THE APPLICATION OF MAIN COMPONENT ANALYSIS METHOD ON INDICATORS OF ROMANIAN NATIONAL AUTHORITY FOR CONSUMERS PROTECTION ACTIVITIES

Manuela Rozalia Gabor[1*], Daniela Ştefănescu[2] and Lia Codrina Conțiu[3]
[1) 2) 3)] Petru Maior, University of Tîrgu Mureş, Romania

Abstract
The National Authority for Consumers Protection, Romania (NACP Romania) is the institution which records various trends from one development region to another as well as from one county to another. The indicators of NACP Romania activities are firmly correlated with other important macroeconomic indicators, even at the level of Romanian counties, hypothesis verified by the authors in a previous research. (Ştefănescu & Gabor, 2008) The paper tests the hypothesis that in the last decade there have been numerous structural changes regarding the economic indicators at county level and we will analyze the evolution of these structural changes in two different periods, respectively year 2000 and 2006, and especially the clustering of Romanian counties, taking into account the macroeconomic indicators and those recorded by NACP Romania, using a descriptive method of data analysis, the principal component analysis (PCA). By applying the PCA method, we can obtain useful information for NACP that, according to its specific tasks, cooperates with local government authorities regarding the development of consumer education strategy and the organization of control activities. In this regard, depending on the level of economic development of each county, the consumption characteristics of the population, the earnings level, as well as the GDP per capita, the NACP can develop differentiated strategies, adapted to the features of each county.

Keywords: The National Authority for Consumers Protection from Romania, principal component analysis, macroeconomic indicators, counties, correlation

JEL Classification: C02, C1, C19, D02, D03, D12, D18

Introduction

Among the economic phenomena and processes there are interdependence relationships, under the influence of essential or non-essential factors that act either independently or grouped, forming another decisive factor in the development of these processes or phenomena.

* Corresponding author, **Manuela Rozalia Gabor** - rozalia.gabor@ea.upm.ro

Statistics, data analysis has, through descriptive methods of data analysis, powerful and effective tools of multidimensional analysis, tools by which derivative information can be gathered being important for market research, economic analysis, etc. Based on these methods the information can be ranked in terms of influence intensity and especially they can be analyzed as a whole and not independently. Less commonly used than the explanatory data analysis methods (regression, for example), descriptive methods provide additional benefits compared to them: the advantage of non-separation of variables into explanatory and explained ones, the advantage of being presented all these influences in a vector space that assembles and recommends these methods of data analysis.

To analyze the data, the descriptive methods can be used successfully in the following cases:

- *to identify the basic dimensions or factors that explain correlations among multiple variables;*
- *to identify a small set of new uncorrelated variables to replace the first set of correlated variables in multivariate analysis* (regression analysis or discriminant analysis);
- *to identify a smaller set of basic variables* starting with a larger body that can be applied to multivariate analysis;
- seeking *new concepts* to reduce the number of variables that describe a situation (Petcu, 2003, p. 122);
- *testing assumptions* on a set of variables (Petcu, 2003, p. 122).

The study of many economic variables, which usually are correlated through descriptive analysis of data, is very important and it represents an useful piece of information for complex and detailed analyses, either for the company management and marketing or for local, regional or national characterizations.

In economics, an individual - consumer, customer, organization, etc.- is characterized by more than one variable, and the other statistical methods (such as correlations) allow the analysis of each variable, but separately, while *the descriptive analysis of data* - and in particular the Main Component Analysis - *allows addressing the multidimensional nature of data / variables that characterize an individual*.

In the present research, using the PCA method, we aimed at verifying the hypothesis regarding the Romanian counties distribution change and the way of NACP and macroeconomic indicators clustering, respectively, which of these groups of indicators characterize better the market conditions in each county.

Another hypothesis aims to verify the extent to which the population of the more economically developed counties, i.e. with a higher level of GDP, would lead to a strengthening of the NACP control activity.

Starting from the correlations already tested in a previous research, for which we obtained results which were statistically significant, we aim at identifying the NACP indicators that are combined with macroeconomic indicators and which influence the dispersion of the Romanian counties. From the correlations highlighted among the NACP indicators and the macroeconomic ones analyzed previously, we preserve the following: the Value of payments from fines to the budget and GDP (Spearman correlation coefficient: 0.62), Total

value of applied fines and GDP (Spearman correlation coefficient: 0.45), GDP and Number of trade firms (Spearman correlation coefficient: 0.67), Value of products infringement and Number of trade firms (Spearman correlation coefficient: 0.50), population and GDP (Spearman correlation coefficient: - 0.65). Results are guaranteed with a significance level of 0.01 and all show an average level of correlations intensity.

By applying the PCA method, we aim at testing the hypothesis that the NACP indicators together with the macroeconomic indicators will form one of the main components and that this cluster follows the previously tested correlations.

1. Methodology – The description of the principal component analysis method (PCA)

The basic of this method is to extract the smallest number of components to recover as much of the total information contained in the original data as possible, these new components expressing new attributes of individuals and built to be uncorrelated among them, each is a linear combination of original variables. (Giannelloni & Vernette, 2001, p. 382) This method provides a graphical view of the *counties distribution map* of the study, according to the similarities among them and the *variables map*, respectively the NACP and macroeconomic indicators according to their correlations.

