

Regression Analysis of Variables Describing Poultry Meat Supply in European Countries

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In this paper, based on the analysis of official FAOSTAT and EUROSTAT data on poultry meat for 38 European countries for years 2007 and 2009, two hypotheses were examined. Firstly, considering four clustering variables on poultry meat, i.e. production, export and import in kg/capita, as well as the producer price in US \$/t, using descriptive exploratory and cluster analysis, the hypothesis that the clusters of countries may be recognized was confirmed. As a result six clusters of similar countries were distinguished. Secondly, based on multiple regression analysis, this paper proves that there exists the statistically significant relationship of poultry meat production on export and import of that kind of meat, all measured in kg/capita. There is also a high correlation between production, as a dependent, and each of two independent variables.

Key words: poultry meat, marketing strategy, cluster analysis, correlation, multiple regression

1 Introduction

Due to technological developments in the last couple of years less physical work is needed, while it becomes continuously replaced with the modern machines. Parallel development of information and communications technology enables the performance of many operations on computers. Furthermore, a number of activities have been moved out of manufacturing and placed in the offices, from where the machines are controlled and monitored.

As the amount of work has declined, people have changed their eating habits. A calorie rich food is replaced by smaller portions and food easy to digest. Since meat is still the main ingredient in people's daily menu, people start to consume more and more poultry meat. Because of increasing demand for this kind of meat worldwide, its production increases (FAOSTAT, 2012).

In European countries the production of poultry products has developed differently. While some countries invested in the development of poultry in order to fulfill their needs, others increased their production in order to export more. Increased demand for poultry products resulted in the growth of its prices.

The objective of this paper is to determine the interrelations between production, import, export and prices of poultry meat in the selected European countries. The obtained results could be very useful for marketing management, when developing an export strategy (Klemenčič, Devetak & Števančec, 2012). The last available data for previously mentioned variables are available for year 2007 (FAOSTAT, 2012). The data are collected on the basis of annual reports about production in each country as well as from the EUROSTAT database (EUROSTAT, 2012).

Furthermore, the aim of this paper is also to find clusters of similar countries taking into account following variables: population, import, export and the prices of poultry meat. The observed clusters could be useful in planning marketing strategies and poultry sales in certain countries.

The first research hypothesis (H1) says that certain clusters of selected European countries may be recognized, considering four variables on poultry meat: production, export and import per capita, as well as the price of that kind of meat per quantity unit. The second research hypothesis (H2) is that there is at least one variable that is statistically significant for an explanation of poultry meat production per capita.

Perner (2008) dealt with global food marketing by investigating the impact of economic and psychological factors that influence on the consumers of poultry products. The profitability of the integrated poultry farm was explained by Bamiro, Momoh and Phillip (2009), who studied the correlation between costs and investments of the poultry production. The habits of consumers were also investigated by Kos Koklič and Vida (2012), who concluded that the food origin is the main factor when buying the product. In the sample of 714 people questioned in Slovenia, 74,1% think that the food origin is very important. Moreover, (Vukasović, 2009) compared the chicken meat products of various producers in Slovenia and found that the Slovenians trust more domestic production.

To address the previous empirical findings, the authors set up a task to find a recent demographic data of the European countries on production, export, import and the prices of the poultry meat and to conduct exploratory descriptive, graphic and numeric, as well as clusters, correlation and regression analysis.

For this purpose, the secondary data are collected from the EUROSTAT and FAOSTAT database, while the descriptive, regression and cluster analysis was performed with the statistical program packages Excel, Megastat, PHStat 2,5 and Minitab 15.

2 Methodology

2.1 Data sources

Data on production, export, import and prices of poultry are taken from FAOSTAT database, while data on population are provided from EUROSTAT database. The sample consists of data for 38 European countries in the years 2007 and 2009. The methodology of data collection is performed with the cooperation of the governments of all countries of the world, through a questionnaire Food and Agriculture Organization of the United Nations (FAO), with the intention "for a world without hunger." The scope of the data collection is huge, therefore FAOSTAT refreshes and displays structured and comprehensive metadata only every five years. In meat and poultry is the last year of published data 2009th.

It should be pointed out that the data for Andorra, the Faeroe Islands, Gibraltar, Holy Seat, Lichtenstein, Monaco, Montenegro and San Marino are incomplete. Since these countries do not produce poultry meat, they are excluded from the analysis.

2.2 Descriptive data exploration

The data for production, export and import are given per capita, based on the information from the CIA World bank and EUROSTAT database. Furthermore, producers price on US\$/t is also included in the analysis.

2.3 Cluster analysis practical application

The modern marketing research is based on data collected by professional international agencies. For the purpose of this

research data collected by FAOSTAT (2012), EUROSTAT (2012) and CIA (2012) analyzed a statistical multivariate approach based mostly on regression and cluster analysis approach. Also, Wong (2009) applied the cluster analysis method studying the business opportunities, and she came to the perception that the usage of cluster analysis method new marketing strategies may be developed.

2.4 Food supply

Stagnation of economic development in the countries all over the world, and so in the European countries, caused an unemployment rising in the labor market. Providing food is becoming an increasingly important element of each of the European countries. Manufacturers are trying to increase grain yield per area unit (ha) using genetically modified organisms (GMOs), but these foods have not been well studied, to be able to lead to long-term solutions (Hall, 2010). From the data in Table 1 it is clear that many countries in Europe have invested and increased production of the classic poultry in the period from 2007 to 2009.

Following, the exploratory data analysis is conducted by using the methods of descriptive statistics. The results for 2009 are given in Table 2.

