ONTOLOGY MAPPING IN THE RESILIENCE STUDY: THE ORGANIZATIONAL PERSPECTIVE FOR EUROPEAN UNION CASE

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Abstract

The ontology mapping in resilience surveillance on organization level can found utilization in analysis of association between idiosyncrasies and structure adaptability. Starting from the data regarding the economic trends for European Union members from 2014 to 2016 the aim of the research is to analyse the European Union resilience through interpretation of the link between members behaviour and structure convergence. The members positioned in European Union was analysed after organization clusterization of the twenty-eight state members. Two different structures are included into analysis for the studied periods: a structure which incorporates just the state members, and other which also take into account the eurozone blue-chips. In order to analyse the members' relation in structure a gravity model has been developed, the obtained results for each state members pair are contained in a skew matrix. The values are interpreted through a knowledge-base to highlight the European Union resilience degree.

Keywords: resilience, ontology, European Union structure, gravitational model, adaptation process.

Introduction

In the last years, the new global trends create asymmetric waves that targeted mostly the regional organizations and economical partnerships (Word Bank Group, 2017). For these, the real challenges came from the interior in terms of functional adaptation to the new environment sensitivities. An important piece in this process it has the *resilience*, concept which describe as generality: a phenomenon or a process which reflect the relatively positive adaptation despite experiences of significant adversity or trauma (Luthar, 2015).

As a dynamical process, the resilience represent the patterns of positive adaptation in development which can contribute to a favourable outcome despite experience with stressors (Hjemdal *et al*., 2006; Windle, 2011). In accordance with

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ISBN 978-606-714-428-4 | ISSN 2393-2384 | ISSN-L 2392-8867

this description, the objective of resilience research is to identify the vulnerabilities and protective factors which can remodel the prejudice.

In the case of European Union, the challenges occupy two dimensions; political and socio-economical which present some symmetries between them: BREXIT, refugee crises or rise of populism are just few of these. In this context, the European Union as an organization, it is subject to a continuous need for internal adaptation which rise from the multi-level dispersion of community. Thus, the vectors which influence mostly the European Union resilience in a long horizon of time can be identified in actors' convergence on the structure and in the integration process. Each of this present related dynamics which can model the organization state through stability degree face to internal asymmetries on network level. Hence, one possible objective of resilience research in the case of the European Union, is to investigate the frequency and intensity of some outcomes in different structure parts which are subject to recurrent emergencies. And different markers which can formulate alternative ways to reduce disaster risk and to strength organization capacity through members response as a compact group.

In this paper, we propose an empirical surveillance of the European Union resilience face disparities between structure convergence and integration through social adaptation process of members into European organization. The aim is to evaluate the structure resilience using the interconnectivity among state members as the interface for action-reaction. For this, we discuss the impact of the economic integration of members concerning to organization state from the perspective of structure convexity.

In order to reach this goal we follow the next three propositions as investigation premises: the large groups known a weight to achieve the common interests through organizational structure (Olson, 1994). Second, the random shocks make that network to known a static state used to absorb the systemic waves. Last, the links between probably states set and result projections are to crispy to insure the predictability in classical way

The rest of this paper has been structured as follow: first section provide a brief discussion of the conceptual framework and his application in International Relations. The proposed analyse method for measurements have been detailed in the second section. In the third section is given the application and data mining, and last section are conclusions and remarks.

1. Conceptual framework

In the last decades the resilience concept known a substantial increasing of multi-disciplinary approach starting from psychology domain to security and economy (Joseph, 2013). This development in applications is related with the concept potential to study the capacity of adaptation in other key research without the need of major changes in definition meaning. Having many similarities in how it has been defined firstly, is confirming the complexity degree of the concept

(Windle, 2011) and obviously it is more easily to be implemented in different research. This possibility is given in part by the many interrelated factors which requires to enchase the theoretical approach on groups or community instead one individual. However, the experience of each individual, from the group standpoint, is important for the resilience construction in terms of *partial dependence*.

In International Relations field, the risk and vulnerabilities do not present isolated variables thus, international organizations and actor are able to actively change. Therefore, the international entities have the capacity to develop custom skills to manage the sensitivity in interaction with others. Currently, the resilience concept play an increasingly important role in understanding and response processes to large events from international system (Brassett, 2013, Borbeau, 2015). In particular cases, the resilience is proposed as an intervention instrument which linking the policy-decisions with the events sensitivity (Coaffe and Wood, 2006; Pain and Levine, 2012). And in economy, as an analytical instrument for events impact study in correlation with actors response (Borchert and Mattoo, 2009; Collier and Skees, 2012).

In the European Union case, the economic resilience is treated as "*the ability of a region to avoid a fall in economic activity or to regain pre-crisis (or pre-shock) peak levels of employment (or GDP)"* (ESPON, 2014, p. 10). Conforming to this, the resilience is understood as a long-term mechanism based on inclusive and economic development among members. The resilience emerge from groups or individuals partnership which are desirable to be linked in different degree with international forums and processes. Somehow this framework is similar with the description offered by Varghese et. al. (2006) who reveal the importance of community in the shocks shift and the reorganizing institutions to adapt to change.

In institutional terms, resilience highlights the necessity to combine the political dialogue with development work in the attempt to construct a comprehensive and a coherent approach of vulnerabilities with the porpoise to improve the real results. Through this is followed to assure a stable environment for the economic growth through the economic convergence of the state members and sustainable financial activity.

The economic crises from 2008 and the asymmetric shocks from the coming years have challenged the European Union resilience framework, highlighting the deep gaps between policy-making and the actors' behaviour. On the financial and economic field, the crisis shown that on the basic structure, EMU do not has sufficient support to stable development of the markets in the eurozone (Suvanto *et al*., 2015). In particularly; divergence across the euro area (Juncker et. al., 2015), the inequality and unfair, the national approach of some components of the single market (Dăianu et. al. 2016) emphasized the shortcomings and inconsistencies of the E.U construction and organization capacity to response to the systemic waves. Nevertheless, they have called into question the need of strengthening the euro area and of the European Union as an organizational framework. However, the unfinished integration of members and convergence process between different

levels, reduce the resilience impact in prevention and recovery from sensitive situations.

2. Methodology

In this section will discuss the data for the distribution fitting, as well the simulations used for assessing the results for the resilience capacity. The numerical analysis for the simulations is also presented.

2.1. Data selection method

The data employed come from open sources maintained by the international institutions and private stakeholders. Five online sources where selected to provide the necessary "image" of the economic network state. The sources selected cover data from economic field, financial flow, trade and stability field. Table 1 documents the five sources selected in this research.

The data selected were required to be statistical dependent or to make reference to these. We use the term '*statistically dependence'* in order to refer to databases where the selected data related to a horizon time are correlated in one way, and can present an event with multiple situations from one perspective. A period characterized through volatility combined with uncertainty preceding with asymmetric waves on the global level was the criterion used to achieve the statistical dependence of data time period proposed. The horizon time for the study was set for the period: 2014-2016 for each of the sites so that quality of fit can be analysed through the network capacities. This study set the horizon time to three years in terms of propagation depth that were statistical dependency met the selection criteria.

Table.1 Sites address, and what domains are covered through data.

