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STRUCTURAL CHANGES IN EGGS PRICES IN EUROPEAN UNION MEMBER STATES

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Abstract: The work relates to changes of the eggs prices in European Union member states since 2004 to 2010. The analysis is based on annually, monthly and weekly average eggs prices. Correspondence analysis is applied to analyze the direction and structure of the changes with reference to all considered states. The unexpected and violent price changes are captured with respect to particular states. Moreover in the reference to chosen states, the model of structural time series analysis is applied to show the price changes in a more detail.

Keywords: Correspondence analysis, Correlation, Dendrogram, Structural time series models.

INTRODUCTION

The work relates to changes of eggs prices in European Union Member States. The prices are collected since 2004 to 2010. The source of the data is the website of Ministry of Agriculture and Rural Development. The principal of the work is to reflect the structure of the price changes in the states.

The problem is the observed price series is multidimensional, as we have 27 states. If any stochastic statistical time series model had been used, the variance-covariance matrix with over 300 various elements would have to be estimated. The length of the collected time series isn't greater than 65 and the task is not feasible. Thus it seems reasonable to use one of the explanatory multidimensional technique and the correspondence analysis is applied in the work.

The bottom line of the work is to compare relative prices, because the mean level of each price series strongly depends on the state. An example of annually averaged eggs prices in two states (in Belgium and Denmark) is given in table 1. The prices are given in EURO/100kg.

Table 1. Annually averaged prices in Denmark and in Belgium

Year	2004	2005	2006	2007	2008	2009
Denmark	136	133	137	142	158	173
Belgium	61	65	77	93	93	103

The prices in Belgium are considerably less than in Denmark in the given consecutive years. The difference is influenced by many factors, which are difficult to capturing and thus the idea of relative prices raised.

DYNAMICS OF ANNUAL CHANGES

General insight in the dynamics of the eggs prices is given in the chapter. The clue is the form of the data given in table 2. The rows of the table consist of the distributions of eggs prices over a period of six years in European Union Member States. Such rows are called row profiles in correspondence analysis.

Table 2. Relative eggs prices over a period of six years.

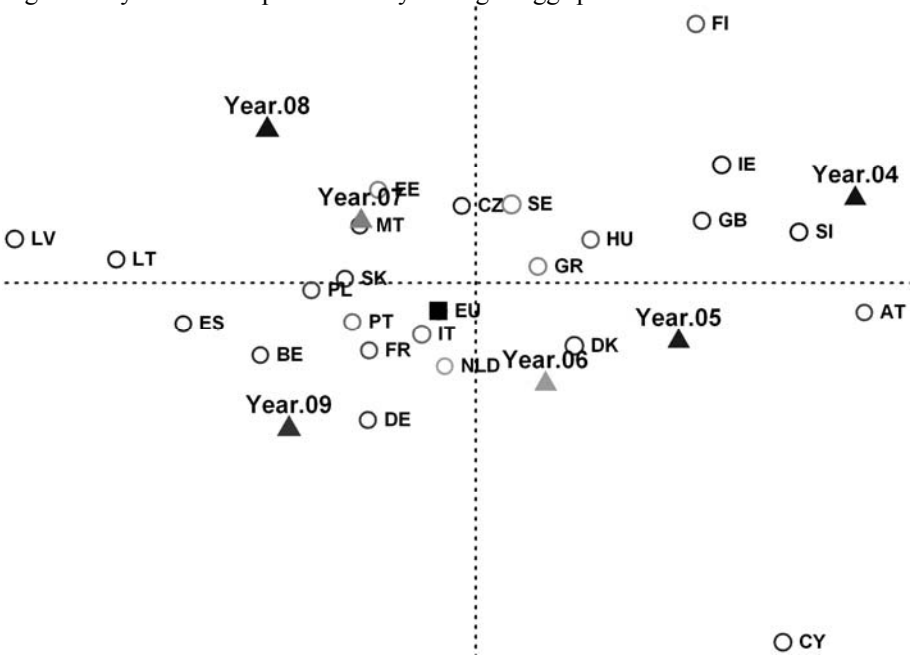
Year	2004	2005	2006	2007	2008	2009
Belgium	12%	13%	16%	19%	19%	21%
Czech Republic	15%	14%	15%	18%	20%	19%
Denmark	15%	15%	16%	16%	18%	20%
- - -	- - -	- - -	- - -	- - -	- - -	- - -
EU	14%	14%	16%	18%	19%	20%
Mean	**15%**	**14%**	**15%**	**17%**	**19%**	**19%**

