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European Union's research and innovation performances under the impact of the economic crisis

Victor-Romeo IONESCU[1]

[1]*Danubius University of Galati, Department of Economics, romeo.v.ionescu@univ-danubius.ro*

Abstract. The paper deals with the analysis of the R&D and innovation activities' impact on the sustainable economic development. There are two approaches of this phenomenon: national and regional. The main objective of the paper is to quantify and measure the disparities between the Member States and to define their trend until 2020. The analysis in the paper is built on three steps: a regression under ANOVA table in order to establish the R&D and innovation disparities across EU28, a cluster analysis used to group the Member States into distinct clusters and a forecast of the gross domestic expenditure on R&D as % of GDP during 2014-2020. The whole analysis and all its results are supported by the latest official statistic data and pertinent tables and diagrams. The main conclusion of the paper is that EU28 is not the best competitor on the global R&D and innovation market. Moreover, there are great disparities between the Member States and European regions connected to their innovative capacities. And the forecast for 2020 is not a positive one.

Keywords: sustainable development, Innovation Union Scoreboard, innovation disparities, innovation clusters.

1 Introduction

One of the most important components of the contemporary modern economies is the implementation of the research and technical progress in the economic processes. This process asks for great expenditures which are financed by the public or private budgets. Moreover, the competition between the greatest global economic actors moved on research and innovation performances.

This is why the new Europe 2020 Strategy is focused on three mutually reinforcing priorities: smart growth (developing an economy based on knowledge and innovation), sustainable growth (promoting a more resource efficient, greener and more competitive economy) and inclusive growth (fostering a high-employment economy delivering social and territorial cohesion) (European Commission, 2010).

In a global context, USA, Japan and South Korea have the greatest performances in innovation systems. EU28 ranks lower position than the above three competitors, but better than Australia, Canada and China (see Figure 1).

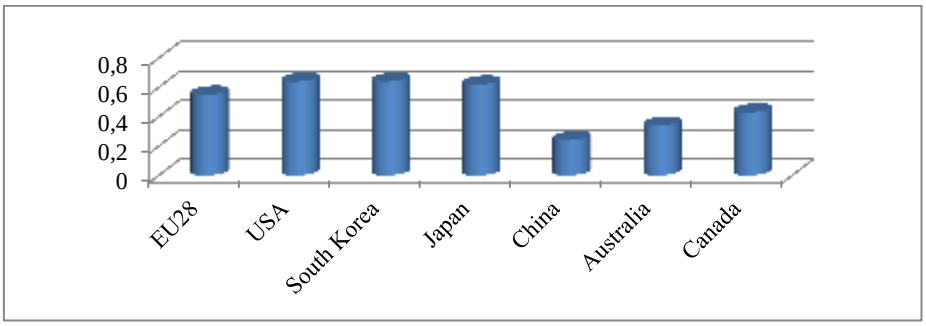


Figure 1 Innovation performance at the beginning of 2014 (%)
Source: personal contribution

The innovation performances presented in Figure 1 are quantified using the following indicators: R&D expenditures in the business sector, public-private co-publications and PCT but also in educational attainment as measured by the share of population having completed tertiary education.

2 Related Work

The impact of the innovation and research on economic development was studied in a lot of scientific papers. The common conclusion of these papers is that research and innovation are the only instruments able to support sustainable socio-economic development and world welfare.

As a result, the target of the business sector has to be the development of new and innovative goods and services able to generate economic growth. Moreover, this economic growth has to bring socio-economic benefits to the society (Ahlstrom D., 2010).

Other researches are focused on the connection between innovation and economic prosperity. In order to do this, there were necessary retrospective and prospective analyses in order to quantify new advances in education, health care and communications. The outputs of these analyses represented the base for policy recommendations designed to encourage an innovation economy. As a result, some specific political measures were implemented: a permanent research and development tax credit, more effective university knowledge commercialization, improving STEM worker training, reasonable immigration reform and regional economic clusters. All these elements can support an innovation economy and sustain long-term prosperity (West D.M., 2011).

European Union, as important global economic actor, understood the importance of creating a European knowledge area in order to sustain and develop the socio-economic prosperity. Moreover, in the context of the global economic resources decreasing, the most powerful resources for the EU become knowledge and the power to innovate. This is why EU tries to become a global technical innovator (EAIHE&UASN, 2012).

The European Commission tried to quantify the innovation capacity of each Member or Associated State, in order to identify innovation leaders. This analysis was supported by pertinent statistical tables and diagrams. The conclusions of this research supported the idea of great disparities between the innovation systems in the Member States. Moreover, the research showed the challenges each country is facing and the innovation opportunities. The target of the EU is to transform itself into a knowledge-based Innovation Union (European Commission, 2013).

