

DYNAMICS OF R&D EXPENDITURE IN EUROPE DURING THE LAST TWO DECADES

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Abstract: *Research and Development represents the priority for the smart growth of Europe 2020 Strategy. Performances in education, research and innovation are important for building the digital society. The paper presents the dynamics recorded during the last two decades. There are compared the changes in the countries' position using a certain type of chart built for the statistic indicators: R&D expenditure as percentage in GDP and the R&D development potential. The conclusions are based on the analysis of these indicators for the European countries in the period preceding the beginning of the economic crisis.*

Key words: *R&D expenditure, GDP per capita, box-plot.*

1. Introduction

The Europe 2020 Strategy established as priorities for exiting the crisis, and for the whole period, the following: smart growth, sustainable growth, inclusive growth.

For 2020, the Strategy supposes an increased level of productivity in order to reduce the lower growth rates. Using the information and communication technologies to spread knowledge may conduct to a better distribution of goods and services, also in the rural and isolated areas. Another objective is an easier access to innovation for all activity sectors.

The Europeans live longer, but they have fewer children. In the future, fewer people will work, and there will be great difficulties to support a higher number of pensioners. There will appear problems for funding the welfare system.

The problem of the ageing populations is a real one and it has some consequences

over the quality of life. Education, R&D investments and innovation may offer a better knowledge based society, more opportunities for jobs, in order for people to work longer.

2. EU Economy during 2001-2008

Using the indicator GDP per capita at PPS, for EU-27 Member States, the candidate countries (Croatia, Republic of Macedonia, Turkey) and EFTA countries (Switzerland, Iceland, Norway), the annual average rates can be calculated, for the period 2001-2008.

The data from Table 1 were the basis of calculation for the annual average change rate for each country, in its last column.

The box-plots from Figures 1 and 2, show that the countries' distributions after the GDP/capita, in 2008 and the GDP/capita relative growth during 2001-2008, both have positive asymmetry,

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because the inter-quartile ranges for each series are different, when compared.

GDP/capita, calculated on the basis of PPS

Table 1

Countries (UE-27) \ Years		2001	2002	2003	2004	2005	2006	2007	2008	Ț
Austria	A	24700	25800	26300	27400	28000	29400	30600	30900	3.25
Belgium	BE	24500	25700	25600	26200	26900	27800	28800	28900	2.39
Bulgaria	BG	5800	6300	6700	7300	7800	8600	9400	10400	8.70
Czech Republic	CK	13900	14400	15200	16300	17100	18200	19900	20200	5.49
Cyprus	CY	18000	18300	18400	19600	20400	21400	23300	24000	4.20
Denmark	DK	25300	26300	25700	27200	27800	29400	30200	30100	2.51
Estonia	ES	9200	10200	11300	12400	13800	15400	17100	16900	9.08
Finland	FL	22800	23500	23400	25200	25700	27200	29400	29400	3.70
France	F	22900	23700	23200	23800	24900	25700	27000	27100	2.43
Germany	G	23100	23600	24200	25200	26300	27500	28800	29000	3.30
Greece	GR	17100	18500	19200	20400	20600	22000	23100	23600	4.71
Ireland	IL	26200	28200	29200	30800	32400	34400	36900	33900	3.75
Italy	I	23300	22900	22900	23100	23600	24600	25800	25600	1.35
Latvia	LT	7700	8400	9000	9900	10900	12200	13900	14400	9.36
Lithuania	LI	8200	9000	10200	10900	11900	13100	14800	15500	9.52
Luxembourg	L	46300	49200	51300	54700	57200	64400	68500	69300	5.93
Malta	M	15400	16300	16200	16700	17500	18200	19000	19100	3.12
Netherlands	NL	26400	27300	26800	28000	29400	31000	32900	33600	3.51
Poland	PL	9400	9900	10100	11000	11500	12300	13600	14100	5.96
Portugal	P	15300	15800	15900	16100	17300	18100	18800	19000	3.14
United Kingdom	UK	23700	24700	25200	26800	27400	28400	29100	29100	2.98
Romania	RO	5500	6000	6500	7400	7900	9100	10400	11800	11.52
Slovakia	SK	10400	11100	11500	12300	13500	15000	16900	18100	8.24
Slovenia	SL	15800	16800	17300	18700	19700	20700	22100	22800	5.38
Spain	S	19400	20600	20900	21900	22900	24700	26200	25700	4.10
Sweden	SW	24000	24800	25400	27000	27100	28600	30600	30100	3.29
Hungary	HU	11600	12600	13000	13700	14200	15000	15600	16100	4.79
Average UE-27		18367	19256	19652	20741	21619	23052	24544	24767	4.36
EFTA Countries										
Switzerland	SZ	27800	28800	28400	29300	30000	32200	35100	35300	3.47
Iceland	IS	26200	26600	26000	28400	29300	29200	30200	30200	2.05
Norway	N	31900	31700	32400	35600	39600	43400	44600	47900	5.98