The mean profile consists of column averages. It's close to European Union profile. Thus it represents the average eggs prices in Europe. The distance between two profiles is measured relatively to the mean profile. An example of the Belgium-Denmark distance is calculated as follows

$$\sqrt{\frac{(0.12-0.15)^2}{0.15}+\frac{(0.13-0.15)^2}{0.14}+\cdots+\frac{(0.21-0.20)^2}{0.19}}$$

The distance is a weighted Euclidean distance. It measures difference between two profiles relative to mean eggs prices in European Union. Large distance between the state profile and the mean profile represents dynamically changing eggs prices in the state. Relatively similar changes of eggs prices in two states imply small distance. The distances between all states can be represented graphically in so called symmetric map (figure 1).

Figure 1. Symmetric map for annually averaged eggs prices



Source: own calculations

The point which represents the European Union profile is close to the origin. The origin represents the mean profile. Arrangement of the points for Italy, Netherlands, Portugal and France suggests that its profiles, that is the distributions of annually averaged eggs prices are close to each other. But it's not the case of Latvia. It's point is far from the origin.

Table 3. Relative eggs prices in Latvia

	R2004	R2005	R2006	R2007	R2008	R2009
Latvia	11%	12%	13%	18%	23%	23%
Mean	**15%**	**14%**	**15%**	**17%**	**19%**	**19%**

The values of Latvian profile are less then values in mean profile in 2004, 2005 and 2006 an then they are greater (table 3). It means that it was a dynamic period of changes of eggs prices in Latvia in comparison with Italy, Netherlands, Portugal or France. The correspondence between the prices of the states can be easily found in figure 1. There are in the figure two clouds of points: the first one for states and the second one for years. The joint display indicates the correspondence between the clouds. Geometrically a particular row profile tends to a position which corresponds to the years which are prominent in that row profile. The purpose is to

give the management all the essentials facts in the most concise form, to show the increase or decrease in eggs prices in particular states and their relation to average price in Europe.

Note that Latvia is close to the position of 2008 and 2009. The values in its profile are greater in the years than corresponding values in the mean profile.

In conclusion let us briefly interpret the display: States which are positioned to the right: Austria, Slovenia, Great Britain, Ireland had relatively large prices in 2004 and 2005 and small in 2008 and 2009. States which are to the left: Latvia, Lithuania, Spain and Belgium had relatively large prices in 2008 and 2009. Cyprus had relatively the largest prices in 2006 and 2005. Note that the Germane profile is rather close to the origin.

DYNAMICS OF MONTH CHANGES

Monthly averaged eggs prices provide additional reference to Germany, Austria, Netherlands and Estonia. Conclusion relates to changed arrangement of prices given in table 4. The row profile of the table denotes now price distribution across states in a particular time. Thus we can describe prices' proportion dynamics in a more detail.