Site	Domains covered	Indicators extracted
STOXX Database (2017)[1]	Financial and investments	SX5E
Policy Uncertainty[2]	Economic policy uncertainty	Economic Policy Uncertainty
Eurostat	International trade	Trade balance
World Economic Outlook Database[3]	Economic outlook	Trade percent change
Eurostat	GDP growth compared	Average 2014-2015

[1] https://www.stoxx.com/index-details?symbol=sx5e
[2] Policy Uncertainty (2017), http://www.policyuncertainty.com/
[3] World Economic Outlook Database (2017), https://www.imf.org/external/pubs/ft/weo/2016/01/weodata/weoselgr.aspx

From these, the *GDP* and *international trade* describe predictive variables for the mapping. The other two variables; *economic policy uncertainty* and *financial - investments* are tacked as response factors to actors behaviour into organization, and the *integration index*, is a deductive value.

2.2. Data integrated in research

As it was mentioned in introduction, this paper attempted a surveillance of the European Union resilience considered fitted economic data from the open sources in a matrix of interaction distance. The values from the columns measure the relationship between members in terms of intensity probable. The first mapping investigate the interaction between large economic bunch, then some threshold intensity, whilst the second mapping integrate the structure ontology in surface to highlight the asymmetries face some threshold.

The matrix of interaction between state members is the first mapping considered, in this order we estimate a gravity model to investigate the distance between economy and opportunity, and can be described as follow:

$$\beta_1 \ln AV_1(X_1; Y_1) + \beta_2 \ln AV_2(X_2; Y_2) - D \qquad (1)'$$

Where: $AV_{i;j}(X;Y)$ - is the average between GDP percent changes for two consecutive years for each country. This process it was made for every pair of state members;

$\beta_{1;2}$ is the integration index for the every state member. Note, this is computed on the suggested approach about economic idiosyncrasy by Vujakovic (2010). And is defined through difference between trade growth and GDP percent changed between the pair of countries. The last element is *D*, and in general terms describe the external distance between members.

From (1) we develop two different mappings, one for each study dimension; economy and interaction. For the first case the expression is:

$$Fs = \beta_1 \ln AV_1(X_1; Y_1) + \beta_2 \ln AV_2(X_2; Y_2) - D_p \qquad (2)$$

Where: *Fs* is the social function. In this approach the distance (D_p) is a penalty value which described the degree of integration for each reporting member from the matrix. The values are 0 for the eurozone members and 1 for non-euro members, exception make the members which for each period of time had a bivalent state, in this case the value taken is 0.5.

In the next step we extend the gravity model to investigate the scale associated with the importance of trade and we rewrite the distance from (1) as:

$$Fs = \beta_1 \ln AV_1(X_1; Y_1) + \beta_2 \ln AV_2(X_2; Y_2) - |\beta_1 - \beta_2| \qquad (3)$$

Where: $|\beta_1 - \beta_2|$ express the exploitation of the spatiality in sense of interaction between members in terms of metric measured value in organization.

In this case, it can be observed that expression of the distance as module is a proxy which represent the relationship between trade and the mass variables. And is the only value which is approximated because of internal markets convergence from European Union and his regulation. We use this instrument since can provide a measure of predicted trade opportunities in the sense of search and match model (Antweiler, 2007). However, considering that distance is meant to represent the "trade discrepancy" as possibilities in the context of integration, the heuristic interpretation is stated in terms of "gravity flow interaction potential" i.e. transfer and communication.

The second mapping is used as an interpretation instrument and represent an application of a knowledge system to increase the quality of ontology architecture analysis. For this, we use a free open-source ontology editors; *Protege*[4] and *OWLGred*[5] to determine the flow of the known base described in *Protege.* The reason for which we use these programs is because it enable to share the application domain information using a common vocabulary instead of a code or a mathematical one to organized knowledge and to leverage the linked data. Second, the matrix represent dyadic relations between state members, and because his large volume it cannot be applied a *large-N* research -multicolinearity (Ebbinghaus, 2006; Masue et. al., 2013). However, the interpretation of ontology structure through data allow to identify the inconsistency and reason.

The difference which appear in application is that for the second matrix we introduce in *Protege* construction the European blue-chips stakeholders, with the porpoise to capture the markets vectors given by the perception about the economy evolution by most important companies from euro zone. In this stage for interpretation we imply the response factors with the aim to attribute to the model a reality approximation. Thus, the simulation can make a testing of reality where the dependence variables to be caught[6].

Figure 1 shows the ontology characteristics through list of the known-base metrics and his classes when the structure is setting to 28 members and institutions class. Thus, we express the functionality of organization through 12 relations properties and 8 actors properties. The aim of this is to assure an interpretative framework for European Union according with internal interface and to reveal the construction functionality.

[4] Note: the site for free download is http://protege.stanford.edu/
[5] Note: the site for free download is http://owlgred.lumii.lv/
[6] Note: the site for free download is https://www.w3.org/2002/07/owl#Thing which need to be open on *Protege.*

Figure 1. SPARQL Query and ontology metrics

subject	object
Non_euro_members	Members
Stackeholders	not (Institutions)
Stackeholders	E.U
Euro_zone_members	Members
Members	E.U
Secondary_stackholders	Stackeholders
Blue_chips	Stackeholders
Institutions	E.U
Euro_zone_members	'Coordinate their monetary policy-making through European institutions' some xsd:string
Primary_stackeholders	Stackeholders
Blue_chips	Euro_zone_members

Ontology metrics:

Metrics

Axiom	663
Logical axiom count	584
Declaration axioms count	56
Class count	9
Object property count	11
Data property count	7
Individual count	29
DL expressivity	SROIF(D)

Class axioms

SubClassOf	11
EquivalentClasses	5
DisjointClasses	2
GCI count	0
Hidden GCI Count	1

Object property axioms

SubObjectPropertyOf	3
EquivalentObjectProperties	0
InverseObjectProperties	1
DisjointObjectProperties	0
FunctionalObjectProperty	5
InverseFunctionalObjectProperty	1
TransitiveObjectProperty	1
SymmetricObjectProperty	2
AsymmetricObjectProperty	2
ReflexiveObjectProperty	0
IrrefexiveObjectProperty	0
ObjectPropertyDomain	15
ObjectPropertyRange	20
SubPropertyChainOf	0

Data property axioms

SubDataPropertyOf	3
EquivalentDataProperties	0
DisjointDataProperties	1
FunctionalDataProperty	5
DataPropertyDomain	8
DataPropertyRange	7

Individual axioms

ClassAssertion	29
ObjectPropertyAssertion	422
DataPropertyAssertion	40
NegativeObjectPropertyAssertion	0
NegativeDataPropertyAssertion	0
SameIndividual	0
DifferentIndividuals	1

Annotation axioms

AnnotationAssertion	21
AnnotationPropertyDomain	1
AnnotationPropertyRangeOf	1

Source: Author computation.