Although this method is based on the same principle as the factorial analysis (being a linear factorial method), the main component analysis differs with the factorial analysis through the way it defines the elements of the original data table and the calculation of distances among points. As a descriptive method of data analysis it only applies to quantitative variables and large tables that contain information about more than 15 individuals and 4 variables. Another feature that distinguishes it from the factorial analysis is given by the *way it transforms the terms* (Pintilescu, 2003, p. 24), such as in the main component analysis is used the relation (1), while in the factorial analysis is used the relation (2).

$$x''_{ij} = \frac{x_{ij} - \overline{x}_j}{\sqrt{n} * \sigma_j} \quad (1)$$

$$x'_{ij} = \frac{x_{ij} - \overline{x}_j}{\sigma_j} \quad (2)$$

PCA phases are illustrated in Figure no. 1. The stages shown above are followed by the interpretation of analysis results, Saporta and Stefanescu (1996, pp. 76-80) showing two kinds of interpretations to be made for PCA, respectively the *"internal" interpretation* the correlations among components resulted based on the principal component analysis and original variables (represented by the circle of correlations) and the *"external" interpretation* among variables and additional individuals, the counties, the explanation of the results being made based on data that were used to obtain them.

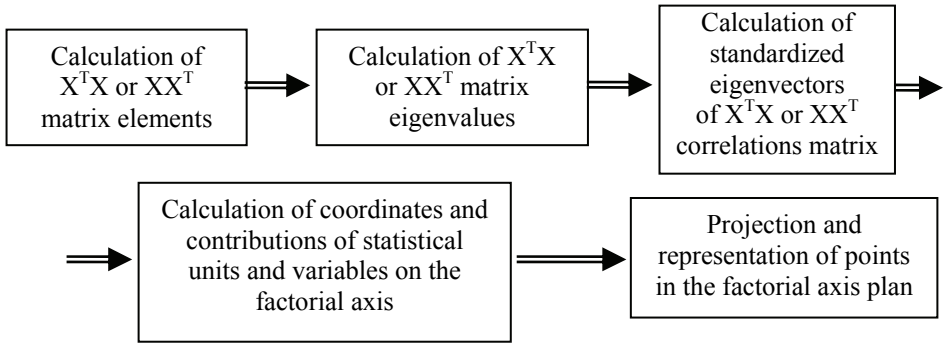

Figure no. 1: Stages of the Principal Components Analysis

Source: Pintilescu, C., 2003. *Analiza datelor.* Iaşi: Editura Junimea, p. 37

In the main component analysis, in choosing the number of factorial axis to be analyzed, *the components*, the following criteria are used:

- *Kaiser's criterion* (the criterion of supra-unitary value) which consists in choosing the number of axis for which the eigenvalues correspond to values greater than one (Saporta & Stefanescu, 1996, p. 507).

- *Evrard's criterion* (the criterion of slope or "granularity") based on the graphical representation of the eigenvalues and tracing the sudden failure of inertia explained by them.

- *Benzecri's criterion* (the criterion of coverage percentage) that infers the choice of that amount of axis that explained more than 70% of the total variation of the cloud of points.

- *parallel analysis method* (developed by Horn) is applicable to standardized data and requires generating random samples, the variables characteristic to population are presumed to be uncorrelated two by two. (Saporta & Stefanescu, 1996, pp. 508-509)

- *regression method* is similar to parallel analysis but it does not involve generating random samples and the PCA does not have to be performed on each sample. (Saporta & Stefanescu, 1996, p. 511)

In this paper, to ensure a higher degree of objectivity of data processing we used a cumulative number of the specified criteria: Kaiser, Evrard and Benzecri criteria.

When selecting the number of main components, the standard linear combinations are used. They have as a starting point, instead of the R correlation matrix, the covariance matrix, and it is the choice of standard linear combinations having the biggest variance. *Unlike factorial analysis* - where the X variables variations are shaped through linear transformations of a fixed, limited number of factors called "hidden" or latent - PCA seeks linear combinations among variables, ordering them by their own values of covariance matrix. For the PCA method application we used SPSS program, and in detailing the internal and external interpretations we used Excel program for the descriptive statistics of the PCA results.

2. Results obtained through PCA method

The applicable approach of this method is based on the statistical data presented in Annexes 1 and 2, for both periods, respectively year 2000 and 2006 using the following groups of variables:

- *Variables specific to the activity carried on by NACP Romania*: the total number of controls accomplished, the value of products infringement O.G. 21/1992 per total and for imported products, total value of applied fines and value of payments from fines to the budget;

- *Macroeconomic variables at the county level*: population by county at 1 July, GDP per county, number of trade firms, turnover of trade firms, average net nominal monthly earnings per total economy.

