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MILK PRODUCTION RELATED TO PRICE OF RAW COW'S MILK IN SELECTED EUROPEAN COUNTRIES

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ABSTRACT
Dairy industry and its production contributes to the economies of many regions and countries worldwide. Except the milk production there is also number of other impacts such as the human nutrition, landscape creation and environment among the others. The European dairy sector undergoes numerous changes a period of crises and regulations in last few decades. After abolition of milk quota system, the European milk producing countries started to be exposed to the milk prices of the world market. In the submitted article, the impact of five explanatory variables, which cow's milk, butter, milk powder, cheese, and farm milk production belong among, is analysed to the explained variable the price of raw cow's milk coming from the countries whose data is available in the Eurostat database; that is, Austria, Belgium, Croatia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom. Regression analysis of panel data with territorial and time dimensions is applied using three techniques, which the pooling, the random, and the between approach belong to. Supplementary analytical approach represented by the cluster analysis resulted into triplet of clusters, selected for the further modelling process. Results of the regression analysis showed no influence of butter production to the level of raw cow's milk. The visualised outcome signifies the distribution of the individual countries among the examined clusters. It underlines the fact that the cheaper raw cow's milk price causes a concentration on the specific part of the production that is easier to produce. It is important to realise that the coefficient of determination of the regression models reveal their statistical significance as a whole. Obtained results can serve as the background for further analysis of impact of other milk products as the factors influencing the raw cow's milk prices.

Keywords: milk; milk product; dairy; price; regression analysis

INTRODUCTION
Dairy represents important industry in many European countries, not only for production of milk and milk products, but also for its contribution to the landscape creation and environment.

Growing consumption of dairy and other livestock products is bringing important nutritional benefits to large segments of the population worldwide. However, the rapid growth in production and consumption of livestock products also presents risks to human and animal health, the environment and the economic viability of many poor smallholders, but may also offer opportunities for small- and medium-scale dairy industries **(Muehlhoff et al., 2013; Mura and Gasparikova, 2010; Jasińska-Biliczak and Sitkowska, 2014; Stasiak-Betlejewska, 2015; Kowal et al., 2016; Mura and Mazák, 2018)**. For the last fifty years, the dairy sector in most developed countries has shifted towards bigger herd size and significantly higher annual milk production per cow. The driving force in this development has been the farmers' ability to increase incomes through higher productivity, adopting the many technological innovations which often require high capital and therefore bigger herds to be profitable **(Gerosa and Skoet, 2012)**.

The European dairy sector is characterised by 600,000 dairy farms, 12,000 processing facilities and 300,000 jobs. It produces 15% of all agricultural revenues of the European Union. This production creates a quarter of the world´s milk production and its dairy products are also exported all over the world but 87% of all dairy production is consumed by european households. This European Union sector has many strengths. The first and the most important strength is the capacity to supply milk of a consistent quality with very slight year-on-year variations in supply volumes. Milk production in the European Union is the only agricultural output that can boast this stability **(Lemoine, 2016)**. The vast majority of milk produced on farms (96.8%) located in the European Union comes from cows, although in a number of the southern member sates significant quantity of milk is also produced by sheep, goats and buffaloes. The European Union milk sector is highly varied, something which can blur the measured changes. Specialised farms had on national average between 3 and 141 dairy cows. Milk is used either on farms or processed in dairies **(Marquer, 2015)**. Milk in the European Union is used for fabrication of cheese (37%), butter (30%), cream (13%), drinking milk (11%), acidified milk (4%), powser products (3%), and other products (2%). Majority of milk (96.8%) is processed and known as the whole milk, remaining part (3.2%) is non-processed milk, which is delivered to the national nondairy industry, returned to farms or lost **(Eurostat, 2016)**. Milk from other milk producing species is usually more expensive and thus many times a subject to fraudulent activities like many other high-priced foodstuffs **(Velioglu et al., 2017)**.

Agricultural products price volatility is influenced by crop production; the more dispersed and volatile crop production is, the higher the volatility of agricultural prices; in the case of cow milk, market stability is higher, compared to the sheep milk market **(Grodea, 2011)**. Dairy products, in particular, have higher income elasticities of demand than most other food items, including meat and fish. In other words, as incomes increase, expenditures on dairy products will grow more rapidly in percentage terms than most other food items **(Muehlhoff et al., 2013)**.

