SIMILARITIES AMONG CEE COUNTRIES REGARDING FINANCIAL STABILITY INDICATORS

Suela Kristo[*]-Etis Jorgji[**]-Arsena Gjipali[***]

Abstract

The globalisation trend increases the financial linkages, increasing in this way the contagion effects. This issue become even more sensitive for post-communist European countries as their economies have created relatively new financial systems being currently of little experience, moreover when they become part of EU. Therefore, in this study we try to find similarities among CEE countries regarding financial stability indicators. We apply cluster analysis techniques for the period 2007-2011 in order to see also the trend of homogeneity of these countries. Among the CEE countries appear Czech Republic, Hungary and Slovak Republic as more integrated. Less integrated in these countries are Balkan countries, which tended to be in a long distance from the EMU cluster. Similarities are also required within SEE countries to clarify their position. This inclusion clarified the position of Albania, which seemed to have much more similarities with EMU group. Furthermore, seems even more obvious that Serbia is again far away from other countries. There is an increasing tendency of homogeneity of these countries in the last three years, more obvious in the last year of the period under the study.

Keywords: Financial stability, CEE & SEE countries, cluster analysis

1. INTRODUCTION

The globalisation trend in one side increases the financial linkages, increasing in this way the contagion effects. In the other side, the financial systems face competitive pressure. These issues become even more sensitive for post-communist European countries as their economies have created relatively new financial systems being currently of little experience, moreover when they become part of EU. There is a growing consensus that interconnectedness should be a key variable in assessing the systemic risk for the financial stability (IMF, BIS, and FSB, 2009). Therefore, in this paper, we want to answer these basic questions: 1) how close to each other CEE or SEE countries in terms of financial institutions

[*]Suela Kristo, is graduated in Economics at Tirana University in 2000 and works in the Faculty of Economy, University of Tirana since this year. She holds Msc and PhD in Economics. She teaches and has research interests mainly: in the microeconomics field, financial institutions, competition policy, market efficiency, comparative Central and East European politics, etc.

[**]Etis Jorgji is a lecturer at the University of Tirana, Faculty of Economy. She holds a bachelor as a Foreign Trade Economist from University of Budapest since 1997, and a PhD from University of Tirana in 2012. Etis Jorgji lectures Economic History, Economic Theories and Economic Thought, Introduction to Economics. Her interest in research is in international trade, international relations and migration, and she has published in some regional journals as well as participated in several international conferences.

[***] Arsena Gjipali is an associate professor at the Faculty of Economy, Tirana University. From 2000 and on she has been teaching at the BA and MA levels in the areas of economics, Microeconomics and Labour Economics. Her main interest in research is on developing socio-economic analyses related to the human capital quality in Albania and the South and East European countries, focusing on the labour market, education and migration issues. Arsena Gjipali has earned her PhD in Staffordshire University, UK in 2008.

stability are; 2) how these similarities have changed during the years of the period under consideration; 3) Whether the CEE countries EU members are closer to each other than those outside it?

We apply cluster analysis techniques to examine the degree of financial integration of these countries, focusing in particular on the financial institutions. Cluster analysis aims to find similarities between the two countries and cluster them into groups. This analysis cannot impose restrictions on relationships between countries and cannot find the factors that have contributed to these relationships. Such an analysis is very important as a first step of other deeper analysis that tries to explain the relationship between financial institutions and factors affecting on these relationships.

In our analysis, we will focus specially on the stability of financial institutions, although it not fully captures all features of financial institutions or financial systems. The paper uses this characteristic as a basis for describing, comparing, and analyzing financial institutions between CEE countries, and their evolution over time in the period 2007-2011. At first were selected 15 CEE countries to observe similarities between their financial institutions. We also try to capture perhaps more similarities between those who are members of the EU and those outside it. The results showed differences between EU member countries. In one side, we have more integrated countries such as Czech Republic, Hungary and Slovak Republic, and on the other side less integrated such as Bulgaria and Romania. With regard to the countries outside the EU, Albania is closer to other integrated countries in the EU, strengthening the relationship between financial institutions of these countries. While some other, such as Serbia, Macedonia and Bosnia and Herzegovina are far away from all other countries. Later we continue with cluster analysis for SEE countries and Euro area (EMU). We included EMU in order to clarify similarities with Balkan countries. Results showed that Albania is closer to the EMU group. However, Serbia seems to stand again far away from all countries and EMU group.

The paper continues with section 2, which provides a review of the literature on the financial linkages, particularly about stability dimension. Section 3 describes the general methodologies for cluster analysis. Section 4 explains the data and theoretical foundation for the choice of variables. Section 5 presents the results, while section 6 concludes and outlines areas for further research.

2. LITERATURE REVIEW

There is widely known the importance of financial institutions in development of any economy. Financial institutions play a significant role in economic development because they determine which firms should use a society's scarce saving (Schumpeter, 1912). Levine (2005) with its paper reviews highlights that financial institutions and financial markets exert a powerful influence on economic development, poverty alleviation, and economic stability. Furthermore, Aghion et al., (2005), in their cross-country comparisons have shown that financial sector development has a stronger impact on growth in low- and middle- than in

high-income countries. The potential harmful consequences of cross-border interconnectedness for domestic banking sector stability have been illustrated rather dramatically during the recent global financial crisis, when shocks to one country's financial system were rapidly transmitted to many others (Čihák et al., 2011).