Table 4.Price distribution across states

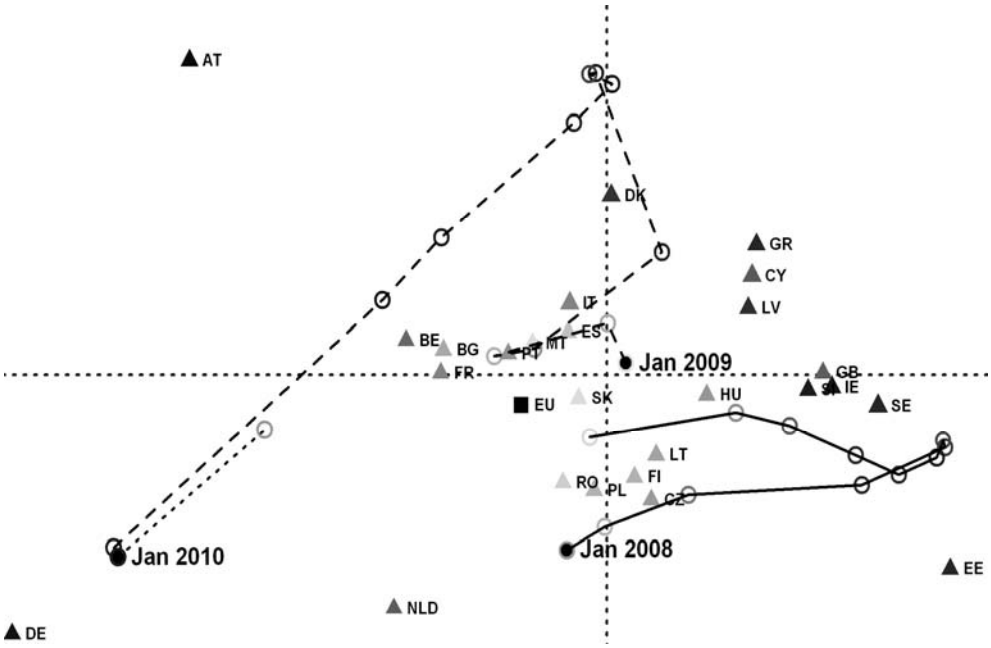
	Belgium	Bulgaria	Czech Republic	- - -	Denmark
Jan 2008	3.2%	3.3%	3.7%	- - -	4.5%
Feb 2008	3.2%	3.3%	3.7%	- - -	4.5%
- - -	- - -	- - -	- - -	- - -	- - -
Feb 2010	3.2%	3.7%	3.2%	- - -	5.0%
Mean	**3.0%**	**3.4%**	**3.2%**	- - -	**5.0%**

Source: own calculations

The profiles of the table 4 are represented by joined with a line points in figure 2. Solid line represents the year 2008, the dashed one the year 2009 and the dotted one the beginning of the year 2010. It reflects the very purpose of the graph. We can see clearly and instantly any upward or downward movement. In particular it allows of several price changes be demonstrated simultaneously in time. Thus we see the difference between the year 2008 and 2009. In the middle of 2008 we have relatively large eggs prices in Estonia, Sweden, Slovenia, Ireland and in Great Britain. Then the prices decreased in 2009.

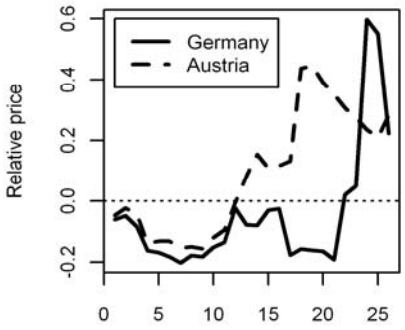
The most dramatic changes in eggs prices occurred in Germany, Austria, Netherlands and Estonia. It is seen that in Germany and Austria the prices increased at the end of the year 2009 and in Estonia in the middle of 2008. The lowest prices in Netherlands occurred in the middle of 2008 and 2009.

Figure 2. Symmetric map for monthly averaged prices



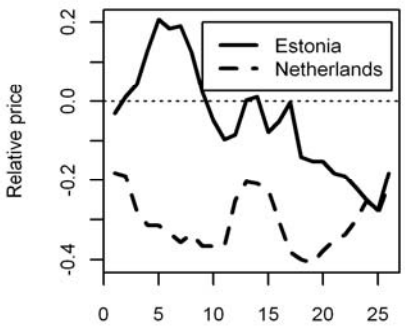
The four States may be examined in a more detail. The figures 3 and 4 reflect the changes. The time factor is shown in the bottom line of each figure and is given in weeks. The price of eggs in Germany and Austria increased over 40% with respect to the mean profile.