Last, but not the least, the research and innovation performance is quantified across the G20. The analysis used the total number of basic patents (inventions) published from each national office and the ratio of national basics to all basics. A similar analysis was performed to determine the major areas of innovation for each region in comparison to global innovation (Gaze L.& Breen J. (2013).

3 Problem Statement

The analysis in this paper is built on three levels. The first level is a comparative analysis between the EU28 Member States and regions, in order to point out the innovation disparities. In order to do it, we used regression under ANOVA table. The dependent variables were the innovation performance's scores for all analysed countries and regions, while the independent variable was time.

The second level of the analysis is the cluster one, which is focused on the idea of dividing the Member States and regions into different clusters and on the idea of the innovation disparities' increase, as well. The TwoStep cluster analysis used the Euclidean distance measure and Schwarz's Bayesian Criterion as clustering criterion. The number of clusters was fixed to four.

The third level of the analysis deals with a forecast of the gross domestic expenditure on R&D as % of GDP during 2014-2020. The forecast is supported by the SPSS software under ARIMA method, where the dependent variables are the gross domestic expenditures on R&D in all Member States and the independent variable is time.

The whole analysis and its conclusions are supported by pertinent statistical tables and diagrams built on the latest official statistic data.

4 Analysis of results

European Commission succeeded in using 25 indicators in order to quantify the Innovation Union Scoreboard (IUS). These indicators were grouped into three categories: enablers, firm activities and outputs (see Figure 2).

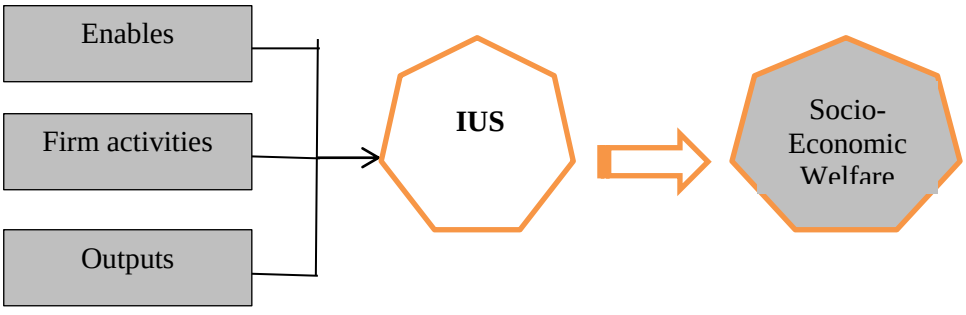


Figure 2 Concept of Innovation Union Scoreboard (IUS)

Source: personal contribution

The Enablers cover three innovation dimensions: human resources; open, excellent and attractive research systems and finance and support. Firm activities quantifies: firm investments; linkages&entrepreneurship and intellectual assets. Finally, the Outputs are focused on: innovators and economic effects (European Commission, IUS, 2014).

The EU Member States' innovation performances are presented in Table 1.

Table 1 Innovation performances in 2013

State	Innovation score	State	Innovation score	State	Innovation score
Bulgaria	0.19	Latvia	0.25	Romania	0.28
Poland	0.30	Lithuania	0.31	Croatia	0.32
Malta	0.33	Slovakia	0.34	Hungary	0.35
Greece	0.40	Portugal	0.45	Spain	0.45
Czech Rep.	0.46	Italy	0.47	Cyprus	0.50
Estonia	0.50	Slovenia	0.50	France	0.55
Austria	0.60	Ireland	0.65	UK	0.66
Belgium	0.68	Netherlands	0.68	Luxembourg	0.69
Finland	0.71	Germany	0.73	Denmark	0.74
Sweden	0.76				

Source: European Union, 2014, p.2.

Using Table 1, the regression analysis shows the disparities between the Member States, according to IUS (see Figure 3).