Countries (UE-27) \ Years		2001	2002	2003	2004	2005	2006	2007	2008	F
Candidates										
Croatia	CR	9900	10700	11200	12100	12700	13500	15000	15700	6.81
Rep. Macedonia	MC	5000	5200	5300	5800	6400	6900	7700	8200	7.32
Turkey	T	7400	7400	7400	8600	9500	10500	11100	11400	6.37

Boxplot for average dynamic rate of GDP, in European countries, during 2001 - 2008

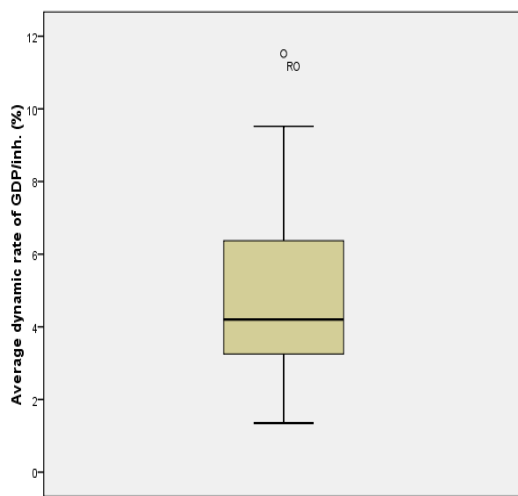


Fig. 1.

Boxplot for GDP/inhabitant in European countries, in 2008

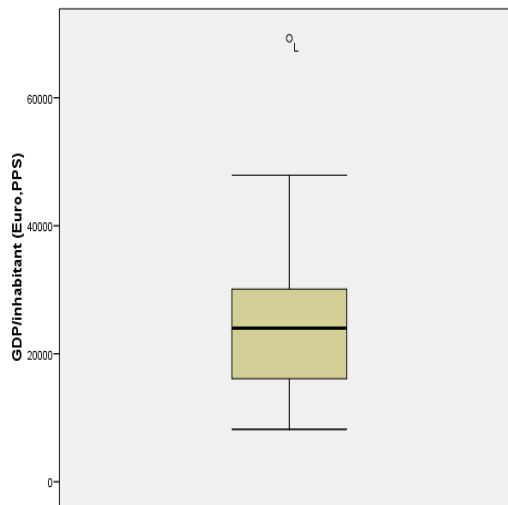


Fig. 2.

The asymmetry is emphasized in Figure 2, because the distance between the third quartile and the median is larger than in Figure 1. Box-plots offer the possibility to compare data series having different measure units and offer information about the outliers.

Both box-plots show one outlier. The country with the GDP/capita being an outlier in 2008 is Luxemburg.

The outlier for the fastest dynamic growth of GDP/capita, as annual average in percentage, is Romania, for the analyzed period 2001-2008.

A proportion of 50% from the considered countries has the GDP/capita in 2008 between 16,100 euro/inhabitant and 30,100 euro/inhabitant, at PPS.

These countries have the dynamic rate of GDP/capita between 3.25% and 6.37%, according to the descriptive indicators, established in Table 2.