3 Results

Based on the indicators given in Table 2 for 38 European countries for the year 2009 and the obtained results for 2007, following is concluded:

- **Production:** On average, 18,96 kg/capita of poultry meat was produced in 2009, which is for 0,71 kg/capita more than in 2007. Furthermore, comparing with 2007, standard deviation increased by 0,88 kg/capita, while the coefficient of variation equals 58,27%. The frequency distribution is still positively skewed (skewness=0, 85), while the peak is sharper for 0,13 relative to 2007 (kurtosis=0, 92). Based on Table 4, poultry production of the following countries is still above the average: the Netherlands with 50,72 kg/capita, Belgium with 43,99 kg/capita and Hungary with 38,69 kg/capita. The biggest growth in production is achieved by Belarus with an increase of 5,73 kg/capita, Poland with 5,66 kg/capita and Slovenia with 5,13 kg/capita, respectively. The biggest fall happened in Luxembourg, where the production was decreased by 23,91 kg/capita, stimulating the strong decline in producer prices for 43,52%. The main cause of such a change lies in strong competition of nearby countries, i.e. Germany, Belgium and France, which have been producing the poultry meat under much lower prices. In this segment, Luxembourg is a serious outlier.
- **Import:** In 2009 the import of poultry meat averaged 7,81 kg/capita, (in 2007 it averaged 7,3 kg/capita) with standard deviation of 6,7 kg/capita and coefficient of variation of 86,71%, showing that the variability was for 3,65% bigger than in 2007. The distribution is still positively skewed (skewness=2,02) and peak becomes sharper relative to the normal distribution (kurtosis=6,36). Country

Table 1: Production, import, export of poultry meat in kg/capita and producer price in US \$/t for 38 European countries in 2007 and 2009

Country	Production (kg/capita)		Import (kg/capita)		Export (kg/capita)		Producers price (US \$/t)	
	2007	2009	2007	2009	2007	2009	2007	2009
Albania	4,10	5,32	5,66	8,23	0,00	0,00	2.954,30	3.341,40
Austria	14,89	14,99	10,47	11,06	6,80	7,00	2.700,20	2.790,30
Belarus	17,11	22,84	1,68	1,33	0,99	2,24	1.781,20	1.741,80
Belgium	43,02	43,99	16,20	16,20	34,04	38,11	1.633,10	1.588,30
Bosnia& Herzegovina	5,21	8,82	2,66	3,59	0,42	1,11	2.438,80	1.408,60
Bulgaria	16,13	17,25	5,51	8,39	1,58	3,86	1.759,70	1.846,20
Croatia	11,77	8,57	2,56	3,50	1,46	1,85	1.902,60	1.926,50
Czech Republic	21,01	19,29	6,09	8,40	2,47	2,58	1.306,50	1.380,70
Denmark	31,53	31,40	8,61	10,24	20,05	21,89	1.140,90	1.326,90
Estonia	8,58	11,09	13,05	13,35	4,33	4,99	2.197,50	1.964,80
Finland	18,58	19,37	1,85	2,25	2,10	2,09	1.562,50	1.722,20
France	26,32	28,16	4,57	5,48	8,48	8,74	1.839,40	1.906,10
Germany*	13,58	15,64	7,53	8,21	5,37	6,24	1.649,40	1.649,40
Greece	10,53	10,09	5,32	5,94	1,54	1,61	2.289,00	2.597,20
Hungary	37,56	38,69	3,02	3,38	10,00	12,21	1.521,30	1.531,90
Iceland*	24,83	22,61	1,18	1,14	0,00	0,00	5.874,70	5.874,70
Ireland	26,99	26,95	13,45	13,71	13,67	13,99	1.341,60	1.482,60
Italy	17,23	19,00	0,73	0,88	1,90	2,20	2.935,80	2.732,40
Latvia*	9,01	10,25	13,62	11,61	2,10	2,33	1.429,20	1.429,20
Lithuania	20,17	21,38	10,77	7,65	5,92	6,25	2.004,90	1.614,00
Luxembourg	24,37	0,46	16,11	17,23	0,65	1,10	8.607,60	5.722,20
Malta	11,46	11,70	17,19	18,85	0,01	0,00	1.382,00	1.644,70
Netherlands	45,86	50,72	26,76	35,48	56,68	61,52	1.393,50	1.402,20
Norway	14,83	16,91	0,13	0,24	0,03	0,02	2.659,90	2.680,00
Poland	25,59	31,25	1,46	1,04	6,69	8,83	1.664,70	1.580,20
Portugal	23,84	26,57	3,03	3,84	0,84	0,96	1.263,50	1.015,00
Republic of Moldova	8,75	9,63	3,66	2,38	0,13	0,00	1.948,50	2.195,20
Romania	14,42	17,24	5,32	5,49	0,43	1,70	2.255,00	2.052,60
Russian Federation	13,04	16,50	9,07	6,79	0,02	0,04	2.210,70	2.257,20
Serbia	7,09	8,14	0,17	0,27	0,29	0,21	1.837,80	1.658,30
Slovakia	15,52	13,90	5,72	7,09	3,24	3,22	1.560,10	1.572,80
Slovenia	24,51	29,64	4,76	5,84	9,02	8,81	1.724,40	1.980,60
Spain	25,90	26,41	3,44	3,54	1,89	2,29	1.988,10	1.862,80
Sweden	11,76	11,59	5,38	5,72	1,76	1,31	1.701,20	1.546,30
Switzerland	8,03	8,55	6,95	7,66	0,03	0,02	2.926,20	3.445,00
FYR Macedonia	1,72	1,61	17,80	15,78	0,08	0,08	1.080,30	360,20
Ukraine	14,90	19,56	2,65	4,27	0,06	0,42	1.703,00	1.689,70
United Kingdom	23,87	23,58	11,45	10,90	5,56	4,71	1.547,70	1.534,40

Note: Germany, Iceland and Latvia did not give data for 2009, so data imputations from 2007 were taken