Figure 2. SPARQL and ontology metrics for large structure

subject	object
Health_care_equipment	Activity_domains
Technology	Activity_domains
Telecommunication_Market	Markets
Food_and_goods_Market	Markets
Non_euro_members	Members
Insurance	Activity_domains
Media	Activity_domains
Energy_Market	Markets
Estate_Market	Markets
Chemistry	Activity_domains
Euro_zone_members	Members
Activity_domains	E.U
Members	E.U
Secondary_stackholders	Stackeholders
Research_Market	Markets
Personal_and_household_goo	Activity_domains
Blue_chips	Stackeholders
Health_Market	Markets
Telecommunication	Activity_domains
Euro_zone_members	'Coordinate their monetary policy-making through European institutions' some xsd:string
Aerospace	Activity_domains
Auto_Market	Markets
Electric_utility	Activity_domains
Construction_and_materials	Activity_domains
Financial_Market	Markets
Food_and_beverage	Activity_domains
Stackeholders	not (Institutions)
Stackeholders	E.U
Goods_and_Services	Activity_domains
Petroleum	Activity_domains
Media_Market	Markets
Banking	Activity_domains
Markets	E.U
Retail	Activity_domains
Pharmaceutical_industry	Activity_domains
Automotive_industry	Activity_domains
Services_market	Markets
Institutions	E.U
Primary_stackeholders	Stackeholders
Logistics	Activity_domains
Blue_chips	Euro_zone_members
Real_estate	Activity_domains

Ontology metrics:

Metrics	
Axiom	978
Logical axiom count	806
Declaration axioms count	146
Class count	40
Object property count	18
Data property count	9
Individual count	79
DL expressivity	SROIF(D)

Class axioms	
SubClassOf	42
EquivalentClasses	16
DisjointClasses	2
GCI count	0
Hidden GCI Count	12

Object property axioms	
SubObjectPropertyOf	6
EquivalentObjectProperties	0
InverseObjectProperties	1
DisjointObjectProperties	0
FunctionalObjectProperty	8
InverseFunctionalObjectProperty	1
TransitiveObjectProperty	3
SymmetricObjectProperty	2
AsymmetricObjectProperty	3
ReflexiveObjectProperty	0
IrrefexiveObjectProperty	1
ObjectPropertyDomain	20
ObjectPropertyRange	26
SubPropertyChainOf	2

Data property axioms	
SubDataPropertyOf	3
EquivalentDataProperties	0
DisjointDataProperties	1
FunctionalDataProperty	7
DataPropertyDomain	10
DataPropertyRange	9

Individual axioms	
ClassAssertion	129
ObjectPropertyAssertion	473
DataPropertyAssertion	40
NegativeObjectPropertyAssertion	0
NegativeDataPropertyAssertion	0
SameIndividual	0
DifferentIndividuals	1

Annotation axioms	
AnnotationAssertion	24
AnnotationPropertyDomain	1
AnnotationPropertyRangeOf	1

Source: Author computation.

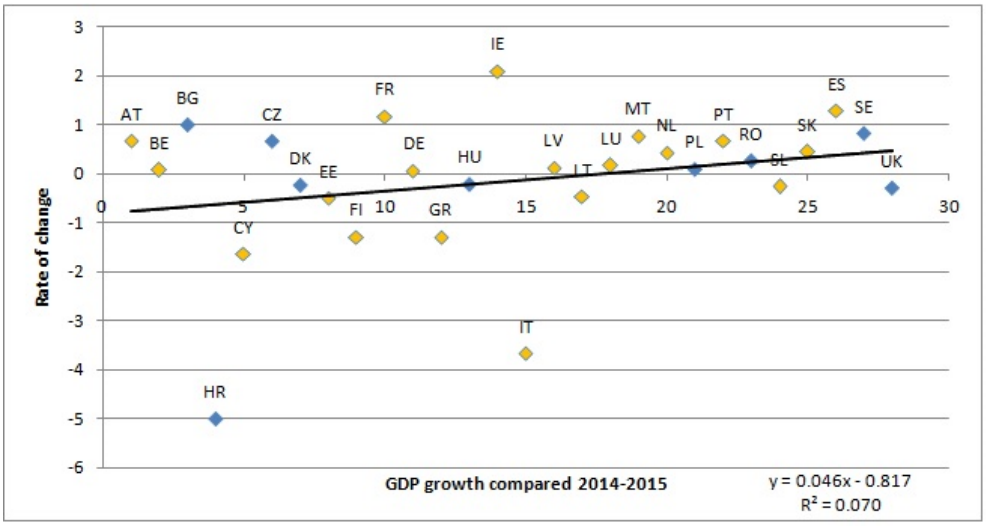
Figure 2 reveal an extensive knowledge base for the ontology in which we added the *blue chips stakeholders* as distinct individuals which are directly dependent to state members from eurozone. The relevance of this step is that he put in evidence the interface changes through implication of stakeholders on the substructure level. Second, determined how others type of actors react to the interface idiosyncrasy and how modify the construction through activity domains implications. However, the difference of new links is weak, which highlight a possible discrepancy between real interconnectivity on the European Union level and interaction framework. In both cases the particularization of actors was made on the low level due to high time period of study required and lack of theoretic instruments which to assure the interpretation of all objects.

3. Data representation and discussion

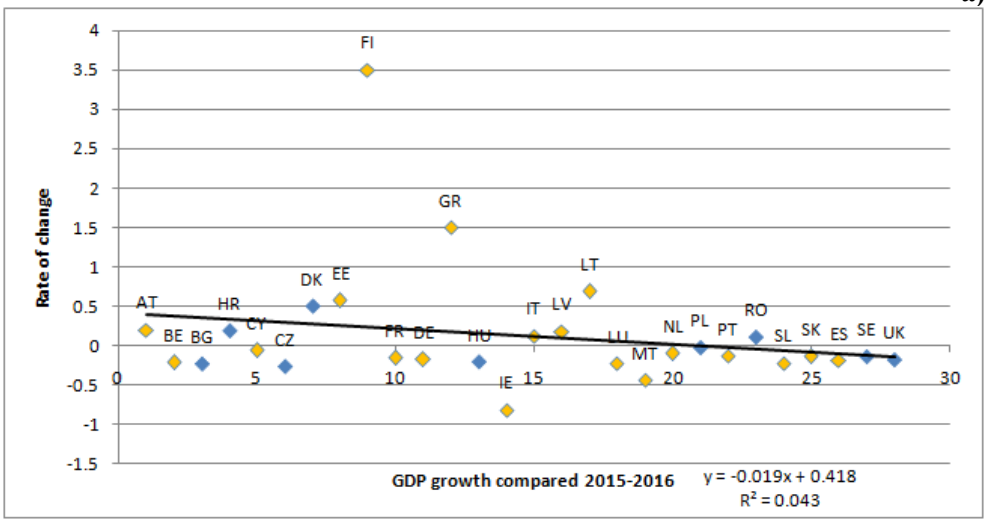
We begin this part with a short discussion of linked between rate changes with GDP compared in European Union. The aim is to reveal some variations

which can results from the goodness of fit from economic mass. Hence, we analyse the GDP difference to highlight the grown trends of the non-euro zone in rapport with eurozone members.