Milk production regulations and dairy crisis

In a well-functioning and free market, firms which cannot keep up with competitors are forced to reduce their market share or even cease their market participation, freeing the resources bound by their production activity and making them available for production by more productive firms. This process contributes to a more efficient production at the sector level, that is, aggregate productivity). Market regulation, however, is suspected to hinder this resource flow by keeping firms with low productivity in the market **(Frick and Sauer, 2016; 2018)**. The European milk quota system was introduced in 1984 and has put limit on the amount of milk EU dairy farmers produce each year. Under the quota system, if a farmer delivered more milk than his quota in any one year he was penalised financially. This involved paying a „superlevy“ on the over-quota amount **(European Commission, 2006)**. The purpose of the milk quotas was the control of structural surpluses resulting from imbalances between supply and demand for milk encouraged by subsidies to the sector **(Costa-Font and Revoredo-Giha, 2018)**. The quotas were originally introduced as temporary instrument for five years, but their use was prolonged several times.

The European Union’s dairy market seems to be slowly emerging from its recent “dairy crisis”, when EU farmers were faced with overproduction and the lowest commodity prices since 2009. However, most of the subsequent recovery and price stabilisation has been due to the stabilisation of global dairy prices due to decreased world and European Union production rather than any EU-led interventions **(Polet and Kuypers, 2017)**. Changes to the European Union's common agricultural policy with subsequent shift to greater market orientation for the European Union dairy industry caused sharp increase of the volatility of European Union dairy commodity. Price variability has become a serious problem for farmers, processors and consumers, which prefer stable prices because they provide increased planning security. Prices for European Union butter increased from 209 € per 100 kg in January 2009 to a high of 424 € in July 2011 before falling back to 241 € in May 2012. After this trough, butter prices started to rise again with a peak of 421 € in September 2013, followed by a trough of 283 € in December 2015 **(Bergmann et al., 2016)**.

After the European dairy quota abolition on the 1st of April 2015, the declining trend in domestic production followed in many countries and exposure to free European market significantly affected the competitiveness of domestic production. European dairy farmers become more dependent on the milk price of the world market **(Schullte and Musshoff, 2018)**. Coincidence of Russian embargo on European food products led the well-subsidised European Union farmers to export to the new markets, especially into West Africa. Analyses of the prospects of Croatian dairy industry under certain conditions of the common agricultural policy and the projections simulation showed that in 2025 in line with the common agricultural policy implementation there might be a decrease of dairy cows number, the raw milk price increase and the collected cow's milk amount increase compared to the five-year average of the 2008 to 2012 period. The positive effect was noted in productivity increase, which consequently may lead to increased deliveries to dairies **(Zrakic et al., 2015)**. In the context of increasing milk production in European Union and overproduction in the Czech Republic, compared to degree of so called self-sufficiency, and difficulties to market the raw milk due to the degree of market demand for milk and milk products but also due to the market position of dairy processors, it is necessary to adopt measures in order to achieve as high quality parameters as possible together with stability of those parameters **(Kovarova and Prochazkova, 2017)**. In some countries ownership concentration of fresh milk processing sector, together with a considerable dispersion and fragmentation of the primary production of raw cow's milk can led to insufficient supply and lack of basic dairy products on the market. The shortage phenomena are manifested in the circumstances of depressed and economically unsustainable low prices of production inputs: raw milk, and quantity decrease, accompanied by changes in the structure of the milk products final production **(Draskovic and Rajkovic, 2010)**.

The new common agricultural policy for the period from 2014 to 2020 for the milk sector, which will have as main component the removal of milk quotas after 2014, represents both a challenge and a threat for the farmers, whose raw milk prices may decrease, resulting in great losses. In order to adapt to the competition on the European Single Market, the dairy industry needs to get supported through investments, in the conditions in which there is a global conjuncture favourable to the consumption of dairy products, in which their world prices are expected to go up, on the basis of the increasing demand of the developing regions **(Grodea, 2014)**.