Source: Author's calculation 2012, FAOSTAT, EUROSTAT

Table 2: Results of descriptive statistics for production, import and export of poultry meat "per capita" and Producer price on US\$/t for 38 European countries in 2009

Descriptive statistics	Production (kg/capita)	Import (kg/capita)	Export (kg/capita)	Producer price (US \$/t)
Number of countries	38	38	38	38
mean	18,96	7,814	6,17	2.054,07
minimum	0,46	0,24	0	360,2
maximum	50,87	35,48	61,52	5874,7
range	50,41	35,24	61,52	5514,5
population standard deviation	10,90	6,69	11,57	1.057,70
skewness	0,85	2,02	3,59	2,37
kurtosis	0,92	6,37	14,39	6,67
coefficient of variation (CV)	58,27%	86,71%	190,05%	52,18%
1st quartile	10,46	3,51	0,56	1,54
median	17,08	6,37	2,22	1,71
3rd quartile	26,53	10,74	6,25	2,16
interquartile range	16,07	7,23	5,69	622,18
mode	#N/D	#N/D	#N/D	#N/D

Source: Author's calculation 2012, Megastat

that import the most is still the Netherlands with 35,48 kg/capita, which is more than 8,72 kg/capita in comparison with the previous year.

- **Export:** The average export in 2009 was 6,17 kg/capita, which is for 0,63 kg/capita more than in 2007 and with an average deviation from the mean of 11,57 kg/capita, or relatively 190,05%, showing the decline of the variability in poultry meat export per capita for 10% relative to 2007. The analyzed data of export are still quite far from a stable normal distribution that is positively skewed (skewness=3,59). The Netherlands extremely increased its export at 61,52 kg/capita and still represents a serious outlier. Such a growth could be explained with the accession of new countries to the European Union, which do not have the borders, thus enabling the import of poultry meat under much lower prices.
- **Price:** Poultry meat price in US \$/t has got the average 2.054,07 US \$/t with the average deviation from the average of 1.057,70 US \$/t, what is 52,18%. Such a result shows quite big variability of the data between the countries. Compared to 2007, the distribution of producer prices is less skewed (skewness=2,37), but still far from the normal distribution. In Iceland was recorded the highest price of 5.784,70 US\$/t. High prices are caused by higher transportation costs, as Iceland is very far from other European countries. Moreover, the producer prices in the Netherlands decreased from 8.607,60 US \$/t in 2007 to 5.722,20 US \$/t in 2009. The reason for that lies in increased supply of the new EU members, i.e. the countries with lower GDP per capita.

3.1 Clustering European countries according to poultry meat supply data

The first research hypothesis (*H1*), according to which clusters of countries considering four variables on poultry meat: production, export and import per capita, as well as the price of that kind of meat per quantity unit, may be recognized. So, a cluster analysis was conducted and respective dendrogram charted for 2007 and 2009, based on standardized data, Ward linkage method and Euclidean distance measure, Figure 6.

3.2 Cluster analysis for 2007

The dendrogram given in Figure 1 shows six clusters of European countries considering poultry meat variables for 2007 given in Table 1.

In Table 3 the European countries are grouper according to the dendrogram from Figure 1.

In 2009 the Cluster 1 is comprised of 12 countries, as follows: Albania, Switzerland, Austria, Greece, Romania, Russian Federation, Italy, Norway, Bosnia and Herzegovina, Serbia, Croatia and Moldova. Cluster 2 is consisted of 4 countries: Estonia, Latvia, Malta and FRY of Macedonia. Cluster 3 is made by 2 countries: Iceland and Luxembourg. Cluster 4 is consisted of 11 countries, which are similar considering clustering variable, and these are: Belarus, Spain, Finland, Ukraine, Portugal, Bulgaria, Germany, Czech Republic, Lithuania, Slovakia and Sweden. A separate Cluster 7 covers: Denmark, Ireland, United Kingdom, France, Slovenia,