Figure 3. Relative prices in Austria and Germany



Source: own calculations

Figure 4. Relative prices in Estonia and Netherlands

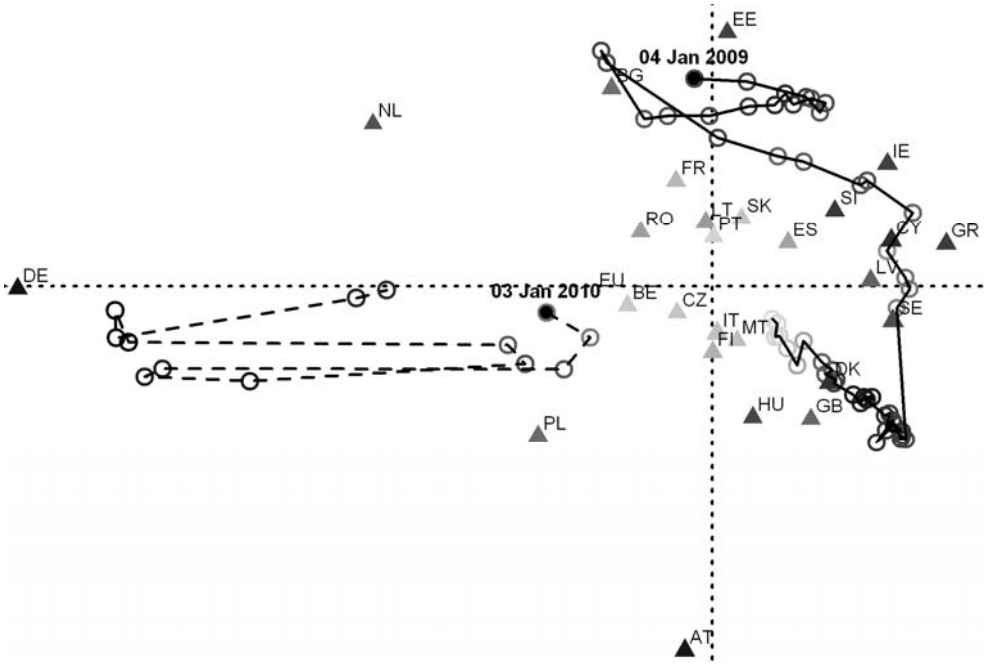


Source: own calculations

DYNAMICS OF WEEK CHANGES

Weekly averaged prices are represented in figure 5. The solid line in figure 5 represents changes in 2009. Relatively large prices occurred in Bulgaria and Estonia at the beginning of the year, in Cyprus, Greece, Lithuania and Sweden in the middle of the year and in Denmark and Great Britain in the end of the year.

Figure 5. Symmetric map for weekly averaged prices

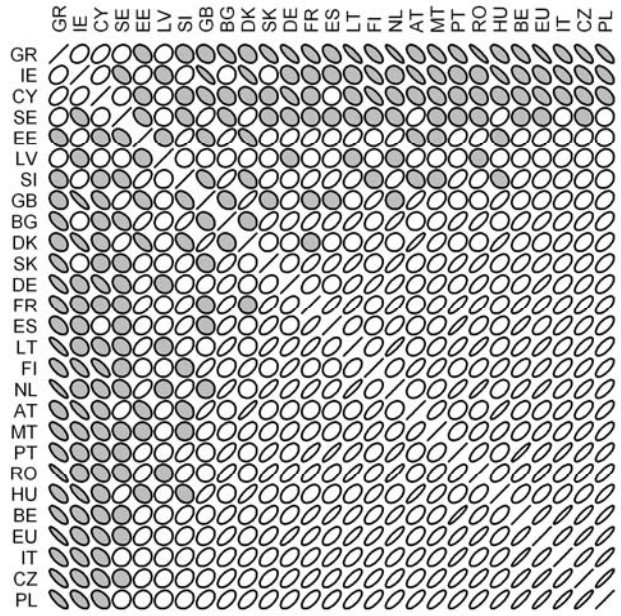


Source: own calculations

The dashed line represents changing prices in 2010. Considerably large changes in eggs prices occurred in Germany at the beginning of the year 2010. The prices were really unstable. The prices have been changing week by week.