Environmental aspects of milk production

In the recent years, climate change has become one of the most discussed topic and therefore the environmental impact of livestock production is also more discussed because it is known to have a great impact on the environment **(Steinfeld et al., 2006)**. All food production has an environmental impact and therefore it is critical to produce sufficient high-quality food from a finite resource supply while minimizing effects upon the environment **(Capper et al., 2009)**. The dairy sector, and agriculture in general, faces three key challenges: the need to produce more in order to feed a growing world population, to produce something different to adjust to consumer demands for food and new services and, last but not least, to produce better in respect of the environment, ecology and efficient resource use **(de Jong, 2013)**. Livestock industry, with dairy sector as one of the fastest growing, largely contributes to the atmospheric and soil pollution and greenhouse gases emissions on the global scale, that is, methane, carbon dioxide, and nitrous oxide. In order to successfully respond to the increasing global demand for raw milk and milk products, the dairy industry will have to mitigate future negative impacts on the environment, modifying the current production systems, and maintain at the same time high quality of final products at an economic priceacceptable for the consumers **(Bosnjak et al., 2018)**. Peculiarities of the implementation of the environmental component of the economic security of the enterprises of the dairy industry and the main aspects of state regulation of milk processing enterprises were investigated also in Ukraine **(Lysenko, 2014)**. To reduce the environmental impact of a product efficiently, it is crucial to consider the entire value chain of the product; that is, to apply life cycle thinking, to avoid suboptimisation and identify the areas where the largest potential improvements can be made. Carbon footprint of butter and dairy blend products, with the focus on fat content and size and type of packaging, including product waste at the consumer level, were investigated. The greatest share of greenhouse gas emissions associated with butter production occurred at the farm level; thus, minimizing product losses in the whole value, chain from cow to consumer, is essential for efficient production **(Flysjo, 2011)**.

Milk production quality and safety

Milk price is influenced by milk quality **(Hanus et al., 2008)** and milk safety. Regulation of food systems exists to ensure safety and enhance consumer confidence in the food which they purchase and consume **(Kendall et al., 2019)**. Farmers‘ production practices such as basic production environment and hygienic condition, disease prevention, and source and use of feed all contribute to the food safety of raw milk **(Yu et al., 2018)**. The likelihood of milk safety being important was two times higher in large farms compared to small-scale farms **(Paraffin et al., 2018)**. Improvement of milk safety can be achieved through good management practices by dairy farmers, market incentives, and increased efforts of various stakeholders and the adoption of best practices **(Lemma et al, 2018)**. Current market shares for premium welfare products are small in Europe **(de Graaf et al., 2016)**. Comparison of organic and convetionally produced milk quality showed, that the factors influencing milk composition, for instance diet, breed, and stage of lactation, have been studied individually, whereas interactions between multiple factors have been largely ignored. Lack of research on interactions between several influential factors and differences in trial complexity and consistency between studies, for instance sampling period, sample size, reporting of experimental conditions, complicate data interpretation and prevent us from making unequivocal conclusions **(Schwendel et al., 2015)**.

Scientific hypothesis

The primary aim of the paper is to prepare a prospective platform with a possible objective of its further future expansion into a regulatory policy intended to arrange for simplification of the controlling mechanisms of the market competition not only in a field of a price determination, but also for the other influencing aspects related to this process.

MATERIAL AND METHODOLOGY

The applied scientific methods correspond with the data examined by the analysis. They bear the specific aims which this paper deals with.

Data

The data comes from the database of the Statistical Office of the European Union (Eurostat). It contains the tables from the database “Selling prices of animal products (absolute prices): annual price” marked apri_ap_anouta **(Eurostat, 2018a)** and the database “Milk collection (all milks) and dairy products obtained: annual data” marked apro_mk_pobta **(Eurostat, 2018b)**. The explored time period covers the time period beginning in the year 2006 and ending in the year 2017.

The explained variable is represented by a price of raw cow’s milk. This analysed value is understood as a price of raw cow’s milk with fat content at a level of 3.7% coming from the agricultural holdings that are covered by the Eurostat data collection. It is stated in the euro currency.

On the other hand, there are the five explanatory variables, where cow’s milk production (CM), butter production (B), milk powder production (MP), cheese production (C), and farm milk production (FM) belong. Cow’s milk production describes amount of the whole output of the explored holdings expressed in tonnes. The remaining dimensions represent production of the appropriate products by the agricultural holdings expressed in tonnes too.

The data set covers all the countries whose data are available in the Eurostat database. The following countries are involved: Austria, Belgium, Croatia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom. The mentioned countries are ordered alphabetically according to their colloquial alternative name. They are called by the alternative names in the further text of the paper.

There is to remind that not all the countries have provided the data collected for the whole explored period. Therefore, the mean data are computed from the available values during the analysed time span.