Based on the stages of PCA application, in the first stage we got the results illustrated in annexes 3 and 4 where the correlation matrices of the analyzed variables for the two periods are illustrated, Pearson correlation coefficients where it is noticed high values for many variables. It is a sign of information redundancy and therefore we try to reduce the dimensionality applying the PCA method both for year 2000 and 2006, and further on we will analyze if during these two periods there were significant structural changes regarding the clustering of Romanian counties based on these variables . The only variable that has changed is the *average net nominal monthly earnings (ANNME)* which recorded an increase of the correlation intensity with other variables of component 1, as well as with the variable the *total number of products infringement*, from a weak negative correlation in 2000 to an average positive correlation in 2006.

For the second phase of the PCA method application, respectively the calculation of their correlation matrix values, the SPSS program has generated results for the two periods considered which are illustrated in Tables 1 and 2. It can therefore be noticed that both for year 2000 and 2006, only two main components can be retained, Romania's counties will be represented by two factorial axis formed by the combination of original variables, since only two components obtained values greater than 1 (Kraiser criterion). Another criterion was taken into account in choosing the two factorial axes, respectively two main components, the Benzecri criterion, and according to data from Tables no. 1 and no. 2 these components explain together more than 70% of the total variance of the cloud of points.

Table no. 1: Total Variance and Eigenvalues Explained for year 2000

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6,595	65,949	65,949	6,595	65,949	65,949
2	1,311	13,108	79,058	1,311	13,108	79,058
3	,761	7,611	86,669			
…	…	…	…			
10	,006	,058	100,000			

Extraction Method: Principal Component Analysis.

Table no. 2: Total Variance and Eigenvalues Explained for year 2006

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	**6,885**	**68,846**	**68,846**	6,885	68,846	68,846
2	**1,900**	**18,995**	**87,842**	1,900	18,995	87,842
3	,514	5,138	92,980			
…	…	…	…			
10	0,007	0,067	100,000			

Extraction Method: Principal Component Analysis.

Based on the results shown in Tables no. 1 and no. 2, we deduced that only two components have eigenvalues greater than 1, expressing 79% of the total variance in year 2000 and 88% in year 2006, which means that we can use them to represent the cloud of points in the main plan. The increase of the total variation proportion explained by the two components is the result of the increased correlation intensity, from low to medium level, of the *average net nominal monthly earnings* variable with other variables of component 1. The graphical representation specific to PCA method, the screen plot obtained, identical for the two periods analyzed, confirmed the two main components resulted from the application of the method, illustrated in Figure no. 2.

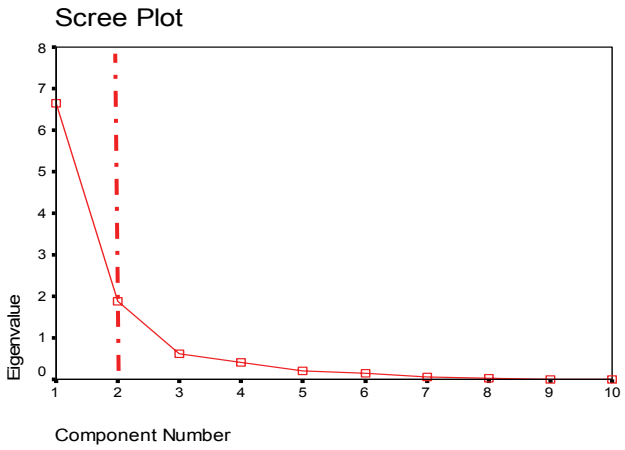

Figure no. 2: Graph Eigenvalues

Analyzing the graphical representation of eigenvalues, and following the Evrard criterion in obtaining the number of main components, we can choose 2 components. If we want to reduce the amount of information and that only the first 2 components bring additional information compared to a variable in the original form, then we preserve only the latter. Also, we should note that a proportion of 79% of the initial information for year 2000 and 88% for year 2006 is extracted from the new variables. We notice that the variables (according to the two correlations matrices from Annexes 3 and 4) *value of products infringement O.G. 21/1992 _total* and *value of products infringement O.G. 21/1992_import*

do not correlate strongly with any of the variables of component 1. In Figures no. 3 and no. 4 are illustrated the components through axes rotation by Varimax method for the two periods. The values of the correlation coefficients from annexes 3 and 4 serve as coordinates of the initial variables in the vector plan of the two main components.