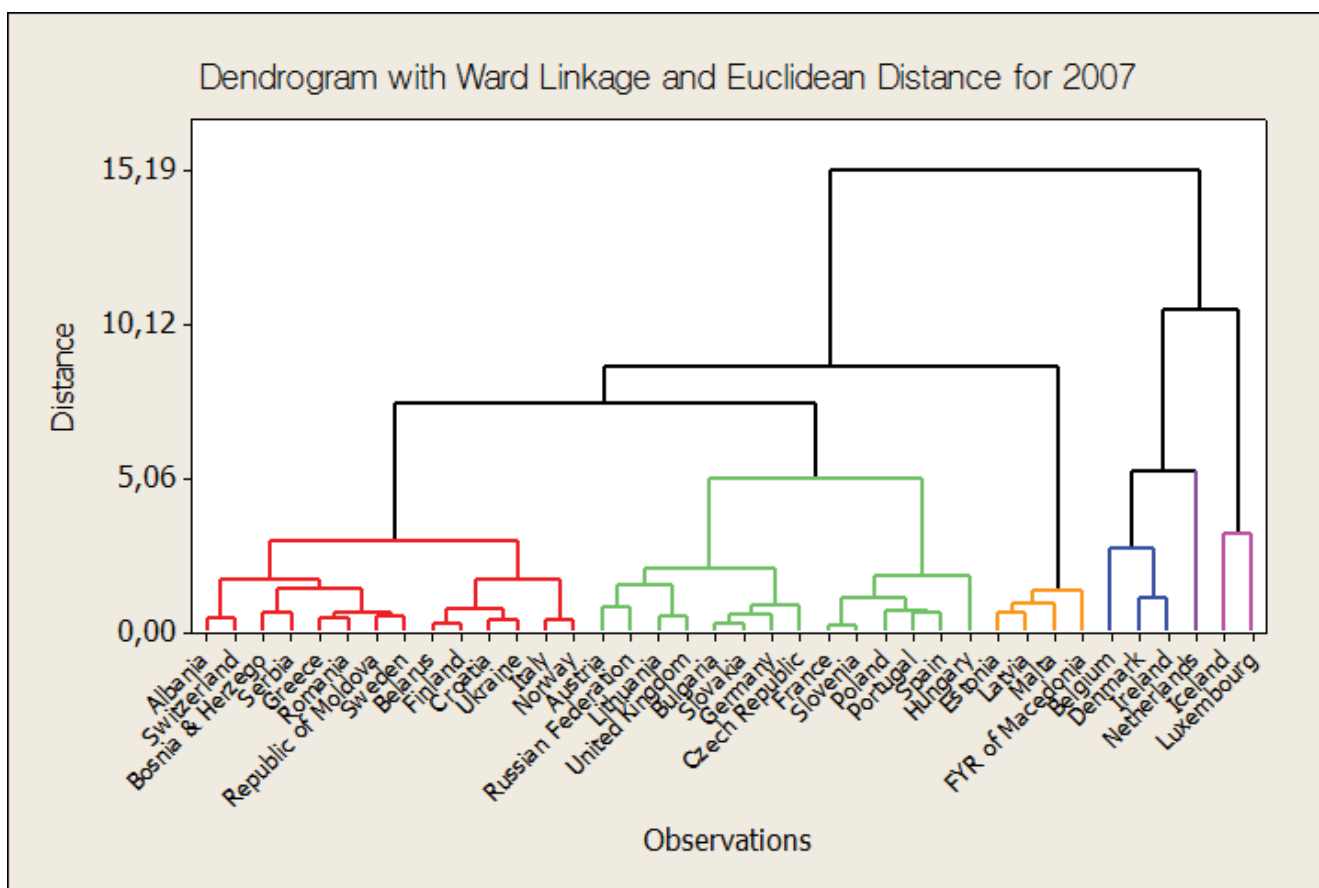


Figure 1: Dendrogram with six clusters created of 38 European countries based on four variables: production, export, import of poultry meat per capita and price of poultry meat in US \$/t for 2007
 Source: Author's creation 2012, Minitab 15

Table 3: Clustering of 38 European countries clustered into six clusters based on four variables for 2007: Production, Import of poultry meat, Export of poultry meat (all variables in kg/capita), and Producer price in US \$/t.

Cluster	No. of countries	Countries
Cluster 1	14	Albania, Switzerland, Bosnia & Herzegovina, Serbia, Greece, Romania, Moldova, Sweden, Belarus, Finland, Croatia, Ukraine, Italy, Norway
Cluster 2	14	Austria, Russia Federation, Lithuania, United Kingdom, Bulgaria, Slovakia, Germany, Czech Republic, France, Slovenia, Poland, Portugal, Spain, Hungary
Cluster 3	4	Estonia, Latvia, Malta, FYR of Macedonia
Cluster 4	3	Belgium, Denmark, Ireland
Cluster 5	1	The Netherlands
Cluster 6	2	Iceland, Luxembourg

Source: Author's creation 2012, Minitab 15

Hungary and Poland. And, finally, there is Cluster 6, which includes only 2 countries and these are Belgium and The Netherlands. Countries comprising one cluster have got more or less similar

The Cluster 1 is comprised of 14 countries with exceptionally small amount of production, import and export, as

well as with low producer prices of poultry meat. Low production is caused by the low price of work in those countries. The poultry meat production implies more physical work, so the price of work has a big impact on the producer prices. The exception is Switzerland, where the state gives producers big subventions from the import quotas (import levies) and this is

the reason of low prices there. These countries are: Albania, Switzerland, Bosnia & Herzegovina, Serbia, Greece, Romania, Moldova, Sweden, Belarus, Finland, Croatia, Ukraine, Italy and Norway.

The Cluster 2 consists of 14 countries: Austria, Russian Federation, Lithuania, United Kingdom, Bulgaria, Slovakia, Germany, Czech Republic, France, Slovenia, Poland, Portugal, Spain, and Hungary. On average, these countries have similar values of production, import, export and prices. They have small standard deviations, which is also a one of the common factors that connect these countries.

The Cluster 3 is made of 4 countries: Estonia, Latvia, Malta and FYR of Macedonia. They have export, import and prices above the average. Moreover, they are characterized by extremely low production of poultry meat, which is caused by low population as well as non-intensive poultry meat production.

In Cluster 4 there are Belgium, Denmark and Ireland. These countries have connections between two pairs of economic features and dependent variables. The first pair is presented by production and producer prices. The countries in this Cluster are diametrical opposites. They have relatively high poultry meat production, while on the other hand the producer prices are low. The second feature of these countries is a positive difference of lower import and higher export (export surplus). This diametrical opposite provides them a competitive advantage and the possibility for higher GDP as well as the background for new investments and the industrial development.

Cluster 5 consists only one country, i.e. the Netherlands. Along with the Russian federation, it has the highest export (932.006.000 t) and it is on the fourth place in import (439.956.000 t) of the poultry meat. With the population of 16.443.000 people and its own production of 754.000t, it is placed seventh. Compared to other European countries, the export of poultry meat equals 439.956t, which is more than 349% above the average. The import of 932.006t is equal to import of Germany and France that are placed second and third respectively on the amount of the import of the poultry meat.