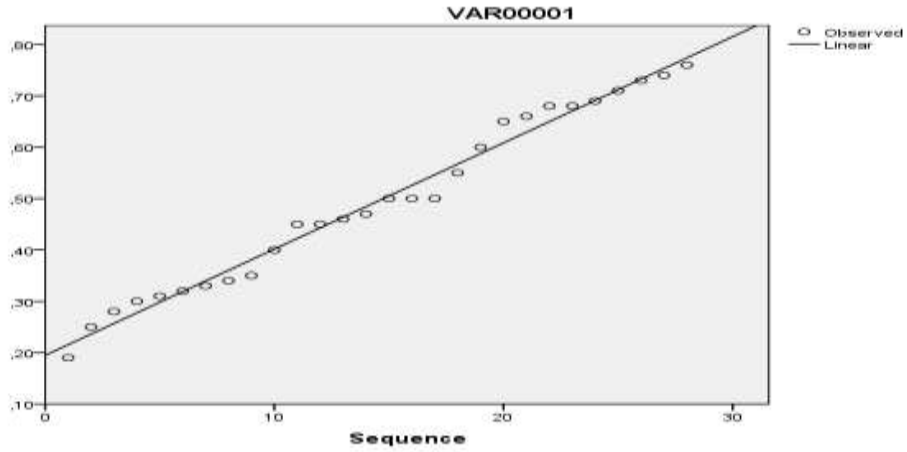


Figure 3 Innovation Union Scoreboard's disparities across the EU28
Source: personal contribution

According to Figure 3 and under the European Commission's approach, the EU28 can be divided into four clusters: innovation leaders (Denmark, Finland, Germany and Sweden) with innovation performances above the EU28 average; innovation followers (Austria, Belgium, Cyprus, Estonia, France, Ireland, Luxembourg, Netherlands, Slovenia and UK) with innovation performances close to the EU28 average; moderate innovators (Croatia, Czech Republic, Greece, Hungary, Italy, Lithuania, Malta, Poland, Portugal, Slovakia and Spain) with innovation performances lower than the EU28

average; and modest innovators (Bulgaria, Latvia and Romania) with innovation performances well lower than the EU28 average.

In order to point out the viability of the above cluster division, we used the cluster analysis. The results of this analysis are presented in Figure 4. We can observe that the cluster division is good.

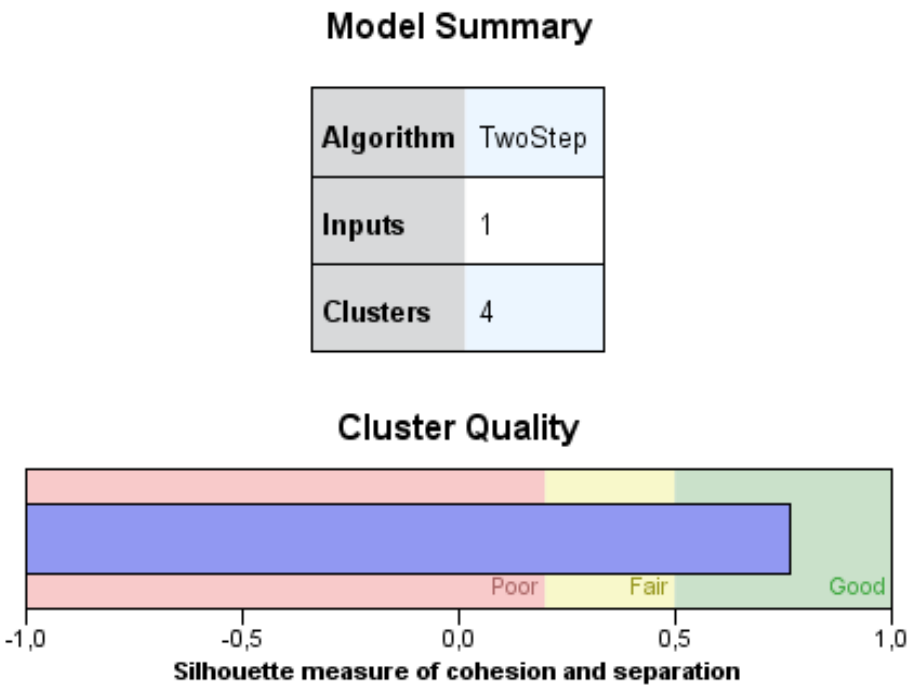


Figure 4 Cluster analysis
Source: personal contribution

The same situation seems to be at regional level. The latest regional innovation research made by the EU had as result the map of the innovation regions (see Figure 5).