Figure 3. GDP linear regression for the two periods: a) 2014-2015; b) 2015-2016.



a)



b)

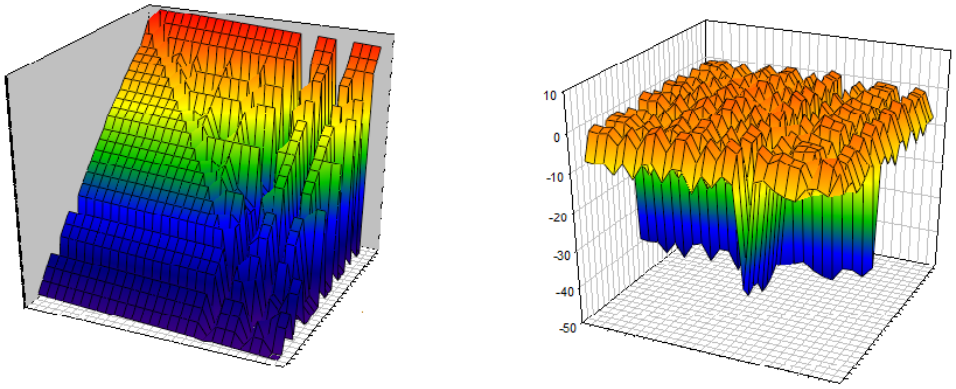
Source: Author calculation based on Eurostat.

In first figure, regression has been spread on the European Union level, as is illustrated. However, the rate of change indicate a strong correlation between returns and goodness of fit, nevertheless exist some marginal states which are spacers loud by the group. For the second period -figure from the right - the regression indicate a low correlation, and a tendency from the non-euro members to approximation quickly to eurozone. However, Finland and Greece maintain a relatively distance knowing a growth in change volume. Thus, the relationship between GDP growth and rate of change has decreased face to previous period. However, in the period 2015-2016, the R- square known a dropped from 0.07 to 0.043 which present an alteration in the variability interpretation of the response data around of change in the predictor.

This discussion show that goodness of fit known in a short period of time two different trends which describe a process which make a link between non-euro and euro zone - in difference terms- to pas from a relatively approximation to discrepancy in a very short time.

The second mapping search to express the matrix values through ontology construction in the aim to develop explication with large sense about the structure resilience for the pairs period 2014-2015 and 2015-2016. For this step the methodology consist by overlapping the matrix over ontology and after that to interpret the results. Therefore, we start with the first time pair 2014-2015.

Figure 4. European Union knowledge- matrix plot for 2014-2015[7]



a) Surface for the economic matrix perspective b) Interaction opportunities surface

Source: Author computation's based on Eurostat and IMF.

Imagine a) represent the economic outlook of European Union through knowing base. As showed in surface plot, the performance of the European Union

[7] Note: for figure a) the gravitational constant is set to 0.0801 on standard deviation based on *Euro Stoxx 50* Index. In the second graph, for discussion the e*conomic policy uncertainty* value is set to 156.93 as median estimate between averages for every period: 2014; 2015.

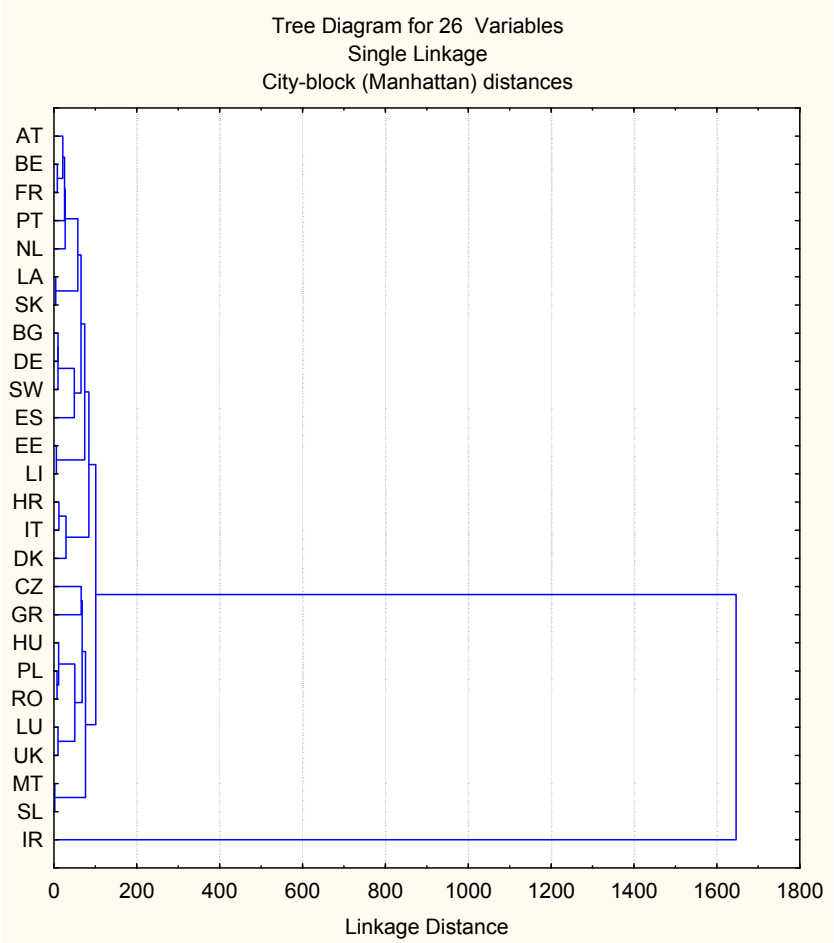
members create some high variations on the interface level. However, the rate change of GDP on this period is possible to hide these fluctuations from surface. In accordance with figure 3 for the same period of time, the sources of these represent a reactions chain among members who known a lower changes in this period. If the resilience was strong in this period, then the values of variations need to know a decrease trend, instead the structure imagine show us the contrary.

The second imagine from the figure 4, shows how the economic perspective affect through variation degree the interaction between state members and stakeholders. What result is that the effects are not only depth -in sensitivity terms- but also in shift-as gaps-. Namely the GDP trends mask a sensitivity increase on the European Union level which can be translated in a rugged environment for the actors. On this period of time, the idiosyncrasies represent a random distribution of sources for the state alteration. The group evaluation suggest the existence of a significant divergence among members on structure level in terms of relative magnitude.

For the surface interpretation from the figure 4 we use the *explanatory data analysis* to be able to identify the systemic relations between variables when we do not have an expectations about the nature of relations. The difference by the general approach consist in the fact that similarities between variables are expressed in the correlation matrix face to distance between investigated objects. In special we use the hierarchical cluster analysis method as an alternative for factor analysis to identify and to measure the patterns from multivariate data sets. In accordance with this theoretical framework, for the surface 4a we have:

In figure 5, the variables (state members) are reorganized in an efficient manner described on the “similarity distance” values from the basic matrix set. More technical, the reorganization consist from evaluation of different configurations following to maximizing the goodness fit. Is simply to observe a structure compounded from three groups of states, with a low distance between members and a poor links set. However, clusters value are very closeness. The group which have the most closeness degree is the upper pair for which the structure characterization as similarities is more intense than for the rest. The Austria, Belgium and France it look likes to be more connected each other face to relations with others. Is interesting that Germany (DE) is more nearest from Sweden and Bulgarian than for other “core members” on the structure level. In this case, the closeness can be translated in agreements or in a better understanding of the partners. On the bound limit is Ireland who known the higher discrepancy in terms of similarities in relations whit the rest of members. Nevertheless, is the only state which possess a direct link as individual with two different groups. However, the clusters interpretation show a concerning difference among members for this period which from integration process need to presents more similarities between themes.