The length of weekly averaged price series is equal to 65. It's over two times longer than in the previous case of annually and weekly averaged prices. Thus it gives possibility to construct a reasonable stochastic time series model for some of the series. The idea was to separate simultaneous changes in the series and simple correlations between all pairs of the series was calculated. The appropriate correlation matrix is graphically represented in figure 6.

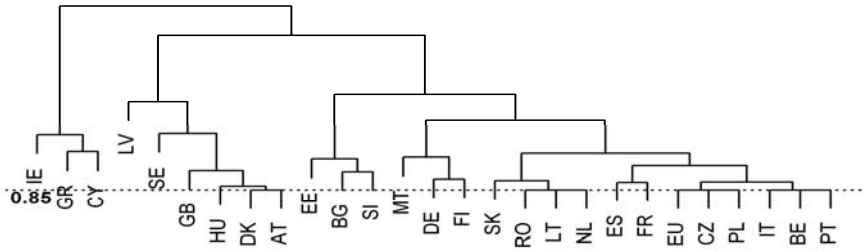
Figure 6. Graphical correlation matrix representation



Source: own calculations

Thin ellipsis represents highly correlated price series. Negative correlation is represented by gray ellipsis and positive by white one. Let's note that the majority of eggs prices in European states are positively correlated. Highly positively correlated price series are represented at the bottom of the dendrogram in figure 7.

Figure 7. Dendrogram

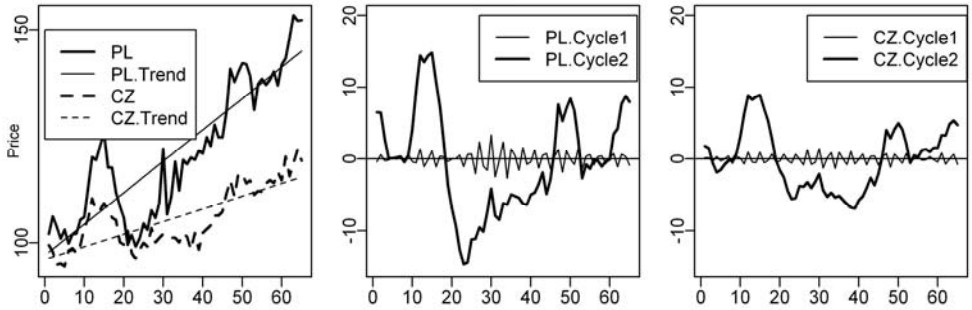


Source: own calculations

Four groups, with simple correlation exceeding 0.85 within each group, were sepqareted. The first group consists of Denmark and Austria, the second: Romania, Latvia and Netherlands, the third: Czech Republic and Poland, and the forth: Italy, Belgium and Portugal.

The three groups of four can be analyzed with the use of structural time series model. The best fit of the model was obtained in the case of Poland and Czech Republic. Note that the eggs prices are highly correlated with the mean prices in Europe. The price series can be separated into deterministic simple trend and two stochastic cycles (figure 8).