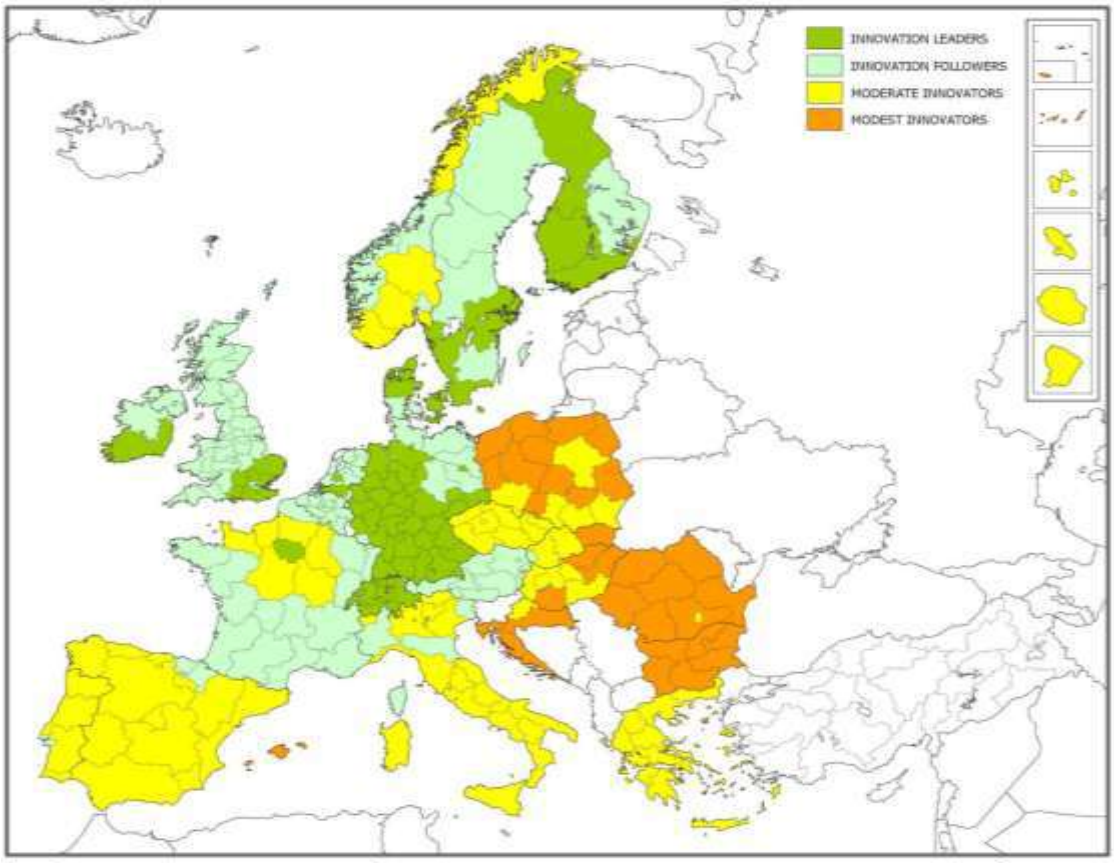


Figure 5 Innovation regions
Source: European Commission, RIS, 2014, p.2.

According to Figure 5, the above four clusters grouping is available at regional level, as well. As a result, there are: 34 innovation leader regions, 57 innovation followers regions, 68 moderate innovator regions and 31 modest innovator regions. Moreover, the most innovative European regions are placed in the most innovative Member States. Denmark, Germany, Finland, France, Ireland, Netherlands, Sweden and UK cover almost all innovation leader regions (27 from 34 regions).

The innovative economic processes have to be followed by important financial supports. As a result, a very important indicator is the gross domestic expenditure on R&D as % of GDP. According to this indicator, EU28 has worst rank than USA, Japan and South Korea (see Figure 6).