The growing financial linkages in the globalisation trend make the financial system architecture more difficult to be planned. Contagion effects that are transmitted through financial linkages could also result in heightened cross-country spillovers of macroeconomic fluctuations (Claessens and Forbes, 2001). Early theoretical literature on banking networks emphasized the benefits of interconnectedness for network stability. Allen and Gale (2000), based on an examination of a stylized four-bank network, concluded that a "complete" network is more resilient than an "incomplete" network, due to both wider possibilities for risk sharing in complete networks and individual banks bearing a smaller share of the shock. An important part of the network analysis literature focuses on "cascading" effects in a network (May and Anderson, 1991; Watts, 2002, etc). The phenomenon of large but rare cascades triggered by relatively small shocks has been observed in areas as diverse as collective action, the diffusion of norms and innovations, cultural fads, and cascading failures in infrastructure and organizational networks. Watts (2002) reviews the literature and presents a possible explanation of this phenomenon in terms of a network of interacting agents whose decisions depend on actions of their neighbours, based on a threshold rule. His model points out factors that make a network relatively more prone to the occurrence of large "cascades". Sorensen et al., (2006) explain that, in the period 1998-2004, the banking sectors in the euro area countries seem to have become somewhat more homogeneous, although the results are unequivocal and considerable differences remain. Karreman (2009) examines the contemporary financial geographies of Central and Eastern Europe and argues how these may affect the established European financial centre network in the future. The results show a distinct spatial order of financial centres organised around three main city clusters: a 'south-east' cluster controlled by Athens, a 'central-east' cluster controlled by Vienna and a 'Baltics' cluster controlled by both Copenhagen and Stockholm. Beck et al., (2010) introduces the updated and expanded version of the Financial Development and Structure Database and presents recent trends in structure and development of financial institutions and markets across countries. They found a general deepening of financial markets and institutions over time, which is more pronounced in the high-income countries and more pronounced for markets than for banks. Čihák et al., (2011) using model simulations and econometric estimates based on a worldwide dataset, find an M-shaped relationship between financial stability of a country's banking sector and its interconnectedness. According to them, it may be beneficial for policies to support greater interlinkages for less connected banking systems, but after a certain point the advantages of increased interconnectedness become less clear.

There are various studies within the literature that used different clustering methods for a given classification problem and compared their results (Nanda et al., 2010). Our contribution is to try clustering CEE and SEE countries related to stability of financial institutions based to a newly launched Global Financial Development Database. This analysis had to confront

significant gaps in information on regional financial interlinkages that is necessary to inform policy decisions regarding financial institution.

3. METHODOLOGY

The objective of cluster analysis[1] is to determine the natural groupings (or clusters) of observations. In our study, we search in the data for groups of countries, in which countries in the same group are more similar to each other than to those in other groups. We use cluster analysis as an exploratory data-analysis technique. This technique would give a better and more accurate explanation of the observations with a minimal loss of information, because it requires no assumptions about the independence of the observations. However, this method like other methods imposes some limitations. There are several cluster-analysis methods, where most of them allow a variety of distance measures for determining the similarity or dissimilarity between observations. On the other side, before applying this method is necessary to perform data transformations and/or variable selection. Then, it may be difficult to determine how many clusters are really in the data and how significant are the cluster formed[2].

There are two general types of clustering methods: partition and hierarchical. Partition methods break the observations into a certain number of final clusters in advance. Two partition methods are kmeans and kmedians. On the other side, the hierarchical clustering is the most useful methods and it consists in creating hierarchically related sets of clusters. Hierarchical cluster analysis begins by separating each object into a cluster by itself. At each stage of the analysis, the criterion by which objects are separated is relaxed in order to link the two most similar clusters until all of the objects are joined in a complete classification tree.

Hierarchical clustering methods are generally of two types: agglomerative or divisive. Agglomerative hierarchical clustering starts with single elements and aggregate them into clusters, while divisive hierarchical clustering starts with the complete data set and divide it into partitions. In this study, we chose to apply hierarchical techniques, since the number of final clusters was unknown. Furthermore, the agglomerative methods were preferred to the divisive ones because they are widely implemented in software.

The hierarchical cluster method consists in an ordered paired list $\{t, W_t; t=1... T\}$, where t beings the different year and W_t beings n row-matrices of the observed variables for the n individuals in each year. In the case of CEE, n represents 16 countries, hence in the other case n represents six countries. A description of variables in W_t is given in Section 3. From each W_t matrix, applied in each year, we obtain a D_t squared n×n distance matrix. For a particular t year, the initial D_t matrix is represented as:

[1] See Dillon and Goldstein (1984), Everitt et al., (2001) for more definition of this term.
[2] See Korobow and Stuhr, (1991) for more detailed explanation.

$$D_t = \begin{pmatrix} 0 & \cdots & d_{1i} & \cdots & d_{1n} \\ \vdots & \ddots & & & \vdots \\ d_{j1} & & 0 & & d_{jn} \\ \vdots & & & \ddots & \vdots \\ d_{n1} & \cdots & d_{ni} & \cdots & 0 \end{pmatrix}$$

where d_{ij} represents the distance between the individuals i and j. In order to obtain the final dendrogram, we should do the specification of the following parameters:

Type of distance, which defines the formula for calculating distance and it is used to approximate the similarity of two financial institutions. The most typical and well-known distances that might be used are the Euclidean and squared Euclidean distance, the Manhattan or city block distance, the Mahalanobis distance or the Chebychev distance, among others. We decided to use the squared Euclidean measurement in this study, since it place greater emphasis on outliers to generate distance patterns[3].