Methodology

The substantial methodological approach applied in the paper is the sensitivity analysis in a form of the regression analysis. The data set entering the modelling process bears a form of the panel data meaning there are two dimensions: a territorial dimension and a time dimension.

There are the three approaches of the panel linear regression employed in the analysis: the pooling approach, the random approach and the between approach. The pooling regression model represents a standard form of the panel linear regression model, whilst the random regression model has a strong informative value in a case of the models which random effects are present at. Also, the between regression model performes as a model, which is calculated with a concentration on time factor and that is why, it discards the information present due to the intragroup variability by means of the involved dimensions. Such a procedure is selected due to a demonstration of robustness of the source data and also to have a platform to review the obtained results and a possibility to compare them mutually. All the regression model types are executed also with a presence of a constant value.

The sequential elimination method is selected as the main modelling technique for the regression analysis. This means the worst variable is excluded from the further modelling process. The elimination factor is represented by the *p*-value of the appropriate independent variable. Hence, the variable with highest *p*-value is omitted in the successive regression model. There is to note that the sequential elimination is related to the elementary altogether model for a whole of the countries. This implies the cluster regression models aimed at the particular clusters are adapted to the elementary model. That is why, it involves variables in the final model of the modelling row has not to fulfil the requirement of the statistical significance.

The supplementary analytical approach is represented by a trivial way of the cluster analysis in a form of the interval division. Because of a number of the involved countries, a triplet of the clusters is selected for the further modelling process. This means the first cluster encompasses eight countries, the second one nine countries and the third one eight countries again. This dissection is done according to the dependent variable that is explained by the regression models. So, after taking into account the raw cow's milk price, all the explored countries are ordered according to this value and thus, they are divided into the three clusters. The first cluster contains the countries with the lowest price of the raw cow's milk, the second cluster involves the countries with the middle price values and the third one with the highest prices of the raw cow's milk. As this price the mean price of the raw cow's milk throughout the whole explored time span is considered. Because some of the values are not available, the mean price is calculated by the available figures.

The final step of the analytical process is to compute and to describe the values of a ratio of the regression coefficients related ot the particular variables involved in the regression models meaning quantitative relation between the same independent variable of the altogether regression model and the models assigned to the three individual clusters. Such a procedure demonstrates how many times the particular analysed variable influences the modelled raw cow's milk price in the cluster than in a whole analysed set of the countries.

Statisic analysis

The whole analysis is executed in the R statistical environment through its own programming language **(R Core Team, 2018)** with supplementary help of the *plm* package **(Croissant and Milo, 2008; Croissant et al., 2017)**. There is to remind that the absolutely best statistical significance is demonstrated by p-value at a level of or lower than a value of 2.2×10^{-16}. Such a state means *p*-value can be considered to be equal to zero.

RESULTS AND DISCUSSION

The regression analysis result reveals the interesting relations between the individual observed dimensions. They are described in more detail in the subsequent paragraphs.

The following tables demonstrate the outcome of the regression analysis. Table 1 visualises the regression coefficients of the variables involved in the pooling regression models together with their *p*-values. The first data column shows the estimated coefficients of the altoghether model, the second column relates to the first cluster model, the third column to the second cluster model and finally, the fourth column to the third cluster model. Table 2 is assigned to the pooling model with a constant value, the third table to the model with a concentration on the random effects and finally, the fourth one to the model with concentration on the time factor. A subsequent foursome of the tables from Table 5 to Table 8 make evident the found ratios of the regression coefficients assigned to the individual clusters. A comparison with the original altogether regression models proceeds in a same manner as it is applied in the first four tables. Table 9 demonstrates the overall statistical significance of the produced regression models by means of displaying the coefficient of determination R^2 together with its adjusted version.

The first remarkable fact is that one of the explored variables appers in no final regression model. An only such variable that is not significant in any of the regression models is the butter production. This implies the fact that changes in butter production does not have statistically significant influence on a level of the raw cow's milk at all. It is true even for all the employed panel data regression approaches.

As it is seen in Table 1, the statistically significant dimensions of the pooling regression model are the cow's milk production, the milk powder production, the cheese production, and the farm milk production. Table 2 confirms this result with a supplement of a constant value to the regression model. On the other hand, Table 3 shows that the regression model concentrated on the random effects considers the cow's milk production and the farm milk production with a constant value statistically significant. On the contrary, the time-oriented regression model contemplates the cheese production and the farm milk production with a constant value statistically significant.

