed time period; however, the relative mark-up of the 1st decile decreased, namely in Sweden, Italy and Ireland. This suggests increasing differences among the companies with regard to abuse of market power in these countries. The opposite trend can be found in Austria, the Czech Republic, Germany, Denmark, Estonia, Spain, Portugal, Romania and Slovenia.

Conclusion

The European milk-processing market is characterized by some degree of market failure or abuse of market power, as the case may be. This abuse of oligopoly market power is not large, on average, but significant differences exist among the EU countries. Since the distribution of the mark-up is relatively narrow and skewed toward smaller values, the majority of milk processors are characterized by only a small or almost no degree of market power. On the other hand, 10 % of producers reach a considerably high mark-up.

Focusing on the differences among EU countries, we can specify a group of countries with very low oligopoly market power: Bulgaria, the United Kingdom, Lithuania and Sweden, and a group of countries with high oligopoly market power: Austria, Hungary, Finland and Portugal.

Relative mark-up power developed differently in these countries. The mark-up increased in Austria, the Czech Republic, Germany, Finland, Hungary, the Netherlands, Poland, Romania, Sweden, Slovenia and Slovakia in the analysed time period. The highest increase was achieved in Slovenia, followed by Austria and Slovakia. On the other hand, the most significant decrease was in Estonia.

The development of relative mark-up was connected with the development of the market situation. In particular, we can find similarities between the development of relative mark-up and technical efficiency, which could be associated with the use of milk processor capacities. Moreover, the development of relative mark-up power was influenced by government instruments such as milk quotas. Specifically, the mark-up increased in the years of strong release of the quota. Thus, the results suggest that the recent abolition of milk quotas may have a negative effect on competitive behaviour in the milk-processing market.

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Appendix

EU member country	Revenue share		Output		Labour		Capital		Material		Cases
	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	
Austria	1.1954	0.0623	92737.91	92619.44	174.85	127.03	19220.31	20605.07	67505.84	64938.91	39
Belgium	1.2259	0.1380	119009.53	158101.03	224.05	323.04	29010.03	98144.58	87911.66	116705.26	276
Bulgaria	1.2732	0.2414	12750.47	12187.12	187.88	130.15	6477.57	5955.50	8338.91	6833.12	76
Czech Republic	1.2276	0.1883	40169.18	44254.62	250.87	277.84	6329.18	7527.59	30976.20	34141.31	282
Germany	1.1705	0.1686	204393.79	297311.04	327.98	623.94	29109.30	49245.12	165727.55	238507.13	414
Denmark	1.1294	0.0817	2314193.09	3244577.21	5655.93	7881.13	806052.40	1137111.08	1837613.48	2568995.11	15
Estonia	1.1853	0.1041	22060.50	12941.60	165.32	65.96	8859.25	4191.88	17200.97	10532.23	34
Spain	1.2866	0.2335	97318.62	207871.39	217.55	389.85	33195.77	60794.21	59165.08	98875.76	570
Finland	1.2035	0.1501	233762.15	556660.35	543.01	1296.52	60870.46	146832.59	160166.93	371622.12	84
France	1.3375	0.2703	163090.07	363438.57	394.29	1221.47	37287.62	130303.10	103121.37	216797.25	623
Great Britain	1.0692	0.1104	213097.92	414726.49	653.52	1424.41	65954.16	187000.12	174474.41	330398.53	450
Greece	1.2145	0.1907	33124.48	51782.51	143.51	215.26	21551.84	40357.23	25126.31	33915.50	206
Hungary	1.2847	0.1855	45867.35	41610.41	347.71	286.75	13412.99	19474.07	25799.00	26312.96	79
Ireland	1.0363	0.0623	936141.31	1029748.10	1584.47	1726.40	334514.62	363620.58	799553.63	876715.06	17
Italy	1.2548	0.1720	58544.38	280054.04	131.12	884.89	21966.70	132564.95	36715.53	137415.48	1666
Lithuania	1.1988	0.1218	67461.16	63525.43	513.60	542.51	19391.36	20308.45	57503.08	53283.34	99
Latvia	1.2132	0.1302	26954.79	21212.66	285.23	162.49	10694.06	8011.34	23017.85	18470.78	70
Netherlands	1.1601	0.1326	743312.06	1157316.50	721.11	1789.57	111523.66	286703.80	692966.42	1099254.90	64
Poland	1.1741	0.1506	43544.02	75287.36	270.84	264.81	11128.04	34450.71	34441.66	58196.16	754
Portugal	1.3821	0.3090	54811.82	49628.36	221.63	179.63	22555.00	21683.09	30801.51	21691.28	75
Romania	1.3469	0.2773	16167.80	21185.43	263.93	227.31	7339.68	9406.16	9909.07	11970.90	317
Sweden	1.2651	0.2453	486515.00	699217.69	1288.93	1774.46	211794.57	303555.15	419235.93	608013.29	27
Slovenia	1.1944	0.0645	85541.10	53874.98	364.63	264.64	34005.77	28643.02	64351.01	39421.62	27
Slovakia	1.1531	0.0816	39086.04	30051.27	223.43	116.57	12510.88	9038.48	31360.52	25045.08	87

Note: Output (ths. EUR), Labour (AWU), Capital (ths. EUR), Material (ths. EUR)
Source: own calculation

Appendix A.1: Sample descriptive statistics – dairy.