Linkage method defines the rules for cluster formation. The best-known linkage methods are single, complete, average, Ward's method, centroid, median, and weighted average. However, since the first three methods are more common and broadly known in most of the statistical packages, we used them to obtain the final dendrograms[4]. Overall, the complete and average linkage method led to the most consistent and stable results. We have therefore based our discussion on these methods, and the dendrograms for each time period showing the cluster-relation between the different countries are presented in a condensed form in the appendix. Stata 11 package was applied to carry out the calculations.

4. DATA AND VARIABLES DESCRIPTION

The paper uses the data to characterize and compare financial institutions across countries and over time. As already mentioned, this will be through cluster analysis to assign the countries into groups (clusters). Therefore, countries in the same cluster are more similar to each other than to those in other clusters. The cluster analysis implies that no restrictions or stipulated structures are imposed upon the data ex ante. So, are the data themselves that structure the results, therefore the selection of variables is very important.

There is a vast literature specifically on measuring systemic risk, stress tests, and other tools for financial stability. A key variable used to measure financial stability is the z-score. The **z-score** is the ratio of return on assets plus capital-asset-ratio to the standard deviation of return on assets. This variable indicates the number of standard deviations that a bank's return on assets has to drop below its expected value before equity is depleted and the bank is insolvent[5].Thus, a higher z-score indicates that the bank is more stable. The other indicators, such as the regulatory capital to risk-weighted assets and nonperforming loans to total gross loans, may be better known than the z-score, but they are also known to be lagging indicators of soundness (e.g., Čihák and Schaeck 2010). The first one measures the capital adequacy of

[3] See Kaufman and Rousseeuw (1990), Gordon (1999) and Everitt et al., (2001), for more various levels of warnings about using different type of measures and for importance of using squared Euclidean distance (or Euclidean distance).
[4] See Dillon et al., (1984) for examples of these methods.
[5] see Roy (1952), Hannan and Henwick (1988), De Nicolo (2000)

deposit takers. Capital adequacy and availability ultimately determine the degree of robustness of financial institutions to withstand shocks to their balance sheets. The second indicator is often used as a proxy for asset quality and is intended to identify problems with asset quality in the loan portfolio. In addition of these variables we include: capital to total assets, liquid assets to deposits and short term funding, provisions to non-performing loans, credit to deposits[6].

By selecting these indicators, we aim to capture one of the dimensions of financial system development. These variables are a considerable part of the factors determining the behaviour and development of the stability in the financial institutions without imposing any causality links or structures restriction. The data for all these variables offers from a newly launched Global Financial Development Database, an extensive worldwide database combining and updating several financial data sets. The data have been selected for 15 European countries[7] for the period 2007 to 2011. The data are taken from 2007, the year in which the financial crisis began, until last year offered by World Bank. Moreover, we picked out from World Bank database from 2007 to 2011, to not have missing variables for selected country.

5. RESULTS

We have applied the two methods: average and complete linkage. Both of them give almost identical results, with very small differences. Results obtained from complete method give a more clear idea of the similarities and differences between the banking sectors in these countries, so we decided to illustrate the dendrograms of this method. Figure 1 in appendix illustrates the results of cluster analysis and the table below gives a summary table of the CEE countries classification.

[6] For more description of the variables and a discussion of the underlying literature, see Cihák et al., (2012), and Beck et al., (2010).

7 Montenegro and Kosovo are not included because of missing data.

Summary table of CEE countries classification

Country	**Group 1** *(years)* *(EMU Grup)*	**Group 2** *(years)*	**Group 3** *(years)*
Czech Republic (CZE)	5		
Hungary (HUN)	5		
Slovak Republic (SVK)	5		
Poland (POL)	4	1	
Estonia (EST)	4	1	
Slovenia (SVN)	4	1	
Lithuania (LTU)	4	1	
Albania (ALB)	4	1	
Croatia (HRV)	3	2	
Latvia (LVA)	3	2	
Bulgaria (BGR)	2	3	
Bosnia and Herzegovina (BIH)	2	3	
Macedonia, FYR (MKD)	1	3	1
Romania (ROM)	1	3	1
Serbia (SRB)			5