The subsequent tables, Table 5 to Table 8, expose the desired coefficient ratios. The visualised outcome signifies the distribution of the individual countries among the examined clusters. It underlines the fact that the cheaper raw cow's milk price causes a concentration on the specific part of the production that is easier to produce.

There is to note some of the coefficient ratios bear high values in consideration of the other ones: this is caused by their statistical insignificance. It is demonstrated by the *p*-values visualised in the first four tables.

The coefficient of determination of the regression models reveal their statistical significance as a whole. Some present values mean absolute insignificance because of the employed methodology: the cluster-aimed regression models are constructed according to the altogether regression model. Hence, for instance, negative values come out. Regarding this approach, it is not unnecessary to consider it not suitable. Such an approach can be understood methodically too. It suggests avoiding possibly this procedure.

Table 1 The pooling panel linear regression models without a constant value.

Regressor	Value	Altogether	Cluster 1	Cluster 2	Cluster 3
CM	coefficient	-5.1990×10^{-9}	6.0214×10^{-9}	-1.3003×10^{-8}	-1.3258×10^{-8}
	p-value	0.0499	0.1372	0.0396	0.0924
MP	coefficient	5.6777×10^{-8}	2.6373×10^{-8}	3.3222×10^{-7}	3.2675×10^{-7}
	p-value	0.0476	0.2686	5.017×10^{-5}	0.0003
C	coefficient	-3.4969×10^{-8}	-1.3169×10^{-8}	-5.9182×10^{-8}	6.8076×10^{-8}
	p-value	0.0243	0.4826	0.0053	0.3083
FM	coefficient	9.0227×10^{-9}	-1.2838×10^{-9}	1.6613×10^{-8}	1.8747×10^{-8}
	p-value	0.0002	0.6603	0.0041	0.0567

Table 2 The pooling panel linear regression models with a constant value.

Regressor	Value	Altogether	Cluster 1	Cluster 2	Cluster 3
constant value	coefficient	3.5183×10^{-2}	3.2072×10^{-2}	4.0474×10^{-2}	2.0300×10^{-2}
	p-value	2.2×10^{-16}	2.2×10^{-16}	2.2×10^{-16}	1.493×10^{-9}
CM	coefficient	1.5899×10^{-9}	2.3390×10^{-9}	3.0842×10^{-9}	-9.0066×10^{-9}
	p-value	0.0054	0.0037	0.0183	0.0517
MP	coefficient	-1.0385×10^{-8}	-7.3714×10^{-9}	-4.5982×10^{-8}	2.2634×10^{-7}
	p-value	0.0872	0.1110	0.0146	4.630×10^{-5}
C	coefficient	1.2412×10^{-8}	1.2593×10^{-8}	1.4656×10^{-8}	3.2861×10^{-8}
	p-value	0.0003	0.0014	0.0019	0.3977
FM	coefficient	-2.4673×10^{-9}	-2.8082×10^{-9}	-4.1077×10^{-9}	1.0159×10^{-8}
	p-value	1.077×10^{-5}	1.482×10^{-5}	0.0016	0.0787

Table 3 The random panel linear regression models with a constant value.

Regressor	Value	Altogether	Cluster 1	Cluster 2	Cluster 3
constant value	coefficient	3.2742×10^{-2}	2.9874×10^{-2}	3.4881×10^{-2}	2.9856×10^{-2}
	p-value	2.2×10^{-16}	2.2×10^{-16}	2.2×10^{-16}	2.2×10^{-16}
CM	coefficient	1.7687×10^{-9}	2.4295×10^{-9}	2.2179×10^{-9}	-3.9127×10^{-9}
	p-value	0.0290	0.0056	0.2806	0.1743
FM	coefficient	-1.6414×10^{-9}	-1.7607×10^{-9}	-2.2138×10^{-9}	4.3724×10^{-9}
	p-value	0.0378	0.0216	0.2703	0.1358

Table 4 The between panel linear regression models with a constant value.

Regressor	Value	Altogether	Cluster 1	Cluster 2	Cluster 3
constant value	coefficient	3.2823×10^{-2}	3.1783×10^{-2}	3.4275×10^{-2}	3.2236×10^{-2}
	p-value	2.2×10^{-16}	1.24×10^{-5}	1.034×10^{-5}	8.175×10^{-5}
C	coefficient	1.0795×10^{-8}	1.9384×10^{-8}	5.3594×10^{-9}	2.0777×10^{-8}
	p-value	0.0633	0.0350	0.5619	0.5609
FM	coefficient	-6.8792×10^{-10}	-1.2669×10^{-9}	-4.1043×10^{-10}	-9.7976×10^{-10}
	p-value	0.0911	0.0784	0.5278	0.6703

Table 5 The coefficient ratios of the pooling panel linear regression models without a constant value.