Figure 5. Dendrogram for the economic matrix perspective 2014-15 from fig. 4a

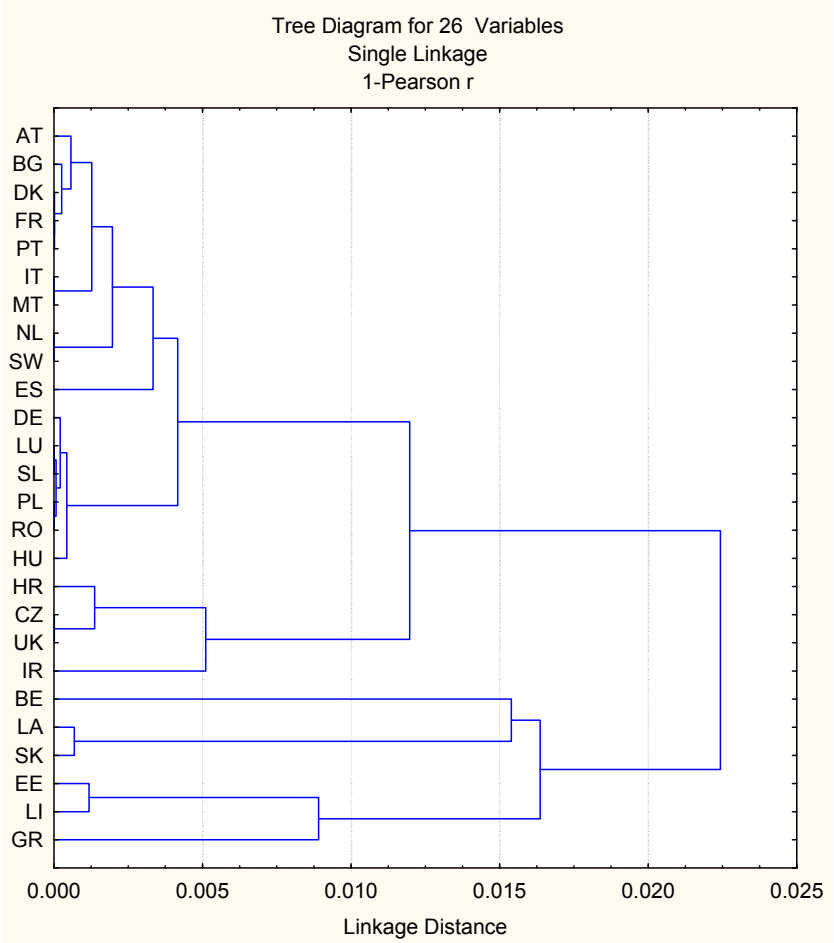


Source: Author computation based on surface for the economic matrix perspective (fig. 4a) which values results from model in page 5-6. For the interpretation, the author use *Statistica* software.

Note, we extract from the prospection the Finland and Cyprus due lack of data in matrix. However this omission do not affect the quality of the interpretation because the data do not create any link.

To deepen the analyse we make a Pearson measure to reveal the linear dependence between variables.

Figure 6. Pearson measure economy clusters

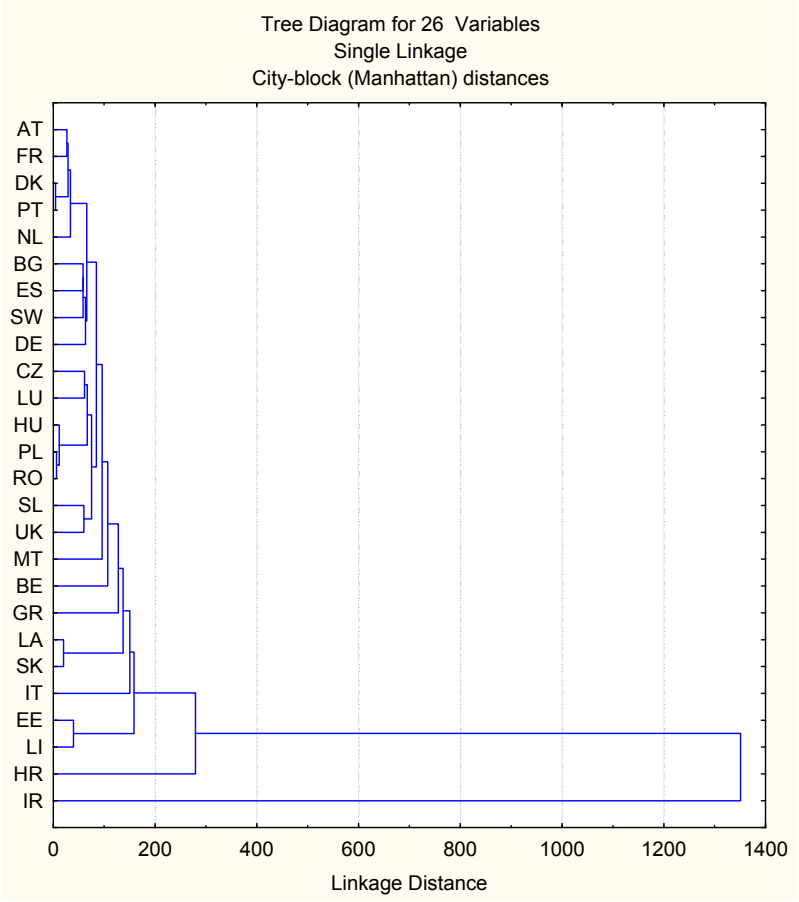


Source: Author computation based on dendrogram from figure 5. For the interpretation, the author use *Statistica* software.

In our case, the correlation coefficient show a very weak positive association, however the values from 0 are too small -under 0.3-. Therefore, the central tendency reveal a weak information about the members distribution in the organization interface, with other words, the changes that some correlations between members in structure to exist is very low. Thus, the continuity of interrelations on this state, will produce low effects size or changes in members movements. And exist a high possibility that changes in variable do not cause the changes in same directions for the state from the members perspective.

For the surface from the figure 4b, the clusters representation will express through next figure:

Figure 7. Dendrogram for interaction opportunity surface 2014-2015 from figure 4b



Source: Author computation based on surface from the Interaction opportunities surface (fig. 4b) which values results from model in page 5-6. For the interpretation, the author use *Statistica* software.