Source: Authors, based on the Global Financial Development Database

Generally, these countries are classified in three groups. The first and the bigger group include 8-11 countries, which are in Euro area group. At this group are always included Czech Republic, Hungary and Slovak Republic. Poland, Estonia, Slovenia, Lithuania and Albania are included to the second group only for one year, whereas Latvia and Croatia are included to the second group for only two years. The second group includes fewer countries compared to the first one (1-6 countries). The countries that are more often included in this group are Latvia, Croatia, Bulgaria, Bosnia and Herzegovina, Macedonia and Romania. The last group, in general, includes only one country. Serbia is always in this group. We can notice that along the observation period the distance of the groups has changed. At the beginning of this period (2007), the differences are relatively small compared to the last year (2011). The differences between groups become larger in year 2008, but after this year, there is an increase in homogeneity between groups. If we make a detailed observation of the CEE

countries to understand better the similarities and the differences between them, we could have these results:

- Serbia is the country that has the biggest differences; forming a group itself for four years (2007, 2008, 2009 and 2011), due to huge differences with the other countries. The only year that the Serbian financial institution appears more similar to other countries is 2010, when all countries seem to have more similarities than the past three years. Serbia has a little more similarities with Macedonia and Romania in 2010, when they are included to the same group. Moreover, it has more similarities with the second group than the first one. Therefore, Serbia appears as the country with the stability indicators of financial institution far away from Euro area.
- Macedonia and Romania appears to be less integrated countries, after Serbia. It appears to have the biggest differences with the other countries. For three years (2009-2011), they are very close to each other and they are included to the second group. Closer to these countries stand Bosnia and Herzegovina and Bulgaria
- Bosnia and Herzegovina and Bulgaria are the other Balkan countries that seem very similar to each other and less integrated with Euro area.
- Albania is the Balkan country that appears more integrated with Euro area. Four of the five years of the period under the study, it belongs to the Euro area group. Albania has much more similarities with Croatia, another Balkan country. In year 2007, financial institution of this country together with Croatia lies closer to this area than any other country. It stays away from EMU only in year 2008.
- Latvia is a country that is part of the EU with fewer similarities to other countries. Greater similarity has been noticed with Balkan countries. Years 2008 and 2009 are the years that it appears to have more similarities with EMU group.
- The strongest relationship in EMU group is among Czech Republic, Hungary, and Slovakia and something less with the Estonia. These countries, together with the Poland, Estonia, Slovenia, Lithuania and Albania stand out as the most integrated countries, regarding this dimension of the financial institutions development.

We try to clarify the results found above for Balkan countries. Therefore, we use cluster analysis for the SEE countries with exclusion of Montenegro and Kosovo because of the missing data. Figure 2 in appendix gives dendrograms of this analysis according to the complete linkage method. Through this analysis, we found the same results as the above. Therefore, Albania is closer to EMU together with Croatia. Then come Bosnia and Herzegovina and Bulgaria followed by Macedonia and Romania. In the end, remains Serbia as the country less similar to other countries and to the Euro area.

6. CONCLUSION

In this study have been used Global Financial Development Database in order to analyze the financial institutions of different countries, under the stability dimension. This was done through cluster analysis for the years 2007-2011. The purpose was to observe the homogeneity of CEE countries, but not only that. We also worked towards finding the

similarities between SEE countries, as well as between countries integrated and those outside the EU.

The results showed that there are not huge differences between members and non-EU members. Thus, in relation to non-member countries of the EU, Albania is more integrated SEE countries. Less integrated are Serbia, Macedonia and Bosnia and Herzegovina. Serbia is not only far away from other countries, but it is far away from EMU group. Among the CEE countries appear the Czech Republic, Hungary and Slovakia as more integrated and closer to Euro area. Less integrated in these countries are Bulgaria and Romania, which tended to be in a long distance from the EMU cluster. In general, Balkan countries are separated from EMU group. The tendency of homogeneity in the period under the study generally shows a decrease until the year 2008, and an increase in the last three years of the period under consideration. Such behaviour might be due to financial crisis that may have increased similarities between the countries. However, this requires further and more detailed analysis.

The study recognizes that financial stability does not capture all features of financial systems. Rather, the paper uses this characteristic as a basis for comparing, and clustering financial systems in these countries and their evolution over the period taken into consideration. Certainly, in other subsequent studies should be included other features of financial systems in order to achieve a more comprehensive analysis. The paper also emphasizes a need for further research, including other stability indicators measured by the most advanced methods.

REFERENCES

Aghion, P., Howitt, P., Mayer-Foulkes, D. (2005), "The Effect of Financial Development on Convergence: Theory and Evidence", *Quarterly Journal of Economics, 120*, 173-222.

Allen, F., Gale, D. (2000), "Financial Contagion", *Journal of Political Economy*, 108(1),

Bauer, P.W., Berger, A.N., Ferrier, G.D., Humphrey, D.B. (1998), "Consistency conditions for regulatory analysis of financial institutions: A comparison of frontier efficiency methods", *Journal of Economics and Business, 50*, 85–114.

Beck, Th., Demirgüç-Kunt, A., Levine, R. (2010), "Financial Institutions and Markets across Countries and over Time", *World Bank Economic Review, 24*(1), 77–92.

Čihák, M., Muñoz, S., Scuzzarella, R. (2011), "The Bright and the Dark Side of Cross-Border Banking Linkages", International Monetary Fund, Washington, DC, Working Paper WP/11/186.