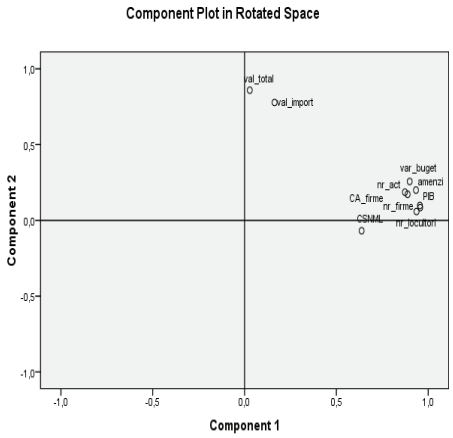

Figure no. 3: Year 2000

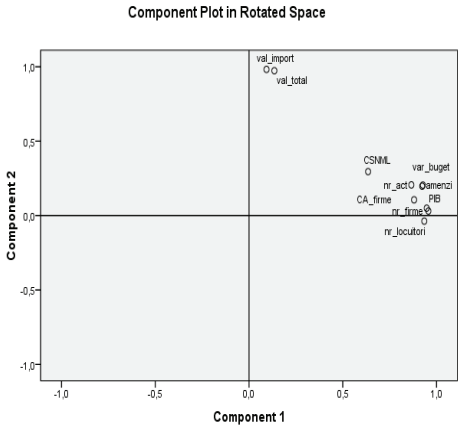

Figure no. 4: Year2006

Analyzing the two graphical representations from Figures no. 3 and no. 4, it becomes clear that the first main component is close to the variables that describe both the measurement indicators of the activity of NACP Romania and the macroeconomic indicators, while the second main component is close to the value of products infringement O.G. 21/1992 both per total value and imported products. But there are recorded changes of variables clustering on the two components from one year to another as such:

- transition from negative values of the first component of the *average net nominal monthly earnings* variable to positive values far from the OX axis formed by the components 2, so its contribution grows in year 2006 compared to 2000 to the component formation;

- OX axis distancing, axis that describes the main component 2 of *the total value of products infringement* variable that forms component 2 and the proximity of *the value of the imported products infringement* variable, these two variables forming component 2.

The results generated by SPSS program for the main component matrix after Varimax rotation in normalizing the eigenvectors according to the third stage of the method, as well as the coordinates of the statistical units contributions and the variables on the factor axes, according to the fourth stage of the PCA method, are presented in Tables no. 3 and no. 4.

Table no. 3: Rotated Principal Component Matrix – year 2000

Initial Variables	Component	
	1	2
GDP per county	,956	,084
Number of trade firms	,955	,098
Population by county at 1 July	,936	,059
Total value of applied fines	,933	,199
Value of payments from fines to the budget	,899	,257
Total number of controls effected	,888	,172
Turnover of trade firms	,873	,186
Average net nominal monthly earnings	,638	-,069
Value of products infringement O.G. 21/1992 _total	,028	,859
Value of products infringement O.G. 21/1992 _import	,163	,777

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization. a Rotation converged in 3 iterations

Table no. 4: Rotated Principal Component Matrix – year 2006

Initial Variables	Component	
	1	2
Number of trade firms	,973	,061
GDP per county	,966	,098
Turnover of trade firms	,934	,125
Population by county at 1 July	,930	-,007
Total value of applied fines	,919	,206
Value of payments from fines to the budget	,916	,197
Total number of controls effected	,842	,200
Average net nominal monthly earnings	,682	,470
Value of products infringement O.G. 21/1992_**import**	,091	,982
Value of products infringement O.G. 21/1992 _total	,124	,974

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization. a Rotation converged in 3 iterations.

To represent the counties distribution on the *map,* respectively the counties of Romania, we used their coordinates which can be found in the variables of *main component 1* and *main component 2*, the phases 3 and 4 of the methodological approach, by calculating the standardised eigenvectors of the correlation matrix. In Tables no. 3 and no. 4 can be noticed the clustering of the ten initial variables on the two new main components related to variables of the two periods analyzed. It is also noticed that the two variables describing specific indicators of NACP Romania explains only 13% of total variance for year 2000 and 19% for year 2006. Regarding the initial variables clustering around the two main components it is their *ranking* that has changed in year 2006 compared to year 2000, respectively:

- *main component 1:*

- the GDP macroeconomic variable from the first position in year 2000 switch on to the second position in year 2006, virtually reversing the place with another macroeconomic variable, the *number of trade firms* that becomes, so, the most important variable of the main component 1 in year 2006;

- another macroeconomic variable the *turnover of trade firms* switch from the 7th position in year 2000 to the 3rd position in year 2006;

- as the *turnover of trade firms* variable positioned on the 3rd position in year 2006, the three variables specific to NACP Romania that constitute component 1 ascended with one level in the hierarchy.

- *main component 2:* the two NACP variables that constitute component 2 switch their position in year 2006 compared to year 2000.

The change of variables hierarchy is accompanied with a correlation intensity increase both within component 1 and component 2, but it is more significant for the second component, from 0.859 and 0.777 in year 2000 to 0.982 and 0.974 in 2006. The hierarchical changes noticed during the 6 years (2000-2006) between the initial variables and the place they hold in the formation of two main components are important for the clustering of Romanian counties on the two principal components. If in the year 2000, the most important aspect was the economic development of districts, the dimension of the counties population, in the year 2006, important are the variables that describe the counties commercial capacity and development, given by the number of trade firms and their turnover, and which are tightly correlated with indicators reported by NACP, the starting hypothesis of this research (these correlations have values higher than the average, between *Value of products infringement* and *number of trade firms*: 0.50, and respectively between *GDP* and *number of trade firms*: 0 , 67).

The last phase, the projection and representation of the individual points (Romanian counties) in the factorial axis plan of the two main components are highlighted in Figures no. 5 and no. 6 where the 41 Romania's counties and city of Bucharest were represented upfront, according to the coordinates of the counties distribution. It is thus confirmed the initial hypothesis of the research, that, during the two periods, there will be structural changes influenced by the evolution of the initial variables values, as well as by the combinations hierarchy within the two components.