Regressor	Cluster 1	Cluster 2	Cluster 3
CM	-1.158182	2.501020	2.550129
MP	0.464509	5.851331	5.755038
C	0.376600	1.692393	-1.946730
FM	-0.142285	1.841202	2.077740

Table 6 The coefficient ratios of the pooling panel linear regression models with a constant value.

Regressor	Cluster 1	Cluster 2	Cluster 3
Constant value	0.894540	1.128878	0.566189
CM	1.471146	1.939878	-5.664858
MP	0.709832	4.427843	-21.795754
C	1.014575	1.180769	2.647442
FM	1.138180	1.664878	-4.117367

Table 7 The coefficient ratios of the random panel linear regression models with a constant value.

Regressor	Cluster 1	Cluster 2	Cluster 3
Constant value	0.912398	1.065335	0.911851
CM	1.373566	1.253971	-2.212157
FM	1.072683	1.348731	-2.663761

Table 8 The coefficient ratios of the between panel linear regression models with a constant value.

Regressor	Cluster 1	Cluster 2	Cluster 3
Constant value	0.968330	1.044241	0.982140
C	1.795545	0.496445	1.924596
FM	1.841604	0.596625	1.424231

Table 9 Statistical significance of the models.

Model	Type	R^2	Adjusted r^2
Pooling-without a constant value	altogether	0.13006	0.10633
	cluster 1	0.00105	-0.10229
	cluster 2	0.35898	0.30967
	cluster 3	0.54295	0.50263
Pooling-with a constant value	altogether	0.22469	0.19624
	cluster 1	0.61234	0.55696
	cluster 2	0.44463	0.38617
	cluster 3	0.60762	0.56006
Random-with a constant value	altogether	0.10001	0.09306
	cluster 1	0.1829	0.16272
	cluster 2	0.1429	0.12342
	cluster 3	0.08547	0.06370
Between-with a constant value	altogether	0.15165	0.07453
	cluster 1	0.64156	0.49818
	cluster 2	0.07149	-0.23802
	cluster 3	0.13474	-0.21136

The difference of earlier observed market situations with high price levels is that it is unilaterally based on the fat component of the milk. Changes of milk lipid composition in term of its enrichment are doable by the manipulation of the composition of animal diets or by the genetic engineering techniques **(Świątkiewicz et al., 2015)**. The contrast to the milkfat situation are the markets of the nonfat components. Large public stocks of skim milk powder are the major obstacle that prices might stabilise at higher levels, and therefore volatility in this sector will be limited. Skim milk powder has nutritional benefits and functional properties, including high calcium and potassium, a low-fat content, excellent gelation, emulsification and foaming properties **(Burke et al., 2018)**. The returns from the different dairy products adjust with some delay to the mix of prices for milk fat, which are mainly depending on butter, and the prices realised in the nonfat part which will mainly depend on the situation in the skim milk powder market.

More cheese and more whole milk powder would also absorb larger volumes of milkfat which are not available for butter and cream. The trade in fresh products like liquid milk, yogurt, cream and other items is developing with strong rates, but modest in terms of milk equivalents when compared to milk powders, butter and cheese **(Richarts, 2018)**.

CONCLUSION

In the submitted article regression analysis was used to verify the impact of five factors, where cow's milk, butter, milk powder, cheese, and farm milk production belong, to the price of raw cow's milk. Regression analysis of panel data claiming territorial and time dimensions coming from the countries whose data is available in the Eurostat database was applied using three techniques, which the pooling, the random and the between approach are. The complete data is accessible for Austria, Belgium, Croatia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom. Supplementary analytical approach represented by the cluster analysis resulted into three clusters (containing eight; nine; and eight countries respectively), selected for the further modelling process.

Results of the regression analysis showed no influence of butter production to the level of raw cow's milk. The obtained outcome from the analysis validates the desired aim of the paper in a way that it prepares a potential platform for the further research by demonstrating the relations between each individual pair of the explored variables. The illustrated coefficient ratios reveal the possible succession of the further steps to construct a regulatory policy.

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