Čihák, M., Schaeck., K. (2010), "How Well Do Aggregate Prudential Ratios Identify Banking System Problems?", *Journal of Financial Stability*, 6(3), September.

Čihák, M., Thorsten, B., Demirgüç-Kunt, A., Feyen, E., Levine, R. (2012), "Benchmarking Financial Systems Around the World", *World Bank Policy Research Working Paper* 6175, World Bank, Washington, D.C.

Claessens, S., Forbes, K. (Eds.) (2001), International Financial Contagion. Norwell: MA: Kluwer Academic Publishers.

De Nicolo, G. (2000), "Size, Charter Value and Risk in Banking: An International Perspective", International Finance Discussion Papers No. 689, Washington, DC: Board of Governors of the Federal Reserve System.

Dillon, W., Goldstein, M. (1984), Multivariate Analysis, New York, Wiley.

Everitt, B. S., Landau, S., Leese, M. (2001), Cluster Analysis. 4th ed. London: Arnold.

Gordon, A. D. (1999), Classification. 2nd ed. Boca Raton, FL: Chapman & Hall/CRC.

Hannan, T.H., Hanweck, G. A. (1988), "Bank Insolvency Risk and the Market for Largen Certificates of Deposit", *Journal of Money, Credit and Banking*, 20, 203-11.

IMF/ BIS/ FSB, (2009), Guidance to Assess the Systemic Importance of Financial Institutions, Markets and Instruments: Initial Considerations, October.

Karreman, B. (2009), Financial Geographies and Emerging Markets in Europe. Tijdschrift voor Economische en Sociale Geografie, Royal Dutch Geographical Society KNAG, *100*(2), 260-266.

Kaufman, L., Rousseeuw, P.J. (1990), Finding Groups in Data: An Introduction to Cluster Analysis. Wiley, New York.

Korobow, L., Stuhr D.P. (1991), "Using cluster analysis as a tool for economic and financial analysis", *Federal Reserve Bank of New York*, Research Paper 9132.

Levine, R. (2005), Finance and Growth: Theory and Evidence. In: Aghion, P and Durlauf, S. (eds.), *Handbook of Economic Growth*. Elsevier Science, The Netherlands.

May, R.B., Anderson, R.M. (1991), "Infectious Diseases of Humans", Oxford University Press.

Nanda, S.R., Mahanty, B., Tiwari, M.K. (2010), "Clustering Indian stock market data for portfolio management", *Journal Expert Systems with Applications, 37*(12), 8793-8798

Roy, A. D. (1952), "Safety First and the Holding of Assets", *Econometrica,* 20, 431-449.

Schumpeter, J. A. (1912), The Theory of Economic Development. Harvard University Press: Cambridge MA.

Sørensen, C.K., Gutiérrez, J.M. (2006), "Euro area banking sector integration using hierarchical cluster analysis techniques", European Central Bank, Working Paper Series 627.

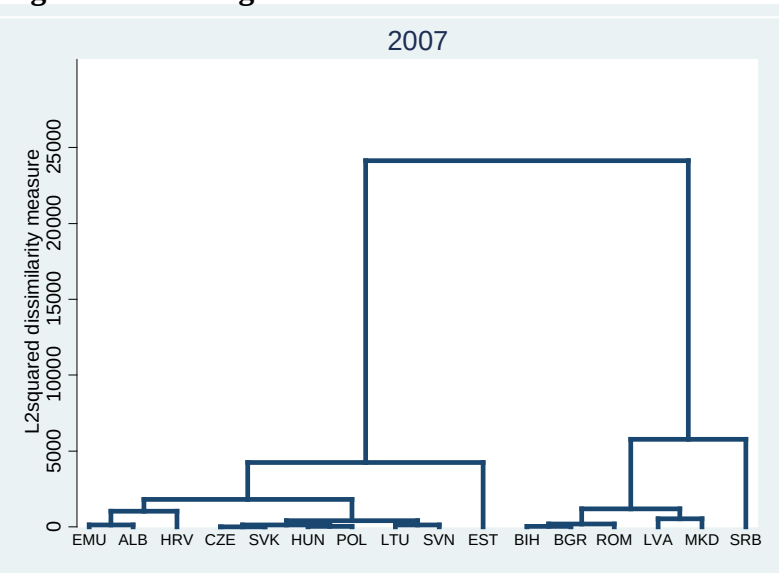
Watts, D., (2002), "A Simple Model of Global Cascades on Random Networks", *Proceedings of the National Academy of Sciences*, 9, 5766-5771.