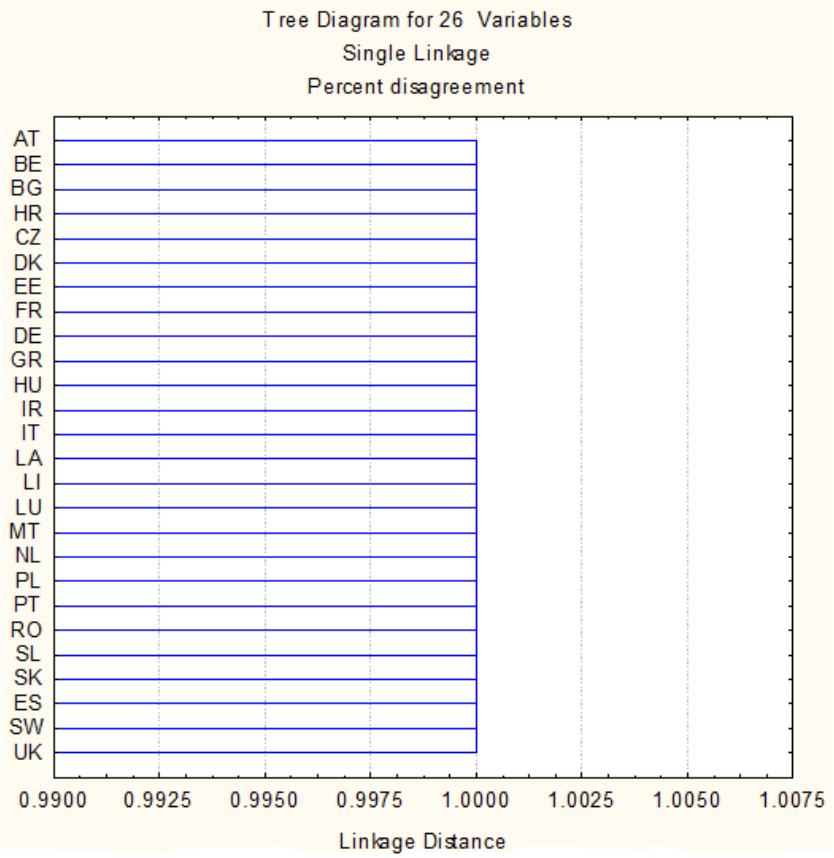
In the computing process we use the same theoretical framework as for previously representation but with the adding of one dependence variable-integration index.

The first major difference is that the groups partition disappear, instead of this, the structure known a cascade form in which the similarities between members rise ascending. The second difference is the improvement of the relations set through increasing it's with new links. However, the clusters value reveal a decrease of closeness and the shape indicate lack of the direct distances between pairs of members. With other words, the members perceive the closeness between them from the perspective of similarity from the reporting view to different dyadic

or triadic groups. And known a spacers between them in the organizational framework. Through this, we can conclude that the reporting to the core from convergence perspective it's made by the members utilized the social reports of the most closeness groups, create through this a sharing preference trend. And the lacks of possibility to recognize the partners as a closeness tendencies rise the uncertainty degree, degrease the centrality, and sustain the contraction on the group level.

The measurement of the linear dependence between variables in this case reveal a *perfect* case, values are 1, therefore are treated as non-meaning.

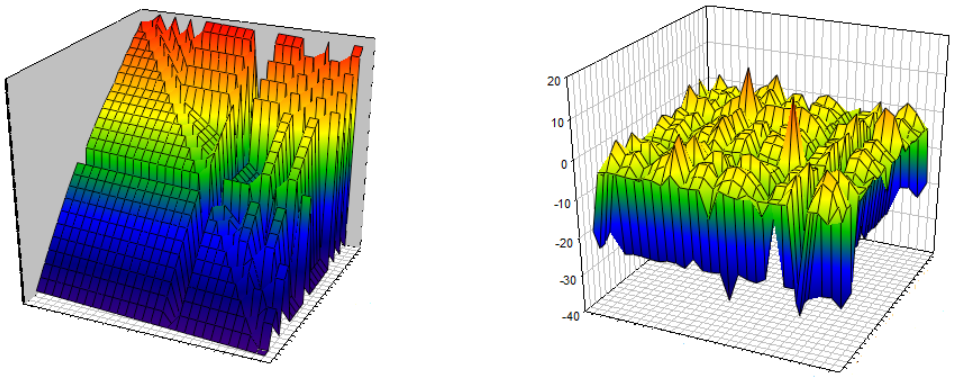
Figure 8. Pearson measure for interaction opportunity surface



Source: Author computation based on dendrogram from figure 7. For the interpretation, the author use *Statistica* software.

For the second time period of time 2015-2016, the matrix interpretation through knowledge base reveal the next surfaces:

Figure 9. European Union knowledge- matrix plot for 2015-2016[8].



a) Surface for the economic matrix perspective b) Interaction opportunities surface
Source: Author computation's based on Eurostat and appsso.eurostat.

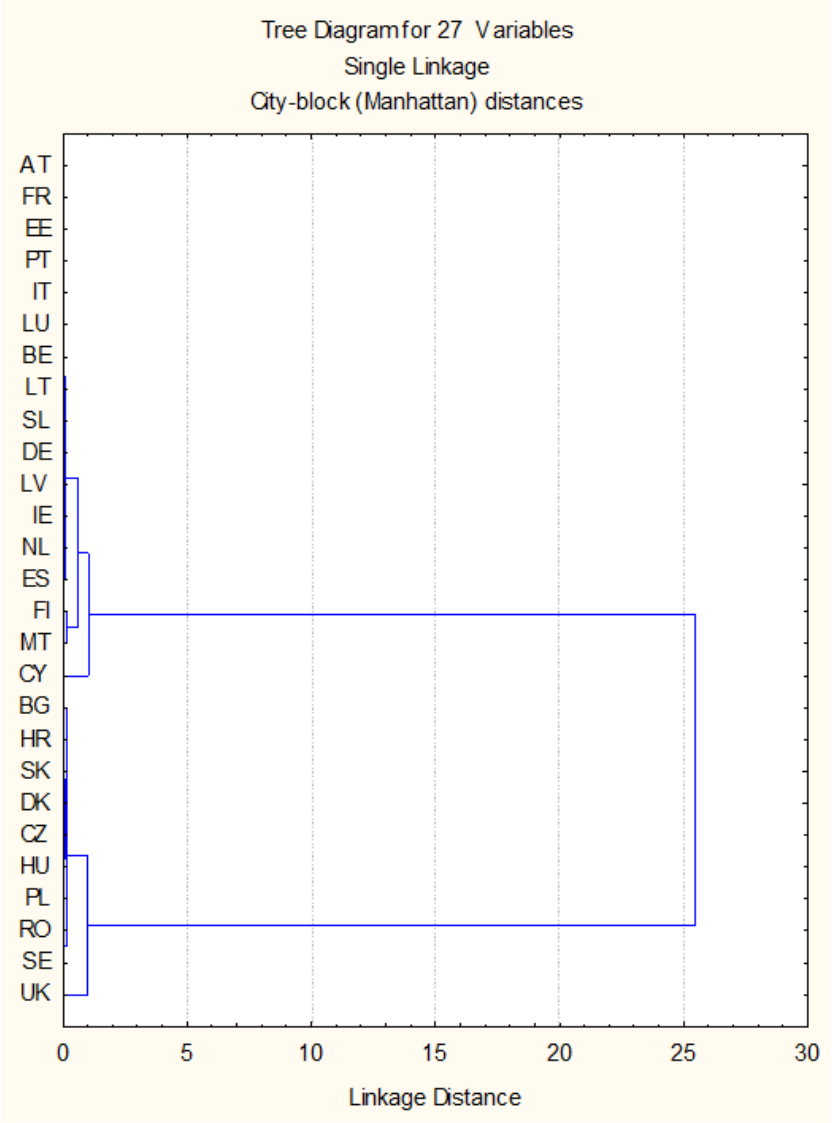
As showed in surface plot from figure a), the performance of the European Union members continue to maintain the previous variation on the interface level. An interesting change in plot is replacement of the Finland and Cyprus with Greece –the gap from surface-. However, the low correlation for this period put in evidence the surface waves and show the links of this with previous period of time. In accordance with figure 3 for this period, the variation sources indicate a perpetuation which remain among actors and conduct to a tension state.