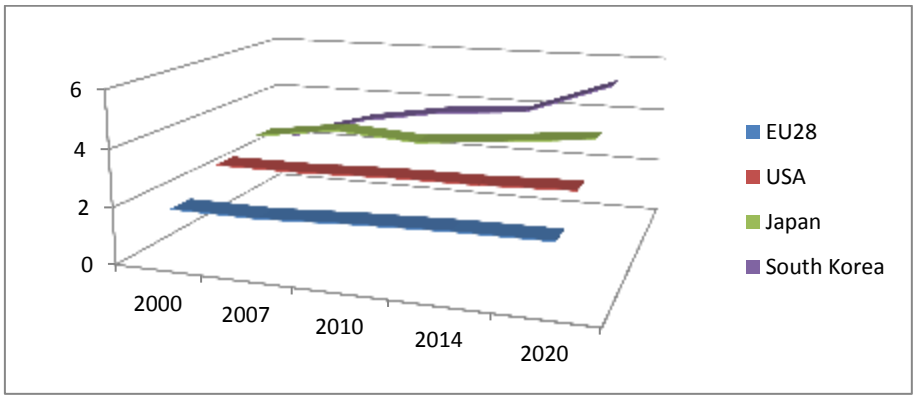
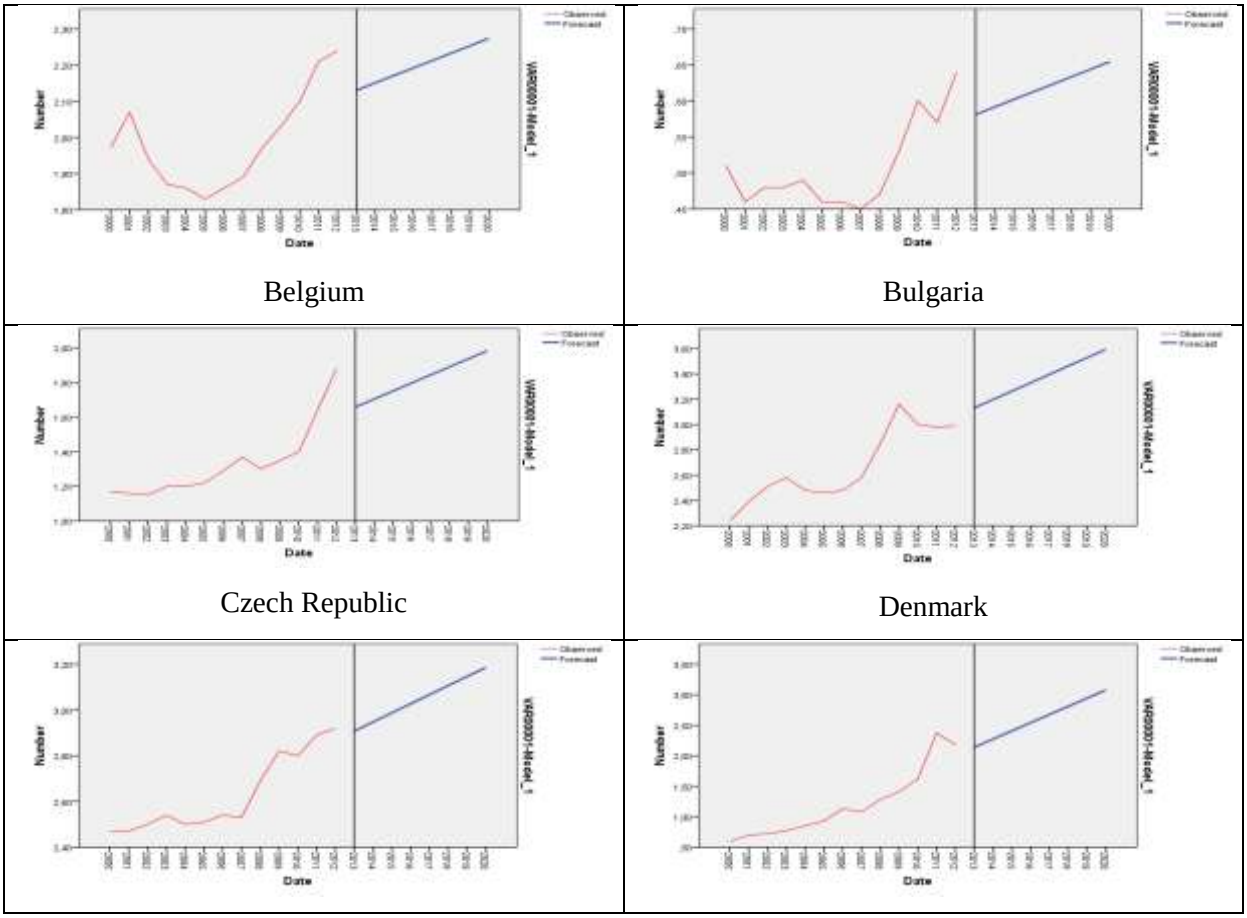
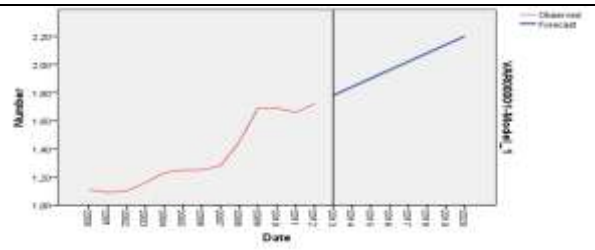
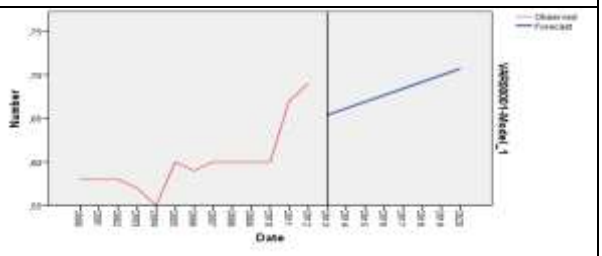
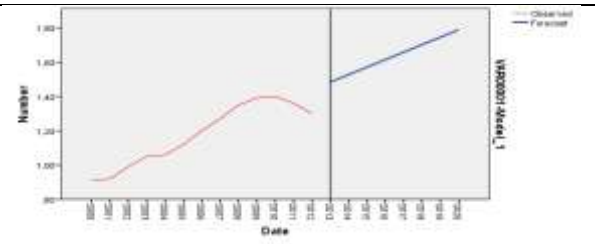
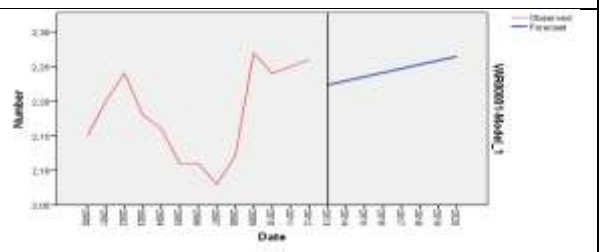