The indicators to built box-plots for GDP/capita and GDP/capita growth Table 2

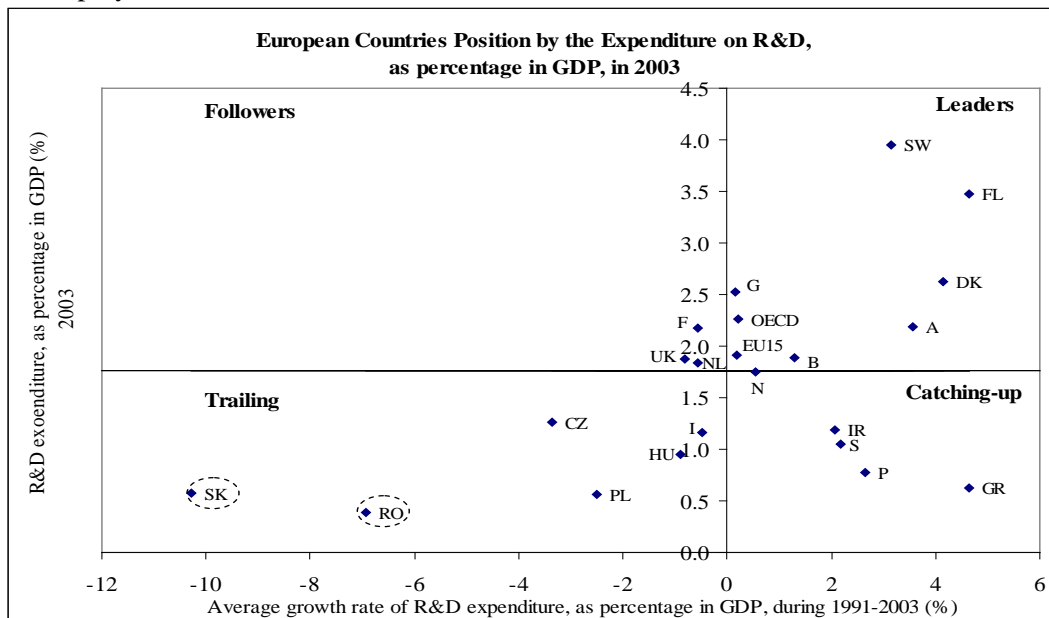
Indicators	GDP/capita, level in 2008		GDP/capita growth 2001-2008	
	Countries	(euro/inh.PPS)	Countries	(%)
First quartile, Q1	Hungary	16,100	Germany	3.25
Median, Me	Cyprus	24,000	Cyprus	4.20
Third quartile, Q3	Sweden	30,100	Turkey	6.37
Maximum value	Luxembourg	69,300	Romania	11.52
Minimum value	Macedonia	8,200	Italy	1.35

The analysis of the economic growth must be continued by analyzing the factors: labour input and labour productivity variations. The GDP per person can be analyzed in terms of changes in labour input and labour productivity. Labour input is the number of persons employed and the employment rate is the ratio between labour input and the number of population. Labour productivity is calculated as GDP per person employed. So the GDP/capita is the product of GDP per person employed and the employment rate.

3. R&D Expenditure of European Countries during 1991-2003

Using the data series for R&D expenditure as weight in GDP and its dynamic rates in the period 1991-2003, the chart from Figure 3, presents the position by R&D efforts in 2003, and their R&D potential.

This kind of graph shows the level of expenditure with R&D, percentage in GDP in 2003 and the R&D potential on the long term, calculated for the period 1991-2003



Data source: OECD Factbook 2006: Economic, Environmental and Social Statistics, Science and technology - research and development (R&D) - expenditure on R&D

* Romania Yearlook 2006, chapter 13

** For Romania, the average growth rate is calculated for the period 1995-2003

Fig. 3. *The Position of European Union Member-Countries by the percentage of R&D expenditure in GDP, in 2003*

The group of the countries: Sweden, Finland, Denmark, and Austria are the *Leaders*, with weights between 2% - 4% of GDP intended for R&D and with an annual average rate of the R&D expenditure dynamic about 4% per year.

Other countries as: Germany, Belgium, Norway, EU15 countries and the OECD countries have lower values of percentage of R&D expenditure in GDP, the level for 2003, between 0 - 2.5%, being close to the average of considered countries and the potential of R&D expenditure, less than 2%. Norway has the average level of percentage of R&D expenditure in GDP, for the analyzed countries.

The central cluster of countries has no specific features from any quarter.

Their dynamic potential lies between -2% and +2%.

The group of *Trailings* is formed by: the Czech Republic, Hungary, Italy and Poland, with a percentage in GDP of R&D expenditure, in 2003, between 0.5% and 1.5%, but situated on a yearly descending tendency about -1%-4%.

The Slovak Republic is the most trailing with about 0.5% of R&D expenditure, in 2003 and the lowest rate of -10%.

Romania is also a trailing country; the percentage of R&D expenditure, in GDP, decreased from 0.8% in 1995, to 0.71 in 1996, until 0.39% in 2003, which was kept in 2004, and of 0.41% in 2005. The average dynamic rate in the period 1995-2003, was of -6.93%

Ireland, Spain, Portugal and Greece are in the group of *Catching-up* countries. Even though these countries have low percentages in GDP of R&D expenditure, in 2003, situated between 0.5% - 1.5%, the average growth rate between 2% - 5%, put them on an ascending trend of R&D expenditure and of the innovation.