The second imagine, shows a more dynamic interaction in the structure despite of the sensitivity degree. We can conclude that situation continuity create an environment where the actors they were forced to act. Namely the GDP regression change disclosed the hidden vulnerabilities on the European Union structures for the evolution, and which can be interpreted as a static state which contain trends spacers. For this period, the social idiosyncrasies describe a source distribution for complaints which conduct to open manifestation of divergence.

Following the above methodology regard to surface interpretation, we start first to construct and analyse the clusters for the surface 8 a.

[8] Note: for figure a) the gravitational constant value is set to 0.0822 on standard deviation based on *Euro Stoxx 50* Index. In the second graph, for discussion the e*conomic policy uncertainty* value is set to 200.93 as median estimate between averages for every period: 2015; 2016.

Figure 10. Dendrogram for the economic surface 2015-2016

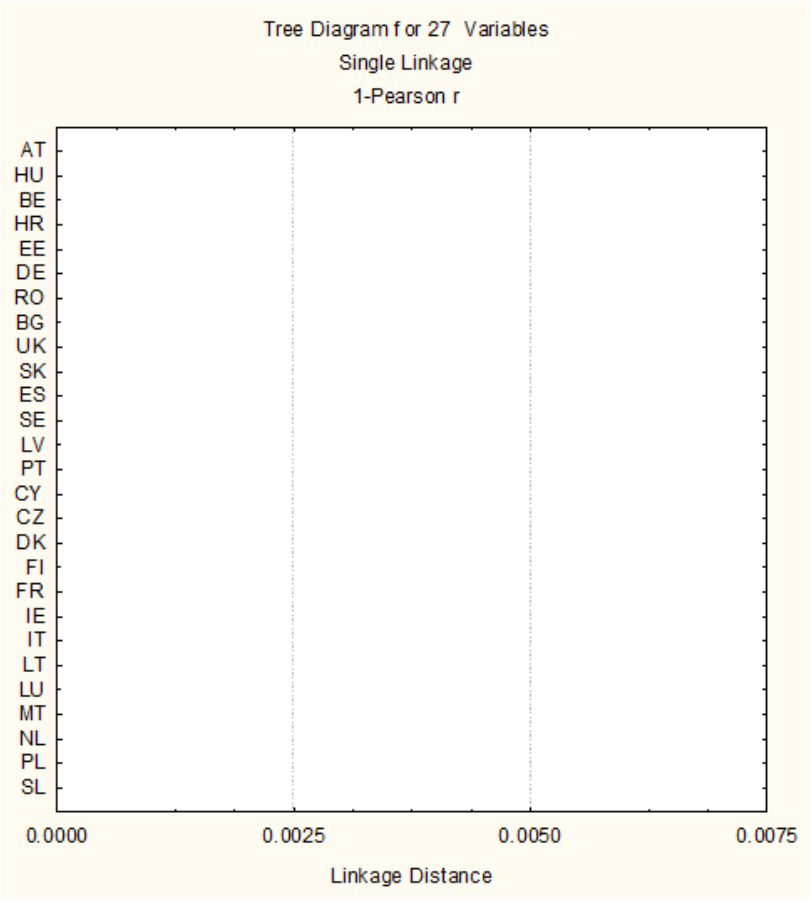


Source: Author computation based on surface from the surface for the economic matrix perspective (fig. 9a) which values results from model in page 5-6. For the interpretation, the author use *Statistica* software.

Note, we extract from the prospection Greece due lack of data in matrix, this omission do not affect the quality of the interpretation because the lacks are not related with any link.

The clusters construction identify two distinct homogenous groups of cases, first group contain the eurozone members, and the second the non-euro members, they known a high discrepancy quantified in dissimilarities. This difference show a deep spacers for this period compared with the previous surface which have three groups instead of two, and with a better understanding of partners on the structure level. Instead, for the economic surface 2015-2016 the members are more connected one with another on the groups level but with an alarming difference on block perception.

Figure 11. Pearson measure for economy clusters.



Source: Author computation based on dendrogram from figure 10. For the interpretation, the author use *Statistica* software.

Both groups shows a "core" in terms of similarities proximity among members, which conduct to considered on the resilience discussion just the clusters

which are rooted in the "cores". The importance of this is revealed in solution terms whose branches are very close together and probably are the most reliable. For a problem of this size the solution is clear need to be searched in the distinct groups, this approach is sustained by the dendrogram that indicates that the clusters formed around groups which known a more integrated process are probably doing a good interaction on the structure level. However, the dendrogram interpretation show us a European Union with two speeds due to the difference of evolution among members in integration process.

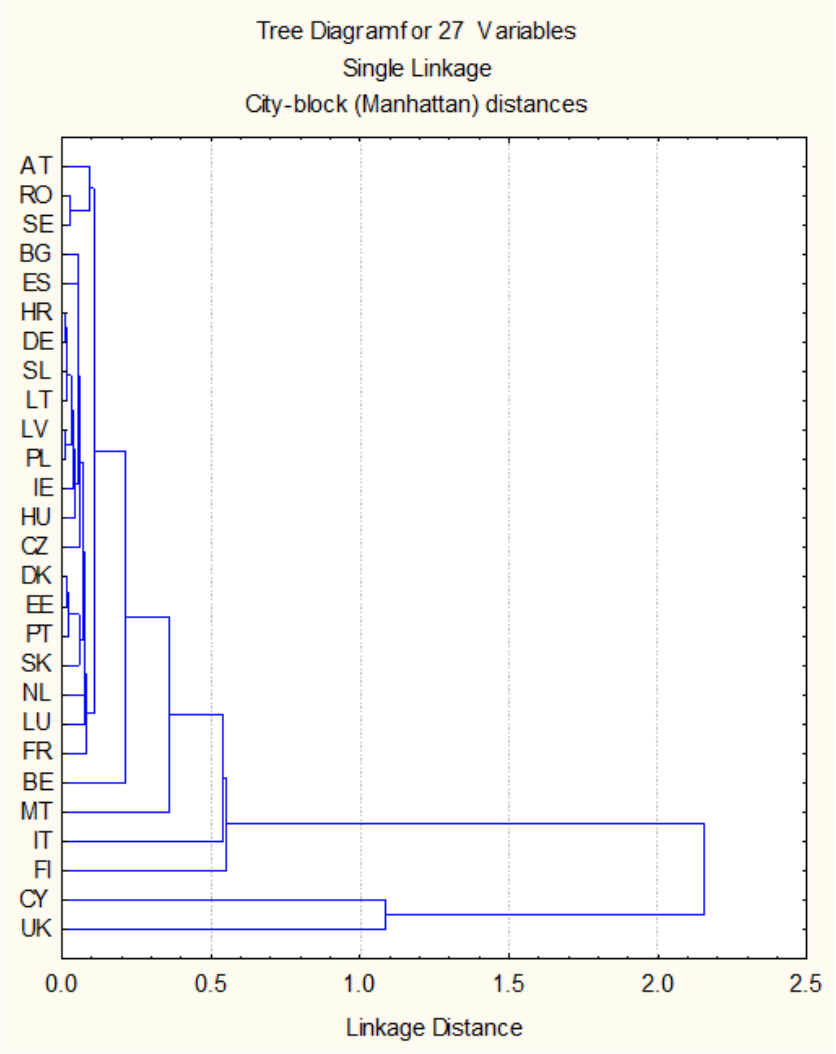
Now, we make a Pearson measure to reveal the linear dependence between variables in dendrogram construction for the economic surface.