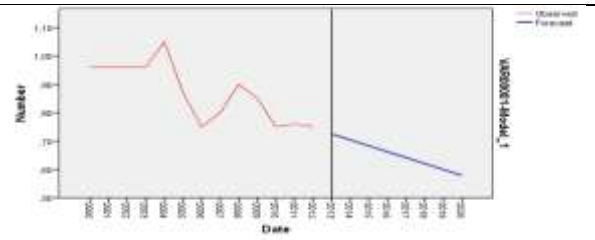
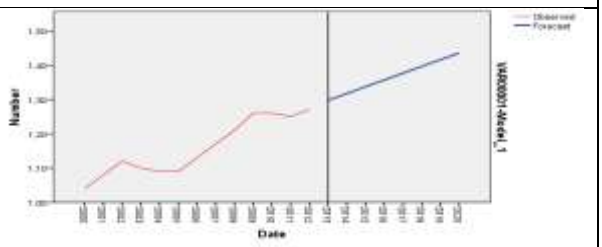
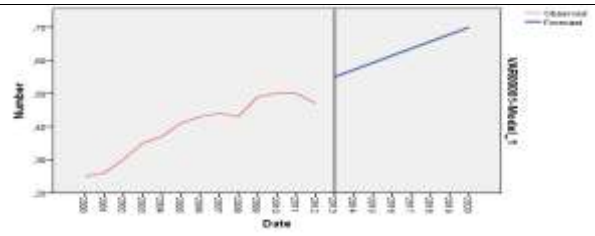
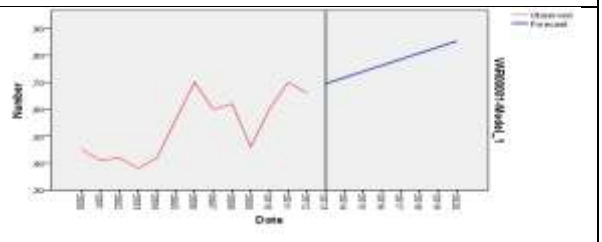
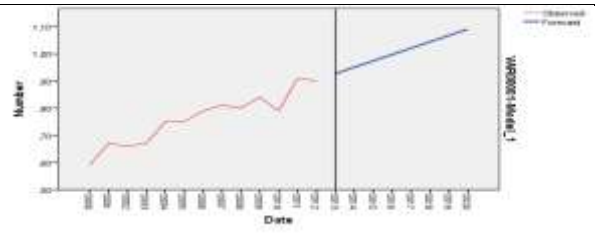
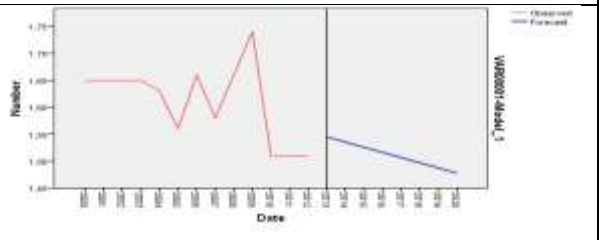