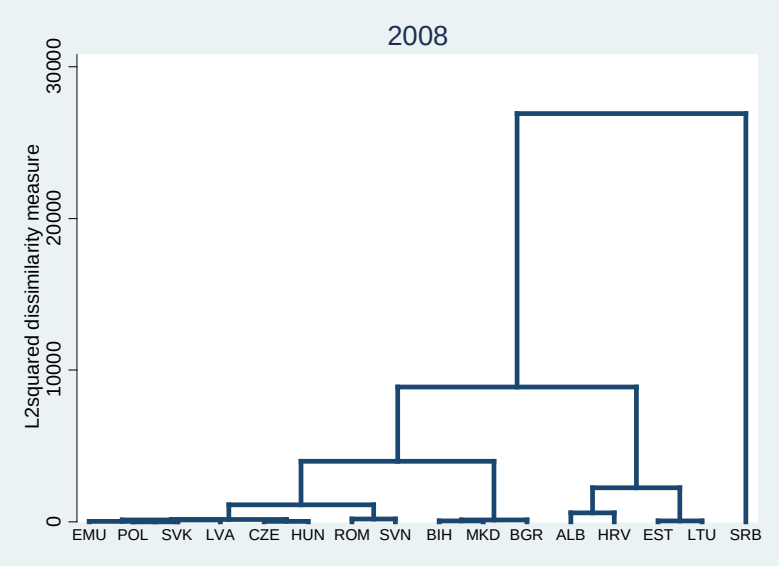
Wolfson, M., Zagros M., James P. (2004), "Identifying National Types: A Cluster Analysis of Politics, Economics, and Conflict", *Journal of Peace Research, 41*(5) 607-623.

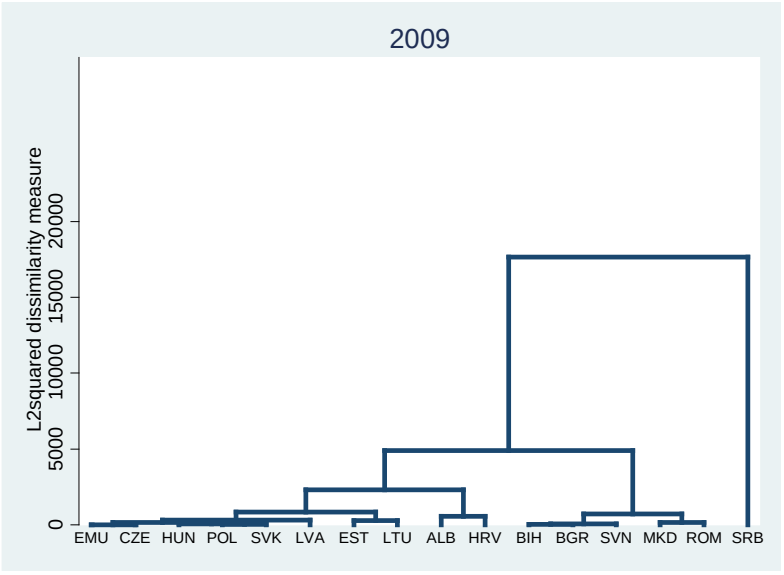
World Bank. (2010). ―A New Database on Financial Development and Structure. "updated 04/17/2013