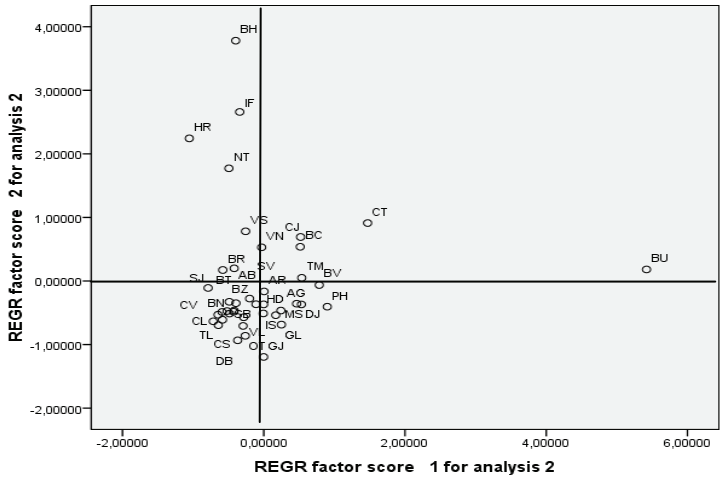

Figure no. 5: Projection and representation of individual points (the counties) in the factorial axis plan of the two principal components for year 2000

To analyze the structural changes of the counties we applied descriptive statistics indicators, individual absolute deviation, mean and standard deviation. Based on these indicators there have been emphasized major permutations in the following counties: Bihor, Satu Mare, Harghita, Neamt, Vrancea, Prahova, the rest of the counties being positioned around the axis origin formed by the two components. GDP macroeconomic variable had a concluding influence in repositioning the above mentioned counties, explained by the fact that this variable has changed its position in the hierarchy of the component 1 variables.

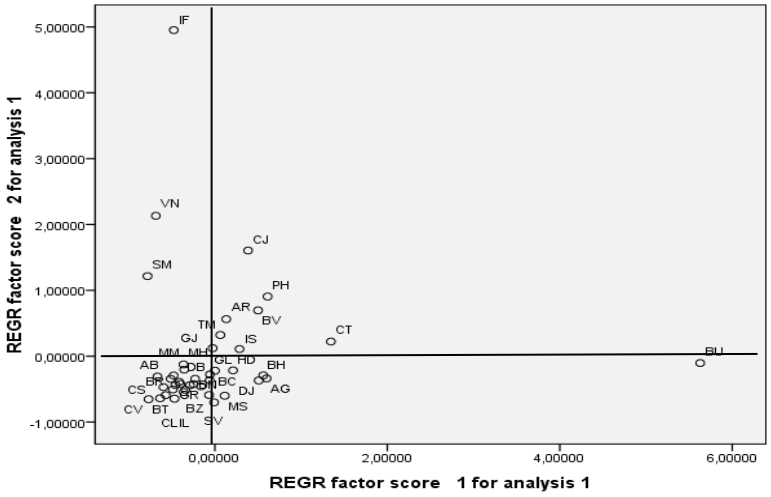

Figure no. 6: Projection and representation of individual points (the counties) in the factorial axis plan of the two principal components for year 2006

The two main components are conceptual. To carry out the internal analysis of the two main components, the correlation coefficients between the original variables of our research, and the two principal components were calculated, the results being showed in Tables no. 5 and no. 6.

Based on data from Tables no. 5 and no. 6, it can be noticed that the initial variables *Value of products infringement O.G. 21/1992_total* and *Value of products infringement O.G. 21/1992_import*, which constitute the second component, are more strongly correlated compared to the initial variables that form the first component, having correlation coefficients close to the average, unlike those belonging with the first component which have very low values. Furthermore, the variables given by the macroeconomic indicators that form component 1 are negatively correlated with the second component, except *the average net nominal monthly earnings* variable, the only variable recording correlation coefficients of moderate intensity. It is such confirmed one of the research hypotheses, that, those counties where ANNME is higher and hence the county level of economic development is higher, the possibility to buy products other than those of the regular market basket and so imported products, leads proportionally to the increase of intensity probability in those counties, as well as the number of complaints and findings of NACP. So, it will determine a directly proportional increase of the number of control actions, the value of imported products infringement, etc.

Table no. 5: Principal Component Score Coefficient Matrix – year 2000

Initial Variables	Component	
	1	2
Total number of controls	,137	,017
Value of products infringement _total	-,171	,629
Value of products infringement _import	-,067	,553
Total value of applied fines	,141	,031
Value of payments to the budget	,128	,078
GDP per county	,160	-,056
Population by county at 1 July	,159	-,073
Number of trade firms	,158	-,046
Turnover of trade firms	,132	,029
ANNME	,122	-,129

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Component Scores.