An important requirement for Romania is to allocate a higher percentage of GDP for research-development and innovation.

4. R&D Expenditure of European Countries during 2001-2008

Using the data concerning the expenditure with R&D, as percentage in GDP in 2008 and the R&D potential calculated for 2001-2008, for mostly the same countries, the same analysis can be made as for the first decade. The changes produced in the positions of the same analyzed countries can be noticed.

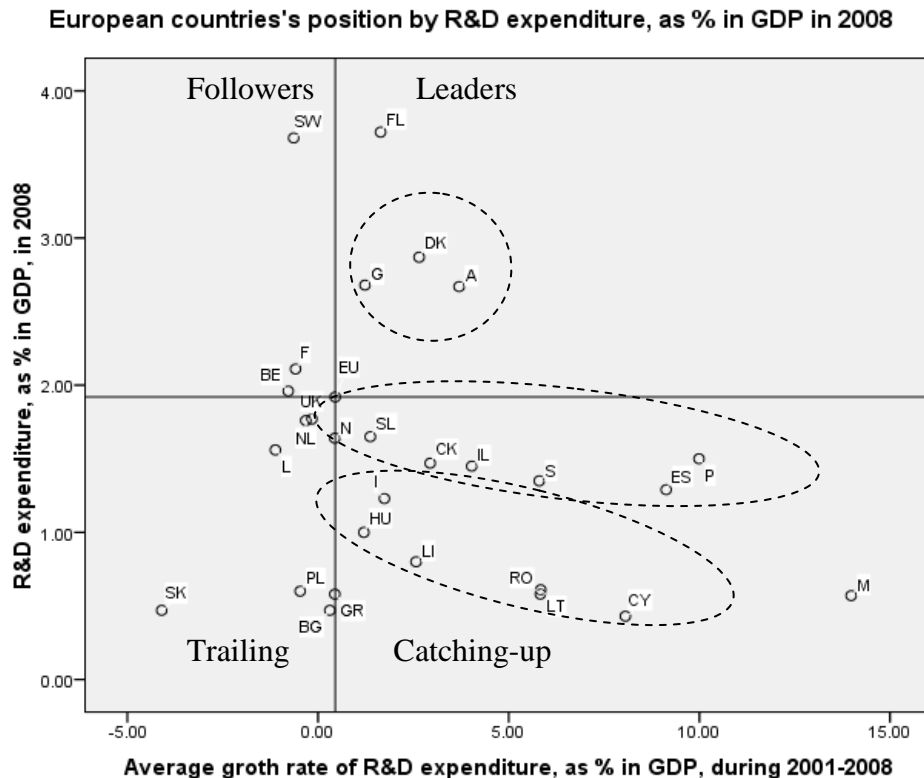


Figure 4. *The position of EU Member States in 2008 and their R&D potential*

It can be noticed that Malta made great efforts in the R&D field, having the greatest average dynamic rate for R&D, close to 15% yearly.

In the *Leaders* frame, there is a group of three countries: Austria, Denmark and Germany, which are placed over the EU average, but less than the EU goal of 3%, having positive average rates less than 5%.

In the *Catching-up frame*, there can be distinguished two different level groups of the New EU Member states: one which is situated below the level of 1% allocated from GDP for R&D – composed by: Cyprus, Latvia, Romania, Lithuania and Hungary – and the other group being situated more than 1%, but less than the EU average of R&D expenditure in 2008, which itself is less than 2%.

The countries from this second upper group are older new EU Member states, such as: Portugal, Spain, Estonia, Ireland, Czech Republic and Slovenia. Only Sweden and Finland are placed over 3% of the GDP for R&D expenditure.

5. Conclusions

In 2008, Romania recorded a positive value of the dynamic rate for R&D expenditure in GDP, mostly the same in absolute value with that in 2003, but having a positive sign, which indicates an ascending trend for the weight of R&D expenditure in GDP, for the future decade.

Romania succeeded in changing the frame of a trailing country, with that of a catching-up country.

Germany emphasized even more its leader position face to 2003.

The Slovak Republic continues to be placed in the *Trailing* frame, in 2008, but the progress made as compared to 2003 is emphasized, when the negative rate was doubled less than that in 2008.

Romania's politic power must be focused to create the framework conditions for knowledge, for the development of new technologies, creating conditions for the diffusion and application of knowledge in new products, processes and services.

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