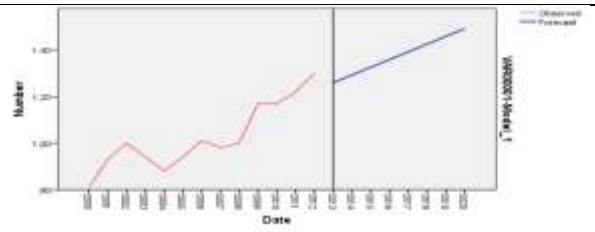
Figure 6 Gross domestic expenditure on R&D (% of GDP)
Source: personal contribution

The disparities in Figure 6 will increase in 2020. While EU28 and USA will achieve low increase rates, Japan and South Korea will focused on important increases of the gross domestic expenditures on R&D.

The next step of the analysis is to forecast the gross domestic expenditures on R&D in all Member States and to demonstrate that the initial cluster grouping will be available in 2020 as in 2014. The forecast is based on the latest official statistic data (Eurostat, 2014).



Germany	Estonia
 Ireland	 Greece
 Spain	 France
 Croatia	 Italy
 Cyprus	 Latvia
 Lithuania	 Luxembourg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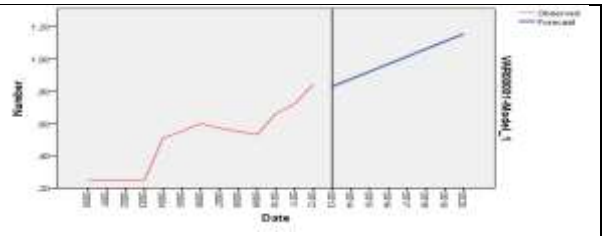
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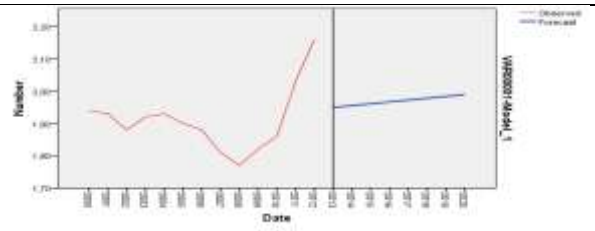
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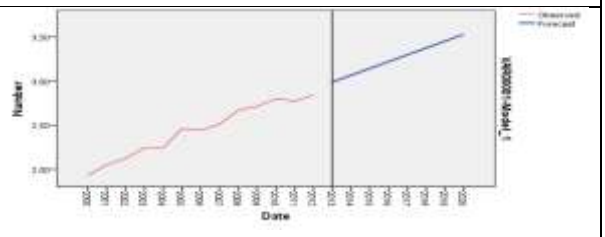
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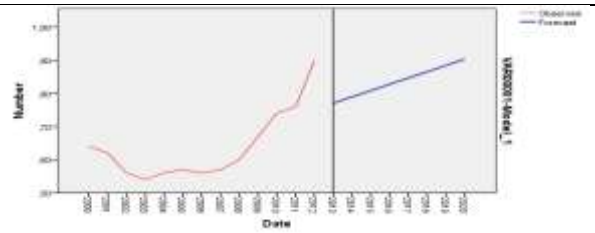
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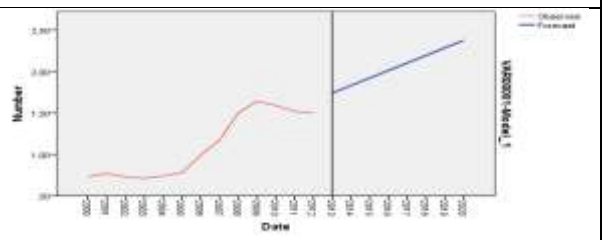
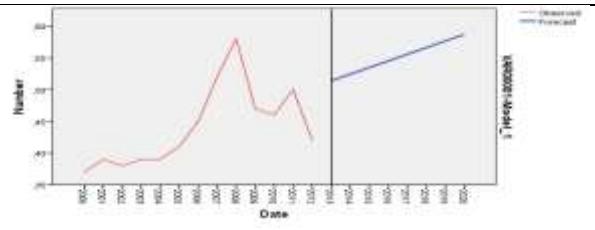
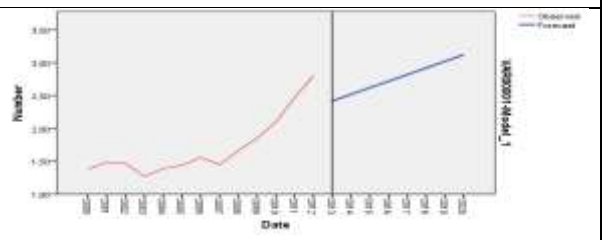
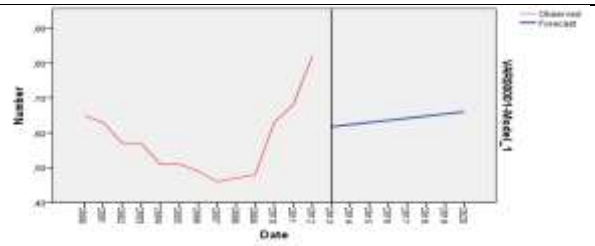
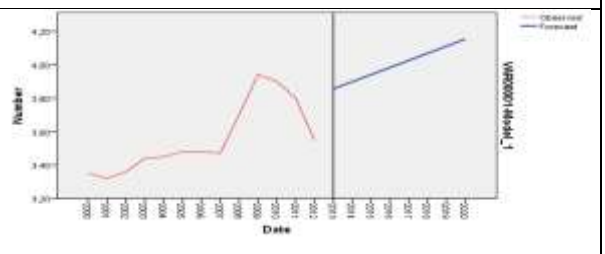