Finally, the Cluster 6 includes Iceland and Luxembourg that are characterized by the low poultry meat production. Luxembourg produces 476.000t of poultry meat and Iceland only 306.000t, thus holding the last place in Europe. Both countries also have low export and import. The reasons for such a situation in Iceland lie in low population density (3,2 people per km², EUROSTAT); low production as well as low export and import. On the other hand, Luxembourg has a high population density (185,6 people per km², EUROSTAT), but also does not have its own production, while export and import are far below the average in a relation to other European countries. However, both countries have the highest producer prices of poultry meat in Europe of 2150.44 US\$/t. The price of poultry meat in Luxembourg equals 8607.60 US\$/t, which is 400% above the European average, while in Iceland the price equals 5874.70 US\$/t which is 273,2% above the average. The prices are high due to economic protection of domestic market, while both countries have high import duty EUR-Lex (2010).

3.3 Cluster analysis for 2009

Further, clustering is made for the same variables and same countries for 2009, using data from in Table 1. The dendrogram could be seen in Figure 2.

In Table 4 the clusters of countries are given according to the dendrogram given in Figure 2.

Some changes in clusters of countries in 2009 compared to 2007 are visible, as follows:

- Cluster 1 is created of 12 countries: Albania, Switzerland, Austria, Greece, Romania, Russian Federation, Italy, Norway, Bosnia & Herzegovina, Serbia, Croatia, Moldova. It happens that Austria and Russian Federation left their old Cluster 2 and joined this new Cluster 1. Austria increased its trade deficit, while the import was 3.496t higher than in 2007. Russia decreased its deficit by 329.774t and now it is equal to 966.831t. Comparing the differences in the deficit with the production, both countries are added to the Cluster of so called "average countries", i.e. in Cluster 1. The deficit calculations are based on the data in Table 1.
- Cluster 2 is comprised of 4 countries: Estonia, Latvia, Malta and FYR of Macedonia (in 2009 it was called Cluster 3). So, nothing changed in clusters of the mentioned countries.
- Cluster 3 covers only two countries. In 2009 Iceland and Luxembourg create a cluster of their own, and that is Cluster 3, just as before in 2007 (they were in old Cluster 6)
- Cluster 4 has 11 countries. Sweden and Finland left old Cluster 1 and joined new Cluster 4, so they are together with Belarus, Spain, Ukraine, Portugal, Bulgaria, Germany, Czech Republic, Lithuania, and Slovakia. Belarus and Ukraine left old Cluster 1 and moved to new Cluster 4. Almost the same production of poultry meat in 2009 was achieved by Sweden with 107.940t and Finland with 103.500t. They also have similar export that equals 12.173t for Sweden and 11.141t for Finland, as it can be seen in Table 1. These two characteristics have put Sweden and Finland in Cluster 4. From 2007 to 2009 Belarus and Ukraine increased their poultry meat production by 32,27% and 29,70%, respectively, moving them in Cluster 4. Such a growth deviates from the average growth of production, which equals 3,78% in Europe. The reason for that are preparations for economic union without the borders, which was formed in 2011 between Russia, Belarus, Ukraine and Moldova.
- Cluster 5 is created of 7 countries, and these are: Denmark, Ireland, United Kingdom, France, Slovenia, Hungary, and Poland. The main characteristic of this Cluster is export orientation on the markets of the European Union. These countries exported above the average export of poultry meat of 104.931t. The exceptions are Slovenia and Ireland, which have the amount production below the average, but have also relatively low import.
- Cluster 6 has got only two countries: Belgium, and The Netherlands. The Netherlands stays the biggest exporting country of poultry meat in Europe with 1.018.685t. Belgium is also included in this Cluster, while it exported 406.314t and had very high export surplus of 45.561t.