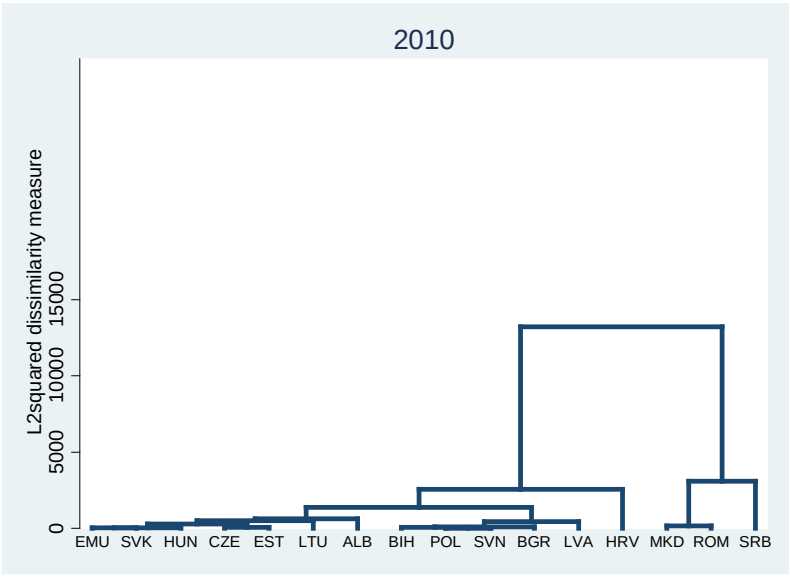
Appendix

Figure 1: Dendrograms of CEE countries classification



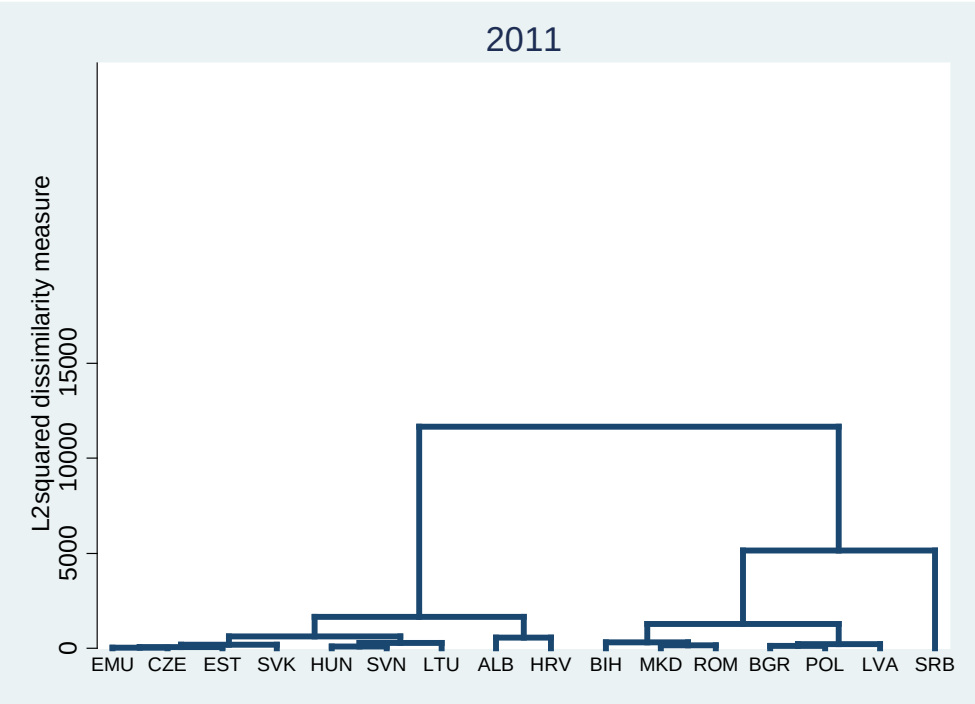


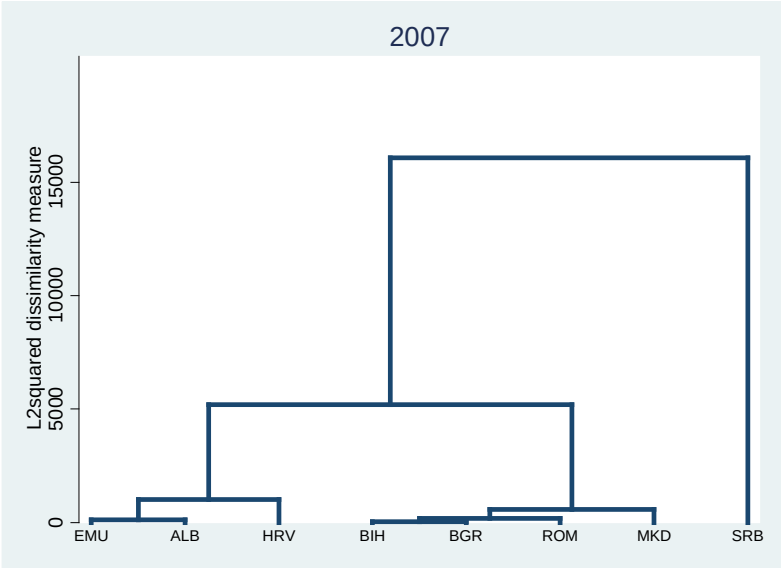

2009
L2squared dissimilarity measure
0
5000
10000
15000
20000
EMU CZE HUN POL SVK LVA EST LTU ALB HRV BIH BGR SVN MKD ROM SRB