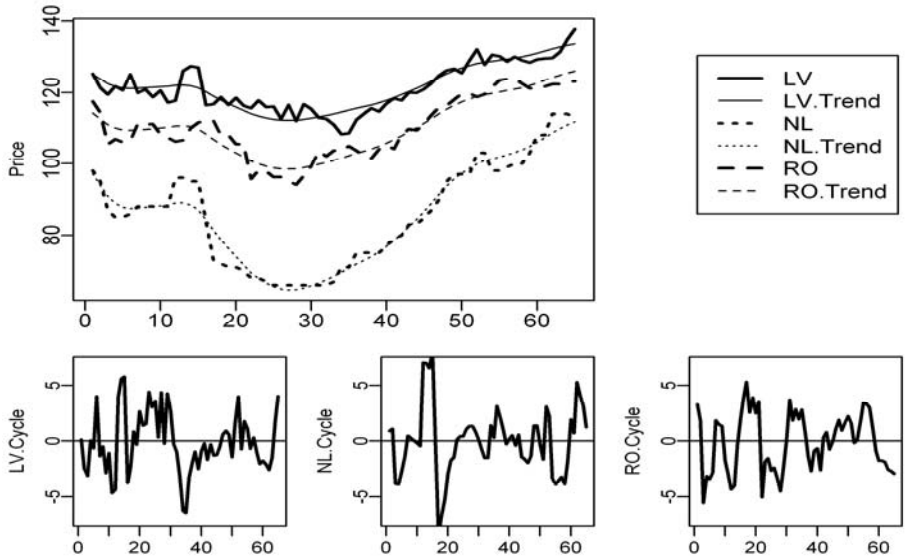
Figure 8. Average prices in Poland and Czech Republic



Source: own calculations

Slightly worse fit was obtained in the rest of the groups. In the case of Latvia, Netherlands an Romania the model consists of stochastic smooth trend and stochastic cycle (figure 9). The trends are similar.

Figure 9. Average prices in Latvia, Netherlands and Romania

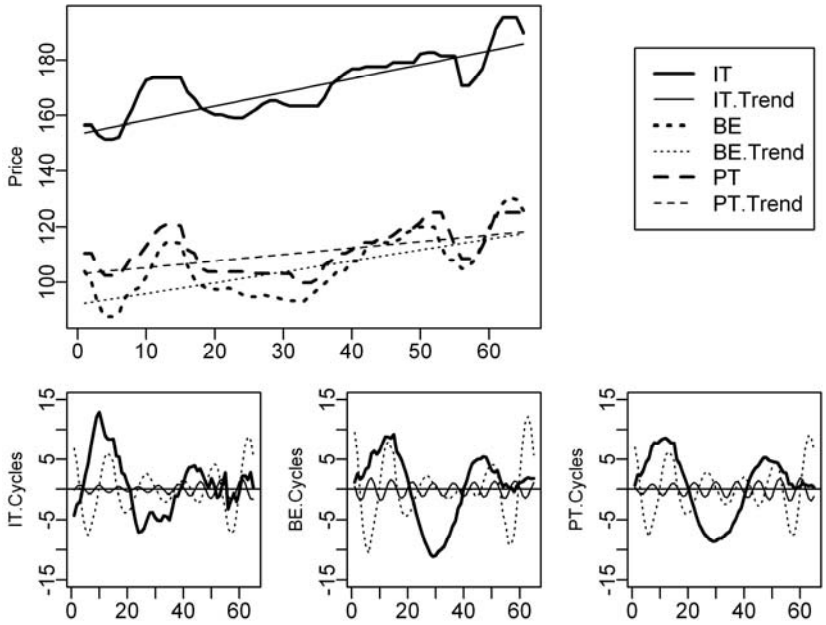


Source: own calculations

The fitted model is not adequately capturing the dynamic structure of the series and the normality assumption is disturbed.

The same problem was found in the group of Italy, Belgium and Portugal. For the group it managed to separate simple trend and three cycles for each series (figure 10). Two of them have relatively high amplitude. Note that the cycles are similar with respect to considered states.

Figure 10. Average prices in Italy, Belgium and Portugal



Source: own calculations

For the last group no model was done, because the series are almost parallel and steady with a one single joint change. Probably the prices are strictly controlled.

THEORETICAL BACKGROUND AND TECHNICAL NOTE

In the work theory of correspondence analysis is used, an approach that has become more used and appreciated over years. The formalization of the analysis can be found in Greenacre (1984) and in the framework of abstract linear algebra in Le Rouan and Rouanet (2004).

Theory of structural time series is used (linear Gaussian form) to separate trends and cycles in the investigated price series. The theory from the standpoint of statistics an econometrics can be found in Harvey(1989) and in Durbin and Koopman (2005).

Necessary calculation are made with R (http://www.r-project.org/) and STAMP (http://stamp-software.com)

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