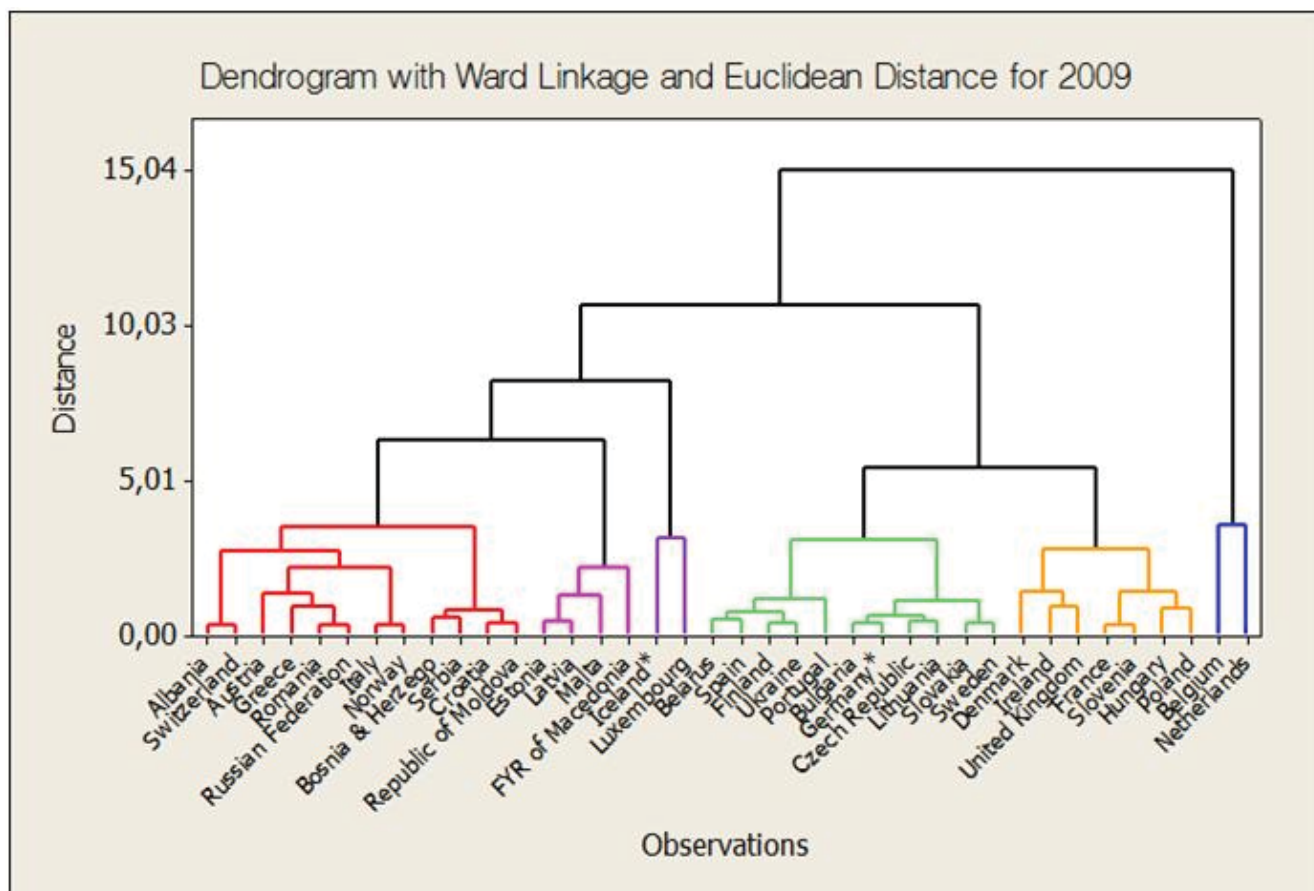


Figure 2: Dendrogram with six clusters created of 38 European countries based on four variables: production, export, import of poultry meat per capita and price of poultry meat in US \$/t for 2009
 Source: Author's creation 2012, Minitab 15

Table 4: Clustering of 38 European countries clustered into six clusters based on four variables for 2009: Production, Import of poultry meat, Export of poultry meat (all variables in kg/capita), and Producer price in US \$/t

Cluster	No. of countries	Countries
Cluster 1	12	Albania, Switzerland, Austria, Greece, Romania, Russian Federation, Italy, Norway, Bosnia & Herzegovina, Serbia, Croatia, Moldova
Cluster 2	4	Estonia, Latvia, Malta, FYR of Macedonia
Cluster 3	2	Iceland*, Luxembourg
Cluster 4	11	Belarus, Spain, Finland, Ukraine, Portugal, Bulgaria, Germany*, Czech Republic, Lithuania, Slovakia, Sweden
Cluster 5	7	Denmark, Ireland, United Kingdom, France, Slovenia, Hungary, Poland
Cluster 6	2	Belgium, The Netherlands

*Since data Producers price of poultry meat are not available in Iceland and Germany for 2009 at the moment of publishing the paper, the average increase of the price of poultry meat in 2008 compared to 2007 is used for analysis.

3.4 Correlation analysis

Correlation matrix consists of the coefficients of linear relation between variables of production, import and export of poultry meat given in kg per capita and is presented in Tables 5 and 6.

Correlation coefficients show that positive linear correlation exists between any two variables considered for 2007 and 2009. Variables Export (kg/capita) and Production (kg/capita) are highly positively correlated with correlation of $r=0,756$ in 2007 and $r=0,766$ in 2009. Also, variables Export (kg/capita)

Table 5: Correlation matrix of variable production, export and import of poultry meat data in 38 European countries in 2007 variables in kg/capita

	Production (kg/capita)	Import (kg/capita)	Export (kg/capita)
Production (kg/capita)	1,000		
Import (kg/capita)	0,267	1,000	
Export (kg/capita)	0,756	0,599	1,000

Source: Author's creation 2012, Megastat

Table 6: Correlation matrix of variable production, export and import of poultry meat data in 38 European countries in 2009 variables in kg/capita

	Production (kg/capita)	Import (kg/capita)	Export (kg/capita)
Production (kg/capita)	1,000		
Import (kg/capita)	0,236	1,000	
Export (kg/capita)	0,766	0,684	1,000

Source: Author's creation 2012, Megastat

and Import (kg/capita) are moderately positively correlated with correlation of $r=0,599$ in 2007 and $r=0,684$ in 2009. Only variables Production (kg/capita) and Import (kg/capita) are weakly positively correlated with correlation of only $r=0,267$ in 2007 and $r=0,236$ in 2009, which seems to be completely logical.

4 Discussion

4.1 Multiple regression model for poultry meat production

With a purpose to test the second research hypotheses H2, that there is at least one variable that is statistically significant for an explanation of poultry meat production in kg/capita, the following multiple linear regression model for the population is analyzed:

$$\text{Production}_{pc_i} = \beta_0 + \beta_1 \cdot \text{Export}_{pc_i} + \beta_2 \cdot \text{Import}_{pc_i} + e_i, \quad i=1, \dots, n,$$

with appropriate model for the sample:

$$\text{Prodûction}_{pc_i} = \hat{\beta}_0 + \hat{\beta}_1 \times \text{Export}_{pc_i} + \hat{\beta}_2 \times \text{Import}_{pc_i}, \quad i=1, \dots, 38.$$

Estimates are calculated using an ordinary least squares method (OLS).