Portugal


Romania


Slovenia


Slovakia


Finland

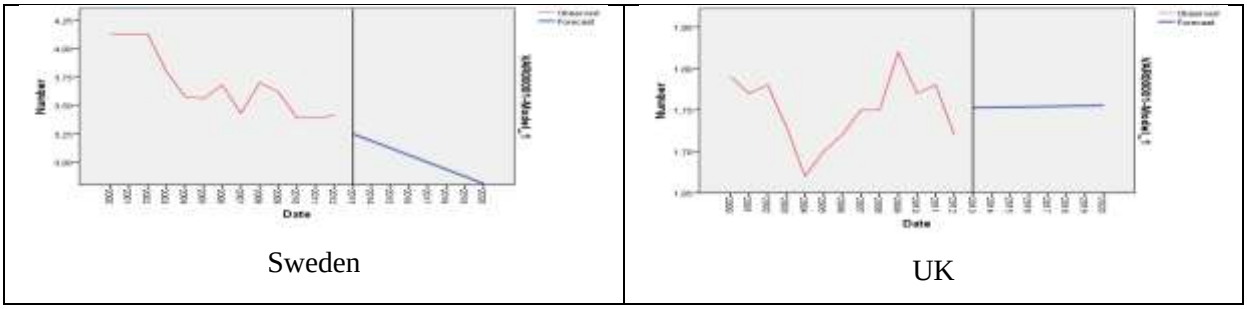


Figure 7 Gross domestic expenditure on R&D forecast (% of GDP)
Source: personal contribution

According to Figure 7, there are at least four clusters across the Member States in 2014: the first cluster covers 11 states and is characterized by gross domestic expenditure on R&D rates lower than 1% of GDP. The second cluster groups 2 states with rates between 1% and 1.5% of GDP. The third cluster is formed by 6 states with rates between 1.5% and 2% of GDP. Finally, 9 states performed rates greater than 2% of GDP.

This cluster division is available for 2020, as well. Moreover, 21 states (75%) will maintain their adhering in 2020 to the same clusters as in 2014.

5 Conclusions

The innovative processes and the applied scientific researches in the present global economy represent an important drive of the future sustainable development. Unfortunately, EU28 is not the best competitor on the global R&D and innovation market.

On the other hand, there are great disparities between the Member States and European regions connected to their innovative capacities. As a result, the Member States are grouped into four distinct clusters.

The financial support for R&D and innovation activities should be important as % of GDP, but many Member States are not able to allocate more than 1% of GDP for this kind of activities. The forecast for 2020 is not optimistically, because the present cluster division (and disparities) will be almost the same as in 2014.

6 Appendix

```
* Curve Estimation.
TSET NEWVAR=NONE.
CURVEFIT
  /VARIABLES=VAR00001
  /CONSTANT
  /MODEL=LINEAR
  /PRINT ANOVA
  /PLOT FIT.
```

Curve Fit
[DataSet0]

Model Description

Model Name		MOD_1
Dependent Variable	1	VAR00001
Equation	1	Linear
Independent Variable		Case sequence
Constant		Included
Variable Whose Values Label Observations in Plots		Unspecified

Case Processing Summary

	N
Total Cases	28
Excluded Cases[a]	0
Forecasted Cases	0
Newly Created Cases	0

a. Cases with a missing value in any variable are excluded from the analysis.

Variable Processing Summary

		Variables
		Dependent
		VAR00001
Number of Positive Values		28
Number of Zeros		0
Number of Negative Values		0
Number of Missing Values	User-Missing	0
	System-Missing	0

VAR00001
Linear

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
,992	,985	,984	,021

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	,781	1	,781	1711,987	,000
Residual	,012	26	,000		

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	,781	1	,781	1711,987	,000
Residual	,012	26	,000		
Total	,793	27			

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Case Sequence	,021	,000	,992	41,376	,000
(Constant)	,195	,008		23,491	,000

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