In this case, the Pearson measurement denotes no linear correlations, thing that denote that $r - 0$ and there do not exist relations between the variables or that is very weak and his not important to be mentioned. Thus, the changes in actors similarities are not correlated with the changes in sensitive distribution.

In the case of the figure 9b, the cluster representation is expressed through next figure (see fig. 12).

This dendrogram reveal some resemblance on interaction surface with the equivalence diagram from 2014-2015. Firs, shows an improvement of the similarities set among members despite of discrepancy which exist on the structure level. In the second way, the distances become much smaller which describe a tendency in interaction and to act in same direction, this trend highlights the approximate same understanding of the environment and of the structure state. Last, the blocks are replaced with a more links on the same level as distance values. Interpreted through figure 11, the interaction dendrogram put in evidence the need of actors to identify the opportunities in the social activity despite of groups sensitivity. For this, they can search common points which can close them in order to assure the continuity of the social process. However, the shape reveal the maintaining perspective by the members to perceive the closeness between them through approach of different dyadic or triadic groups and not directly.

Figure 12. Dendrogram for interaction opportunity surface 2015-2016

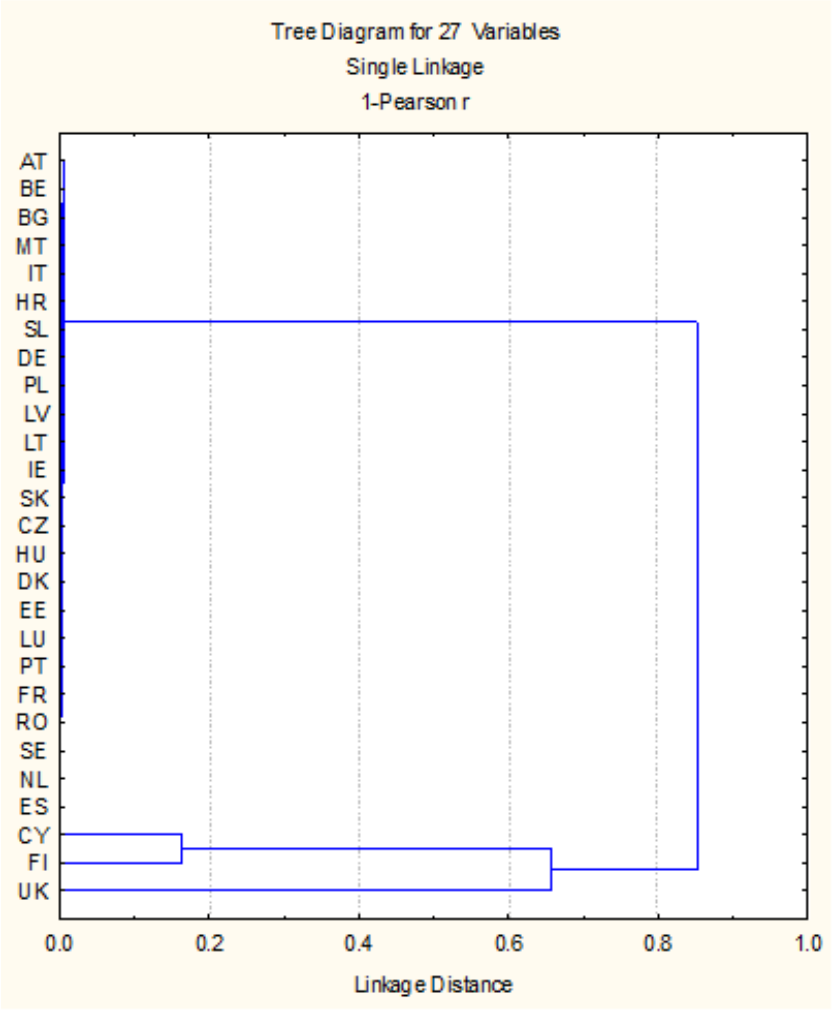


Source: Author computation based on surface from the interaction opportunities surface (fig. 9b) which values results from model in page 5-6. For the interpretation, the author use *Statistica* software.

Therefore, the convergence continue to present a social process in which the actors use the most closeness groups to get closer by other groups. Despite of Greece crises in this period, Cyprus and United Kingdom become the states who known the most increasing removal from the group members followed by Finland and Italy.

For this dendrogram the Pearson's correlation coefficient denote a positive linear correlation.

Figure 13. Pearson measure for economy clusters.



Source: Author computation based on dendrogram from figure 12. For the interpretation, the author use *Statistica* software.

However, the state members which are most closeness in figure 12 in Pearson measurement shows a very weak relation between integration variable and similarities. Instead the United Kingdom with the Cyprus and Finland as a group, denote a strong correlation between variables, the only difficulty is that the last two countries known like others the same very weak value which create some

uncertainty for United Kingdom in relationship with others members. Last, because the majority are instable the strong relationship with United Kingdom it is also uncertain in terms of correlations.

Limitations.

It is important to acknowledge that further interpretative models are required in attempt to explain the correlation between dynamic trends and data meaning. Furthermore, more advance methodologies are needed to cope with the complexity of ontology construction which leading to the necessity of more data as in-put in matrix to increase the mapping accuracy and outcomes.

Conclusions and remarks

This paper is an attempt to deep our understanding of European Union resilience on structural challenge, which is an important process concern. To start off, we quantify the theoretical framework and data using two distinct instruments: gravitational model and ontology mapping. We show that there is sufficient correlation, both across theoretical framework and across instruments, to warrant analysis of these database through knowledge-based interpretation. Following recent literature arguing that resilience analysis may point the organization behavior under different events, we look at structure dynamics. The major contributions of this paper thus consists of the development of a comprehensive set of resilience estimates for European Union in a time period characterized through static state using an Artificial Intelligence mapping.

Interpreting the resilience estimates for European Union through surface surveillance and clusters dendrograms, we highlight how members adaptation to the asymmetric challenges influences the organization response to the vulnerabilities. The results of dendrograms show that members tend to use the integration as a mechanism in the structure and the positioning in this consist in reporting to the groups similarities instead of organization culture. We also find that the organization is prone to mask bouts sources during members evolution when the vectors direction are the same. The results of Pearson measurements for the members grouping on structure suggest that there can be significant variations on connectivity in a delimited horizon of time, these reveal the turmoil degree of the construction to different situations. The resilience patterns assigned in European Union structure, both manifestation over time periods and relative protective factors, do not necessary hold on members level, but the inverse is valid. These asymmetries underscore the necessity of resilience analysis for each individual and groups from organization.

Our surveillance for European Union resilience can be useful for future studies on this issue, in special as far as members influence in structure adaptation analysis is concerned, since there exist a high degree of heterogeneity across members. Future mapping could aim more informing about different aspects of

political process and relationship between state members and stakeholders. This analysis could be thorough by develop the knowledge- based with more information and interpretative instruments to study the linkages between data input on ontology.

Acknowledgment: This work was conducted using the Protégé resource, which is supported by grant GM10331601 from the National Institute of General Medical Sciences of the United States National Institutes of Health**.**

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