4.2.1 Multiple regression model estimated for the year 2007

With concrete estimates the model for 38 countries for 2007 is:

$$\begin{aligned} \text{Prodûction}_{pc_i}(2007) = & 16,9499 - 0,4910 \cdot \text{Export}_{pc_i} + \\ & (1,6558) \quad (0,2176) \\ & + 0,8774 \cdot \text{Import}_{pc_i}; \\ & (0,1217) \end{aligned}$$

$$\begin{aligned} \hat{\sigma} &= 6,3828 \\ R^2 &= 0,6264 \\ \bar{R}^2 &= 0,6051 \\ R &= 0,7914 \\ DW &= 1,709 \\ n &= 38 \end{aligned}$$

The regression coefficient of the regressor variable Export_{pc} is negative and statistically significant at 5% significance level, as the test value t-statistic is -2,2562 with p-value=0,0304. Based on the estimated equation, remaining Import unchanged, a one unit increase in Export (kg/capita) decreases Production of poultry meat on average by 0,491 kg/capita. Based on the estimated equation, remaining Export unchanged, a one unit increase in Import (kg/capita) increases Production of poultry meat on average by 0,8774 kg/capita. The value of the coefficient of determination of $R^2=0,6264$ means that 62,24% of the variation in Production of poultry meat is explained by both Import and Export of the same kind of meat. For conducting the overall test of significance of the multiple regression the test value of Fisher's F is 29,3434 with p-value=0,0000 indicates that two independent variables Export and Import per capita are statistically significant for explanation of Production of poultry meat per capita in 38 countries. The regression standard error is 6,3828 kg/capita

and regression coefficient of variation is 34,97%, meaning the model is moderately representative.

Regression diagnostics for evaluating multiple regression model for 2007 assumptions was conducted, too. Diagnostics techniques, described in Dougherty (2011), Gujarati & Porter (2009), Maddala (2010), Pfajfar (2012), Dumičić, Čeh Časni & Palić (2011) and Asteriou & Hall (2007), were applied using Eviews 7 and Megastat. The following tests were applied: the Jarque Bera test for normality of the residuals; the Durbin-Watson test for autocorrelation; the Breusch-Pagan-Godfrey test for heteroskedasticity; as well as the Variance Inflation Factor criteria for examining multicollinearity were applied.

Firstly, the Jarque-Bera test of normality for residuals was applied. With the JB test statistics that equals 0,9607, and the p-value=0,6248, the null-hypotheses that the residuals are normally distributed may not be rejected at significance level of 5%.

Secondly, the regression model assumes that autocorrelation, i.e. correlation between error terms ordered in time does not exist. Since the test value for *Durbin Watson test* is $DW = 1,709$, so that $0 < DW < 2$, the test for positive autocorrelation of residuals was conducted. The computed DW is larger than the table value $d_U = 1,398$, so the test indicates that there is no positive autocorrelation of the first order.

Further, Breusch-Pagan-Godfrey heteroskedasticity test examines whether the residual variance in a regression model is constant or not. The test value $LM = Obs \cdot R\text{-}sq = 0,3601$ and p-value=0,8352, at any reasonable significance level, the null-hypotheses of the test may not be rejected, so there is no statistically significant heteroskedasticity.

When independent variables are highly correlated, it is difficult to distinguish their separate influence on the dependent variable. So, finally, the multicollinearity test using Variance Inflation Factor (VIF) criteria is conducted. Since the value of VIF is 1,5604 and it is smaller than 5, there is no problem of that kind.

4.2.2 Multiple regression model estimated for the year 2009

With concrete estimates the multiple regression model for 38 countries for 2009 is:

$$\text{Production}_{pc_i}(2009) = 19,2531 - 0,8825 \cdot \text{Export}_{pc_i} + \\ (1,4790) \quad (0,1919)$$

$$+ 1,0703 \cdot \text{Import}_{pc_i}; \\ (0,1108)$$

$$\hat{\sigma} = 5,7666$$

$$R^2 = 0,7424$$

$$\bar{R}^2 = 0,7276$$

$$R = 0,8616$$

$$n = 38$$

The regression coefficient of the regressor variable Export_{pc} is negative and statistically significant at 5% sig-

nificance level, as the test value t-statistic is -4,5993 with p-value= 0,0001. Based on the estimated equation, remaining Import (kg/capita) unchanged, a one unit increase in Export (kg/capita) decreases Production of poultry meat on average by 0,8825 kg/capita. Based on the estimated equation, having Export unchanged, a one unit increase in Import (kg/capita) increases Production of poultry meat on average by 1,0703 kg/capita. The value of the coefficient of determination of $R^2 = 0,7424$ means that 74,24% of the variation in Production of poultry meat is explained by both Import and Export of the same kind of meat. In conducting the overall test of significance of the multiple regression the test value F is 50,423 with p-value=0,0000, which indicates that two independent variables Export and Import in kg/capita are statistically significant for explanation of Production of poultry meat in kg/capita in 38 countries. The regression standard error is 5,7666 kg/capita and regression coefficient of variation is 30,41%, which means the regression model is quite representative.

Regression diagnostics for the multiple regression model for 2009 was conducted using Eviews 7, too.

With the Jarque-Bera JB test statistics that equals 0,6949, and the p-value=0,7065, the null-hypotheses that the residuals are normally distributed may not be rejected at significance level of 5%.

Since the test value for the *Durbin Watson test* is $DW = 2,02$, so that $DW > 2$, considering autocorrelation between random error terms ordered in time, the test for negative autocorrelation of residuals was conducted. The computed DW is larger than the value $(4 - d_U) = 2,6015$, taken for the 1% significance level, so the test indicates that there is no negative autocorrelation of the first order.

The Breusch-Pagan-Godfrey heteroskedasticity test gave the test value $LM = Obs \cdot R\text{-}sq = 3,3446$ and p-value=0,6470, at any reasonable significance level, the null-hypotheses of the test may not be rejected, so there is no statistically significant heteroskedasticity.

When independent variables are highly correlated, it is difficult to distinguish their separate influence on the dependent variable. So, finally, the multicollinearity test using Variance Inflation Factor (VIF) criteria is conducted. Since the value of VIF is 1,8806 and it is smaller than 5, there is no problem of that kind.

5 Conclusion

This paper studies the relationship between variables concerning poultry meat and sales in European countries by using heuristic, as well as descriptive statistics, cluster, correlation and regression analysis.