Table no. 6: Principal Component Score Coefficient Matrix – year 2006

Initial Variables	Component	
	1	2
Total number of controls	,127	,014
Value of products infringement _total	-,078	,471
Value of products infringement _import	-,084	,479
Total value of applied fines	,140	,009
Value of payments to the budget	,140	,005
GDP per county	,159	-,050
Population by county at 1 July	,163	-,098
Number of trade firms	,164	-,069
Turnover of trade firms	,151	-,033
ANNME	,071	,164

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Component Scores.

It should be considered (or it is not a negligible part) that the two periods considered are pre-2007 period, the year Romania joined the European Union, during which Romania had not a high proportion of imports from the EU, where traded products are subject to more rigorous controls than those having as country of origin either non-EU countries or other areas of economic development.

Therefore, we intend to continue this research for at least one period after 2007, the year of accession to follow these structural changes in the counties of Romania, taking into account the NACP indicators and the macroeconomic indicators correlated with those of NACP. This approach is a medium and macroeconomic one to analyze how the NACP indicators are grouped with the macroeconomic indicators to explain the structural changes at the level of Romanian counties. This approach has thus a macroeconomic importance because NACP is a government institution of national importance with a major contribution, both through the indicators pursued and the reported ones, to the explanation at local and regional level of the economic disparities, and, in more detail, the counties commercial development differences. Trade is an important branch of economy, which has an important contribution to GDP formation and, after 1990 and especially after 2007, the moment of trade liberalization with the EU market, has led to an increased possibility for Romania to participate and align to the inter-Community trade. In Romania, NACP, as a public body can also contribute to the Romanian consumer education, civic spirit development - which is one major objective of NACP after 2007, as well as the usage of quality products. But this is closely related to ANNME of county population as well as the economic, trade and counties demographic development (GDP, number of trade firms, the turnover of trade firms, population).

Conclusions

By applying the PCA method we achieved data reduction replacing the original cloud of points with a reduced cloud of points, for a convenient graphical representation and to highlight particularities of Romanian counties in terms of indicators measuring the NACP Romania activity and the macroeconomic indicators registered in two different time periods, year 2000 and 2006, grouped on two main components.

The structure of the two components formed based on the application of PCA method, shown in Tables no. 3 and no. 4 cluster the variables analyzed on the two main components, as follows:

- Component 1: NACP specific variables together with macroeconomic variables;
- Component 2: only NACP specific variables, only *Value of products infringement O.G. 21/1992_total* and *Value of products infringement O.G. 21/1992_import*.
- Significant aspects regarding the variables positioning on the two components, are highlighted based on Figure no. 3 and no. 4:
- The variables that form component 1 are independent (the angle formed by variables vectors form a right angle with each of the analyzed variables). For example: the *amount of payments to the budget* and the *value of fines* with the *population on county* both for year 2000 and 2006.

- There are "close" variables, for example *Value of products infringement O.G. 21/1992_total* and *Value of products infringement O.G. 21/1992_import* for 2006, GDP and population both for year 2000 and 2006.

- There are "opposing" variables whose angle formed by their vectors is obtuse, i.e. component 2 variables with *average net nominal monthly earnings*, *population on county*, practically with almost all the component 1 variables.

- The coordinates of the points formed by the initial variables of both component 2 and component 1 are far from the centre axis-oriented and thus the contribution to the axis formation is a very important one.

As regarding the counties clustering according to the two main components, in Figures no. 5 and no. 6 and Tables no. 5 and no. 6 we notice that most counties are positioned in the negative values zone (both for component 1 and component 2). So, it appears that most counties are sensitive to initial variables but, also, that the second component has a major contribution to counties clustering on the axis formed by the two components. It can be established by a subsequent analysis by applying another descriptive method of data analysis, the discriminant analysis.

We can therefore end that the initial variables that form the second component, are more strongly correlated than the initial variables of component 1 (Table no. 5 and no. 6), having correlation coefficients close to average, as opposed to those of the first component with very low correlation coefficients. Furthermore, the variables given by the macroeconomic indicators of component 1 are negatively correlated with the second component, except the *turnover of trade firms'* variable in year 2000. The explanation could be that, of all the macroeconomic indicators, the *average net nominal monthly earnings* recorded correlation coefficients of moderate intensity, not being strongly correlated either with NACP Romania indicators or any other macroeconomic indicators. Moreover, it is not known the structure of purchases types made by households of all categories in each county.

In addition to obtaining the two components, the method reveals a better visibility of the counties distribution on both components regarding the structural changes as shown in Figures no. 5 and no. 6.

However, the drawing provides us with details about the fact that the Romanian counties compress around them the "active" variables given by component 1 and being "passive" relative to component 2 (they are active relative to the first component variables and passive relative to the variables that contribute to the formation of the second component). Thus, NACP can elaborate four types of strategies for each group of counties that was constituted based on the PCA method application illustrated in Figure no. 6. One group consists of Cluj, Prahova, Arad and Constanța counties which correlate directly with both main components, characterized by a high level of economic development, and a well-developed commercial sector. Another group consists of Vrancea and Satu-Mare counties as well as Ilfov agro-sector, which are characterized by a relatively high level of economic development, a well established commercial sector, but which are more dependent on the NACP variables that form the main component 2, regarding the products infringement and the products imported. An unusual case is the city of Bucharest that has the highest level of economic and trade development, compressing the highest number of shopping centres and

distributors. Thus, each group of counties could be treated differently, depending on the position occupied in the graphic representation.