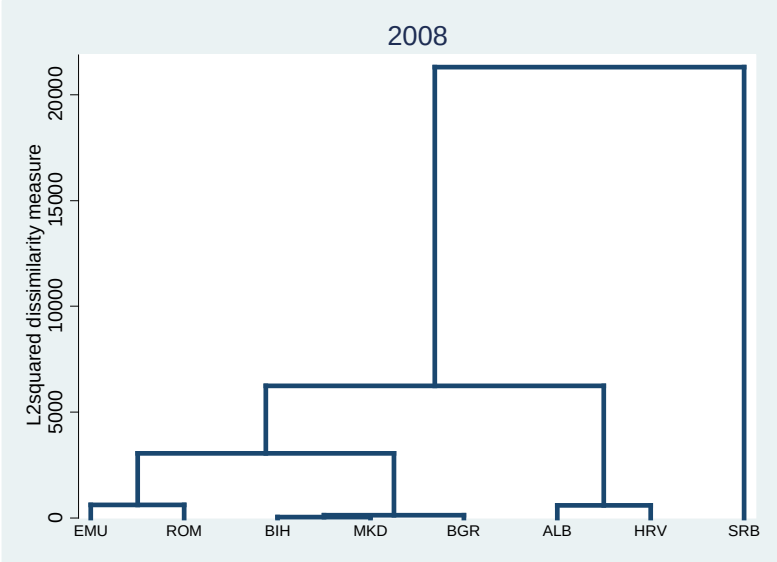

2010
L2squared dissimilarity measure
0
5000
10000
15000
EMU SVK HUN CZE EST LTU ALB BIH POL SVN BGR LVA HRV MKD ROM SRB

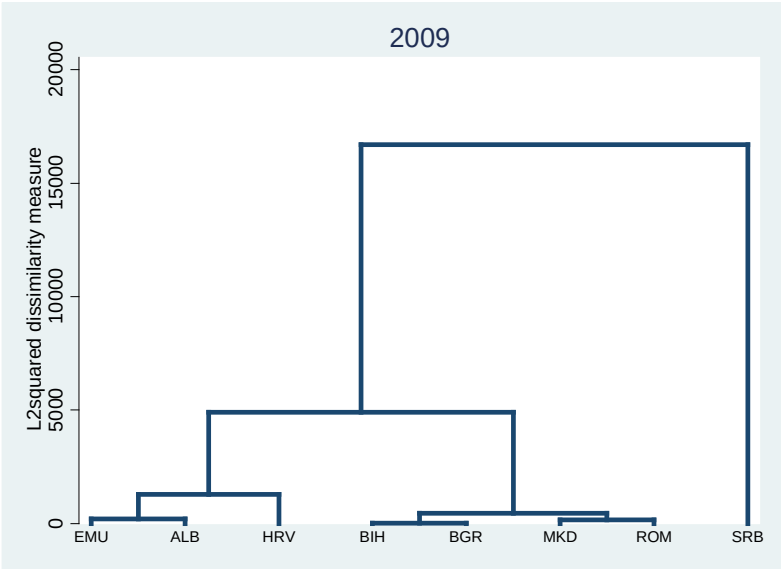
Appendix

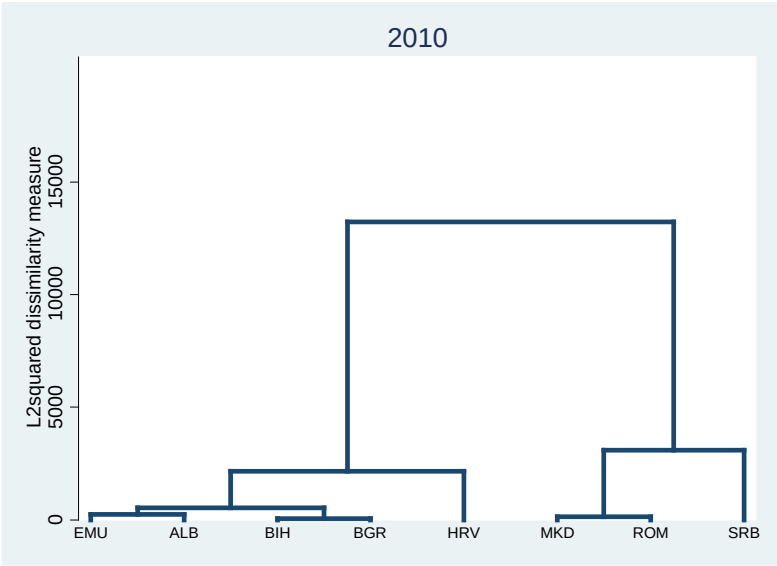
Figure 2: Dendrograms of SEE countries classification

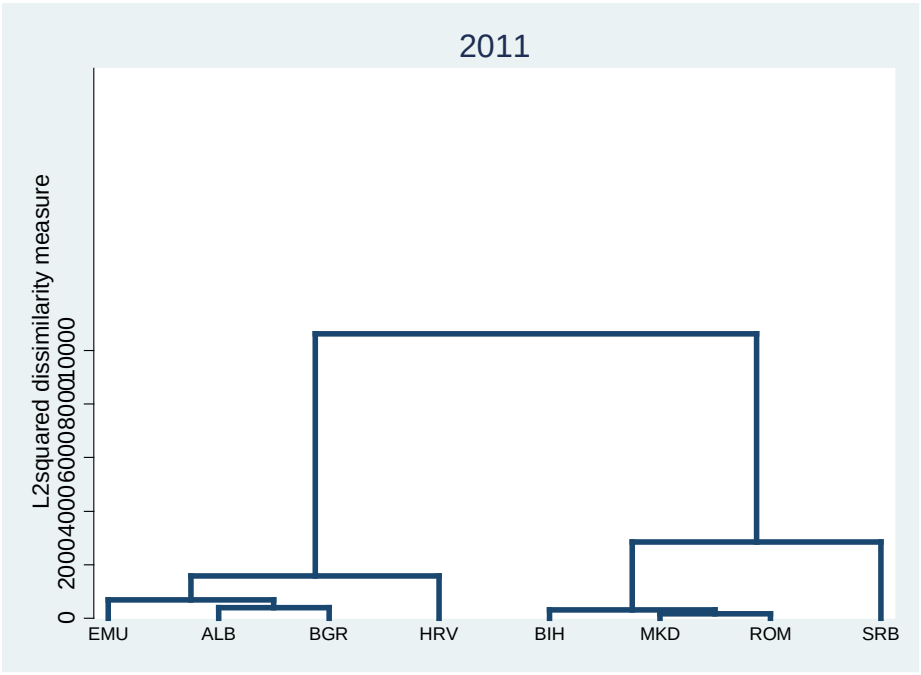





2008
L2squared dissimilarity measure
0
5000
10000
15000
20000
EMU
ROM
BIH
MKD
BGR
ALB
HRV
SRB


2009
L2squared dissimilarity measure
0
5000
10000
15000
20000
EMU
ALB
HRV
BIH
BGR
MKD
ROM
SRB


2010
L2squared dissimilarity measure
0
5000
10000
15000
EMU
ALB
BIH
BGR
HRV
MKD
ROM
SRB


2011
L2squared dissimilarity measure
0
2000
4000
6000
8000
10000
EMU
ALB
BGR
HRV
BIH
MKD
ROM
SRB