Concerning the first research hypothesis (H1), which says that clusters of countries considering four variables on poultry meat: production, export and import per capita, as well as the price of that kind of meat per quantity unit, may be recognized, a cluster analysis of standardized variables, using Ward linkage method and Euclidean distances was conducted. Six different clusters of countries are recognized. In 2009 the Cluster 1 is comprised of 12 countries, as follows: Albania, Switzerland, Austria, Greece, Romania, Russian Federation,

Italy, Norway, Bosnia and Herzegovina, Serbia, Croatia and Moldova. Cluster 2 is consisted of 4 countries: Estonia, Latvia, Malta and FRY of Macedonia. Cluster 3 is made by 2 countries: Iceland and Luxembourg. Cluster 4 is consisted of 11 countries, which are similar considering clustering variable, and these are: Belarus, Spain, Finland, Ukraine, Portugal, Bulgaria, Germany, Czech Republic, Lithuania, Slovakia and Sweden. A separate Cluster 5 covers: Denmark, Ireland, United Kingdom, France, Slovenia, Hungary and Poland. And, finally, there is Cluster 6, which includes only 2 countries and these are Belgium and The Netherlands. Countries comprising one cluster have got more or less similar characteristics considering all four variables on poultry meat, so, the research hypothesis H1 is proved.

Based on the obtained results it can be concluded that the European countries, which are export oriented and invest in the growth of production, have the economic benefits, as well as qualitative conditions for further investments in the development of technology and the growth of production. According to the forecasts (FAOSTAT, 2012), demand for poultry meat is higher than the supply; therefore is necessary to invest in the quality of product in order to obtain corresponding prices, which could give good financial results.

The data analysis shows that the countries from the Cluster 5 are the most important for the Slovenian producers. Furthermore, with well-prepared marketing strategy the countries from Cluster 4 are also very important, while they are attractive thanks to its size and high producer prices, which increase producers' competitive advantage in a relation to the domestic producers. Countries covered with the Clusters 3,4 and 5 are atypical and extreme putting them in a situation where much more investments are needed, which is quite hard to secure during the recession.

Concerning the second research hypothesis (H2), which states that there is at least one variable that is statistically significant for an explanation of poultry meat production per capita, the multiple regression model was set for each of two years considered, 2007 and 2009.

When comparing and evaluating two multiple regression models in analyzing Production of poultry meat depending on two regressors, Export and Import, in 38 European countries for 2007 and 2009, it may be concluded that both models are good. For the multiple regression model for 2009, the regression coefficient of the regressor variable $Export_{pc}$ is negative and statistically significant at 1% significance level. Based on the estimated equation, leaving Import (kg/capita) unchanged, a one unit increase in Export (kg/capita) decreases the regression value for Production of poultry meat by 0,8825 (kg/capita). This estimated value of the regression coefficient is higher than it was in the multiple regression model for 2007, where it was estimated with 0,491 kg/capita. Based on the estimated equation, having Export unchanged, a one unit increase in Import (kg/capita) increases Production of poultry meat on average by 1,0703 kg/capita. This regression coefficient has got the lower value in 2007, and it was 0,8774 kg/capita. The value of coefficient of multiple determination for the regression model in 2009 is $R^2=0,7424$ so 74,24% of the variation in Production of poultry meat is explained by both Import and Export of the same kind of meat. In the model for 2007 only

62,24% of the variation was explained, but this is still good enough concerning the quality of the model. In conducting the overall test of significance of the multiple regression using F-test, both multiple regression models, for 2007 and 2009, show that two independent variables Export and Import in kg/capita are statistically significant for explanation of Production of poultry meat in kg/capita in 38 countries. Regression standard error for the model for 2009 equals 5,7666 kg/capita, with a regression coefficient of variation of 30,41%. For the model for 2007 regression standard error equals 6,3828 kg/capita, and regression coefficient of variation is 34,97%. So, it may be concluded that both multiple regression models, for 2007 and 2009 are moderately representative. Both regression models have got all model assumptions fulfilled, so, they may be used for predictions. Finally, it should be stated, that both multiple regression models' proof the research hypothesis H1, because a production of poultry meat depends statistically significantly on Import and Export of that kind of meat.

6 Further research

This work has some obstacles. One of the problems is that the data from the FAOSTAT database are not updated. The data are only available for a couple of years back (in 2012 the data have been published in 2009). New data are going to be released in 2014 so the researchers are going to be able to continue its work on the relationship between variables connected with the supply of poultry meat in Europe.

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Regresijska analiza varijabel ki opisujejo oskrbo s perutninskim mesom v evropskih državah

V dokumentu, ki temelji na analizi uradnih podatkov Faostat-a in Eurostat-a za perutninsko meso 38 evropskih držav, zajetih za leti 2007 in 2009, sta bili proučevani dve hipotezi. V prvi, ki obravnava štiri spremenljivke, ki se nanašajo na proizvodnjo, izvoz, uvoz perutninskega mesa v kg/prebivalca, kot tudi na proizvodno ceno, izraženo v US \$/t, so bile raziskovane navedene države z uporabo deskriptivne in klaster analize. Hipoteza, da lahko te države razvrstimo po skladnosti v klasterje, je bila potrjena. Kot rezultat analize, so države po skladnosti spremenljivk razvrščene v šest klasterjev. Druga, ki na osnovi multiple regresijske analize raziskuje, da v tem dokumentu obstaja statistično signifikantno razmerje med proizvodnjo, izvozom in uvozom perutninskega mesa, merjeno v kg/prebivalca. Ugotovljeno je, da obstaja visoka korelacija med proizvodnjo, kot odvisno spremenljivko in med vsako od neodvisnih spremenljivk.

Ključne besede: perutninsko meso, strategija trženja, klaster analiza, korelacija, multipla regresija