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STATISTICAL ANALYSIS OF R & D COSTS AT REGIONAL LEVEL IN ROMANIA (2009) AND ITS CORRELATION WITH GDP AND GVA

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Abstract: *Economic development and the success of a company are strongly influenced by the R&D (research and development), dealing with new technologies, maintaining and increasing market competitiveness, developing new ways to exploit. However there is a lack of statistical analyses presenting the spending for R&D activity at regional level in Romania and also a lack of comparison of these data whit economic indicators as GDP or GVA. In 2010 the publication "Investments in research and development: annual ranking of companies in Romania" led by Romanian Centre for Economic Modeling, summarizes the research and development spending at regional level, according to which in 2009 the R & D spending were focused in Bucharest-Ilfov, the Center Region and South-Muntenia. This ranking is due to companies in the automotive aftermarket and automotive manufacturing. This paper presents a statistical analysis and conclusions on research and development spending from enterprises at regional level in Romania for 2009 in relation with the Gross Domestic Product (GDP) and Gross Value Added (GVA). The main novelty of the paper is that beside the statistical analysis it presents as well correlations with the GDP and the GVA for enterprises with research and development activity at regional level for 2009.These result can be used in further studies and researches focusing on R&D activity, spending at regional level in Romania. In comparison to these indicators that can be considered as methods of measurement for development and innovation we present at European, country and regional level the main indicators used to measure innovation.*

Key words: *research, development, region, GDP, GVA, development and innovation indicators.*

1. INTRODUCTION

Research and development – R & D is a crucial factor in the survival of an enterprise as it can lead to intense leaps in national wealth and nations ranking.

In 2010 the publication "Investments in research and development: annual ranking of companies in Romania" was led by Romanian Centre for Economic Modeling, representing the first attempt of its kind in Romania.

The objectives of ranking companies in Romania according to investment in R & D are:

- the intention to provide an accurate picture of how businesses in Romania are oriented in terms of research and development,
- especially to direct the attention of the business environment to a strategy that has to be implemented in order to be competitive to the requirements of the EU market.

Based on this publication, we divided our article in the fallowing headings:

Firstly we present the regional analysis of companies with research and development spending in Romania for 2009. Then, we analyze the Gross Domestic Product (GDP) at regional level in Romania. Furthermore, we present the situation of Gross Value Added (GVA) at regional level. Then, we identify a correlation of high intensity between the intensity of research and development spending at regional level in Romania (2009) and the GDP and GVA. Finally, we present the indicator used at European, country and regional level to measure development and innovation.

Figure 1 presents the main stages of our research.

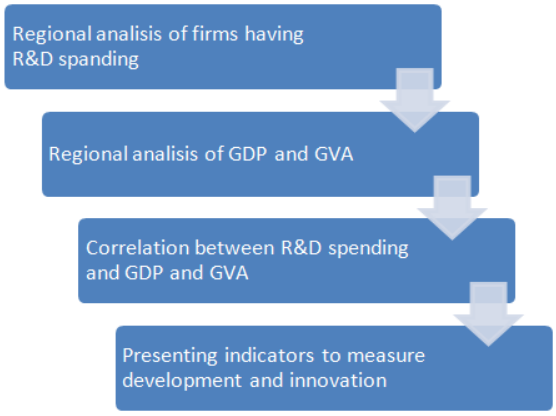

Fig. 1. Stages of the research.

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2. REGIONAL ANALYSIS OF COMPANIES WITH R & D SPENDING IN ROMANIA (2009)

After the crisis the trend of increasing investments in research and development did not continue, except in the South region and Northwest region of Romania.

In 2009 R & D spending of firms in Romania were focused in Bucharest-Ilfov, Center and South-Muntenia regions.

In the Centre and South-Muntenia region this position is due to companies in the automotive aftermarket and automotive manufacturing.

The Centre and South West regions have the highest values share of R & D costs to turnover (R & D intensity) and the South-East and North-East regions recorded their worst performance in this regard.