The results of this research will form the basis of further analysis to identify new changes in the counties structure, due to the effects of economic recession in recent years in Romania, on the two main components obtained from research.

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ANNEX 1

Statistical data used - 2000

County	Total number of controls effected	Value of products infringement O.G. 21/1992 (thou RON)		Total value of applied fines (thou RON)	Value of payments from fines to the budget (thou RON)	GDP per county (thou RON)	Population by county at 1 July	Number of trade firms	Turnover of trade firms (thou RON)	Average net nominal monthly earnings (thou RON)
		Total	Of which: from imports							
Alba	1826	2035	124	67	44	1322,1	395941	2264	11753	188,45
Arad	1713	439	308	100	66	1838,8	476272	3211	29499	191,99
Arges	2173	561	205	103	86	2451,0	671514	5415	35831	203,24
Bacau	2477	1669	495	148	102	2154,8	752761	4946	32586	204,69
Bihor	1622	9510	520	90	78	2146,3	620517	6598	37653	184,84
Bistrita Nasaud	1434	435	77	51	43	944,5	326278	2050	10502	189,99
Botosani	1904	439	130	74	46	925,8	463808	1869	8375	171,02
Brasov	1917	865	323	165	106	2734,7	628643	6536	54510	217,63
Braila	1199	667	509	44	27	1041,2	385749	3175	14215	187,19
Buzau	1569	782	200	71	41	1317,8	504540	4281	17096	195,8
Caras Severin	851	119	99	66	36	1070,7	353209	1789	7957	185,05
Calarasi	859	136	16	56	30	709,1	331843	2021	8124	167,36
Cluj	1909	2747	373	95	77	3241,5	719864	7461	53981	209,71
Constanta	3339	1310	863	234	191	3187,5	746041	7192	53885	241,7
Covasna	937	172	78	66	45	885,7	230537	1553	10587	178,69
Dambovita	837	113	30	33	20	1403,0	551414	2562	12311	210,17
Dolj	1765	622	254	121	85	2147,3	744243	6522	34279	219,48
Galati	1342	566	169	68	42	1995,1	644077	5958	28902	240,5
Giurgiu	1318	551	35	85	54	564,5	294000	1600	14794	192,95
Gorj	1155	55	2	63	39	1668,1	394809	2895	12163	264,58
Harghita	669	1676	1621	38	16	1239,5	341570	2215	16009	175,69
Hunedoara	1191	462	285	78	38	1703,2	523073	3906	19998	238,25
Ialomita	1128	595	147	72	63	836,6	304327	1680	10122	194,46
Iasi	1412	447	166	71	26	2469,1	836751	6246	34139	185,83
Ilfov	1203	3348	1566	135	111	1521,5	275482	2683	12111	247,5
Maramures	946	429	144	53	30	1355,5	530955	3517	16484	181,26

Mehedinti	952	480	225	40	35	779,5	321853	2000	7414	223,68
Mures	1709	308	161	111	98	2403,0	601558	4052	23564	195,91
Neamt	1629	1864	1240	74	49	1483,8	586229	3210	16723	175,53
Olt	1052	188	81	45	36	1387,7	508213	2906	8751	223,62
Prahova	2170	679	245	150	85	2794,1	855539	7030	45145	226,77
Satu Mare	714	404	81	43	42	1134,3	390121	2300	16757	176,99
Salaj	820	656	277	41	39	678,9	256307	1489	7759	185,87
Sibiu	1496	523	180	89	56	1592,5	443993	3120	24114	198,34
Suceava	1929	762	108	76	45	1802,5	717224	4213	21744	177,4
Teleorman	1464	353	128	83	35	1048,8	456831	2857	40307	201,83
Timis	1687	1048	308	127	100	2914,1	688575	6379	49266	194,33
Tulcea	940	110	38	60	29	627,6	262692	2138	7898	187,87
Vaslui	1592	3271	66	147	125	798,8	466719	2027	7888	180,97
Valcea	1184	312	51	67	31	1506,3	430713	3111	15978	200,25
Vrancea	2554	1651	323	146	116	1117,6	391220	2589	11416	179,83
Municipiul Bucureşti	4896	1395	773	451	351	15357,7	2009200	34535	93669	277,45

ANNEX 2

Statistical data used - 2006

County	Total number of controls effected	Value of products infringement O.G. 21/1992 (thou RON)		Total value of applied fines (thou RON)	Value of payments from fines to the budget (thou RON)	GDP per county (thou RON)	Population by county at 1 July	Number of trade firms	Turnover of trade firms (thou RON)	Average net nominal monthly earnings (thou RON)
		Total	from which: from imports							
Alba	2578	2828	2222	161	147	5974.1	378614	2745	2564	756
Arad	3775	9727	8486	748	798	8406.7	458847	4286	5015	790
Arges	2754	1960	1326	969	838	11770.9	644590	6329	7388	882
Bacau	2129	3485	3019	367	277	8506,0	721411	5623	5043	845
Bihor	5515	5970	2600	932	714	9475.4	594982	7230	6818	692
Bistrita Nasaud	3432	1736	1140	526	415	4086.3	317685	2499	1845	727
Botosani	2061	491	161	313	191	3561.3	456765	1968	1490	715
Brasov	4397	12823	8498	963	771	11261.3	595758	7310	9354	815
Braila	2249	2680	2262	247	137	4156,0	367661	3580	2651	730
Buzau	3260	1247	712	467	420	5334.2	490981	4909	3192	724
Caras Severin	2082	1032	742	346	254	4445.2	330517	2144	1314	732

Calarasi	1294	598	391	305	259	2686.8	316294	2331	1254	681
Cluj	4807	18941	15371	699	448	13558.6	689523	8500	10284	905
Constanta	5863	6461	5245	1542	1200	14653.3	716576	8736	9438	914
Covasna	1598	458	390	175	164	2779.7	223770	1761	1721	656
Dambovita	2038	1475	936	318	230	6402.5	535087	3132	2479	860
Dolj	3435	2317	1573	740	666	8839.4	715989	7510	6111	855
Galati	1741	3555	1972	364	340	7159.3	617979	6673	5319	834
Giurgiu	1987	1086	469	407	368	2477.6	284501	1739	2792	763
Gorj	3125	4072	1713	593	398	5984.1	383557	3032	2068	965
Harghita	1777	896	543	215	195	4464.5	326347	2861	2375	704
Hunedoara	3125	2994	2279	828	751	6867.1	477259	4490	3497	813
Ialomita	1804	2407	737	601	422	3341.3	291178	1874	1943	735
Iasi	2698	13290	1165	623	556	10040.6	824083	7317	6518	792
Ilfov	3173	41292	39882	797	682	8696.9	288296	3849	13833	1012
Maramures	2240	5182	3736	356	280	5932.2	515313	3814	3256	702
Mehedinti	2457	2106	1429	415	286	3246.6	301515	2113	1263	876
Mures	3247	599	377	487	424	8174.1	583210	5142	4492	784
Neamt	1794	3357	2299	231	198	5852.7	567908	4057	2845	710
Olt	2464	1114	749	290	259	4560.4	479323	3190	1805	804
Prahova	3592	12860	11247	944	804	13775.3	823509	7514	7558	889
Satu Mare	1413	14318	14022	277	215	4699.7	367677	2786	2759	778
Salaj	1985	1902	1134	148	134	3054,0	244952	1876	1371	781
Sibiu	2584	1503	753	530	392	7637.5	423119	3677	5073	834
Suceava	3118	1082	461	395	252	7054.5	705730	4662	4191	726
Teleorman	2429	572	351	290	294	3847,0	417183	2869	1665	760
Timis	1882	8387	7235	329	287	16069.9	660966	7768	8594	858
Tulcea	1593	774	250	343	198	3027.3	251614	2095	1220	763
Vaslui	2433	1552	710	519	485	5958.7	413511	3367	2559	768
Valcea	2832	1604	1046	325	337	3414.8	456686	2449	1479	717
Vrancea	3024	22395	20581	428	335	4178.6	393023	3055	2121	768
Municipiul Bucureşti	8158	10288	9038	2462	2097	69013.9	1931236	38766	89441	1142

ANNEX 3

Correlation Matrix for the variables of year 2000

	No_controls	Value_total	Value _imports	Fines	Payment_budget	GDP per county	Population	No trade firms	Turnover	ANNME
No_controls	1,000	,174	,221	**,912**	**,892**	**,799**	**,823**	**,800**	**,781**	**,435**
Value_total		1,000	,382	,171	,233	,096	,113	,135	,213	-,044
Value _imports			1,000	,298	,314	,242	,171	,225	,248	,185
Fines				1,000	**,980**	**,876**	**,823**	**,870**	**,797**	**,541**
Payment_budget					1,000	**,851**	**,776**	**,838**	**,762**	**,519**
GDP per county						1,000	**,928**	**,991**	**,824**	**,559**
Population							1,000	**,942**	**,867**	,499
No trade firms								1,000	**,840**	**,553**
Turnover									1,000	,496
ANNME										1,000

ANNEX 4

Correlation Matrix for the variables of year 2006

	No_controls	Value_total	Value _imports	Fines	Payment_budget	GDP per county	Population	No trade firms	Turnover	ANNME
No_controls	1,000	,300	,260	**,890**	**,866**	**,755**	**,727**	**,772**	**,719**	**,577**
Value_total		1,000	**,969**	,302	,295	,223	,145	,198	,243	,476
Value _imports			1,000	,266	,262	,2045	,086	,167	,237	,474
Fines				1,000	**,987**	**,845**	**,784**	**,846**	**,815**	**,705**
Payment_budget					1,000	**,846**	**,786**	**,847**	**,818**	**,687**
GDP per county						1,000	**,918**	**,989**	**,981**	**,697**
Population							1,000	**,940**	**,861**	**,613**
No trade firms								1,000	**,972**	**,662**
Turnover									1,000	**,668**
ANNME										1,000