Regionally the evolution of intensity of investment in research and development is not homogeneous, and annual variations are volatile for some regions due to: the relatively small number of companies included in the survey, nonlinearities of the investments in R & D, and not least the quality of data reported by the surveyed firms [1, 2].

Table 1 presents the ranking of the eight development region by their contribution to total R&D spending of Romania in 2009.

In the Bucharest-Ilfov region the high level of investment in R & D is influenced by the higher number of companies and the presence of the headquarters of large companies in the Bucharest, who operate nationally and/or in other regions (Petrom, Hidroconstrucţia National Society "Nuclearelectrica" etc.).

In the Centre and South-West Oltenia regions the share of R & D costs to turnover (R & D intensity) has the highest values of about two times higher than the national average (2%), thanks to companies as Oltchim and Compa from the South West region, in the Central region this result is due to the Romgaz Company.

The highest R & D intensity fluctuations were recorded in 2007, the general increase of R & D intensity from 1.9% to 2.6% was not homogeneous at regional level. Due to the decrease of R & D investment and the increasing turnover, in the Central region took place a significant decrease in the R & D intensity. While in other regions such as South-Muntenia and Northwest, the values of this indicator increased significantly.

In the Center region of Romania, the lack of investments in 2007 explains the significant decrease of the R & D intensity indicator, which then increases again due to investment in R & D of the Compa firm [1, 2].

Table 1

Ranking of development regions by their contribution to total R & D spending of Romania in 2009

Region	Nr. of firms	R&D spending (lei)	% from the total R&D spending RO.	% from the total turnover RO.	R&D intensity (%)
Bucharest-Ilfov	39	1357602	29.3	45.3	1.2
Center	14	170057	29.4	13	4.2
South - Muntenia	15	220772	22.1	23.8	1.8
South - West - Oltenia	8	75738	15.1	7.6	3.8
West	6	89026	2.5	3.1	1.5
North - West	17	194256	1.6	2.9	1.1
North - East	8	175865	0.6	1.8	0.6
South - East	6	91591	0.3	2.6	0.2

3. GDP AT REGIONAL LEVEL IN ROMANIA

Economists (from Keynes) shared the general consumption term into two parts: private consumption and public sector spending.

GDP = private consumption + state consumption + investment + (exports - imports)

The components of GDP are:

- Private consumption - is normally the largest component of GDP, accounting for household spending in the economy.
- State expenditures - or government consumption, government spending is the sum of all expenditure for goods and services.
- Investment - including investment in land, equipment, inventory and does not include exchanges of existing assets.
- Exports - represents a country's gross exports including goods and services for consumption in another country
- Imports – represents the raw import [3, 4].

GDP can be determined in three ways, giving the same result:

- the production approach,
- the income approach,
- or the expenditure approach.

The most direct of the three is the production approach, summing the outputs of every class of enterprise.

The expenditure approach works on the principle that all of the product must be bought by somebody, therefore the value of the total product must be equal to people's total expenditures in buying things.

The income approach says that the incomes of the productive factors must be equal to the value of their product, and determines GDP by finding the sum of all producers' incomes [5].

Table 2

GDP at regional level between 1999 and 2009 (Lei)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total	2457.5	3609.7	5263.5	6974.9	9084.0	11413.5	13362.8	15967.6	19315.4	23934.6	23341.4
North - East	1778.2	2508.9	3816.1	5057.4	6521.5	7872.0	8907.6	10295.8	12340.9	14794.5	14649.3
South -East	2270.4	3212.5	4708.8	6288.8	8018.6	10470.2	11541.7	13569.8	15641.8	19098.9	18738.2
South-Muntenia	2045.3	2857.4	4248.7	5613.3	7294.9	9407.2	11068.5	13374.6	15757.8	19648.1	19913.7
South - West - Oltenia	2141.4	2993.0	4457.3	5415.3	7547.2	9367.2	10371.1	12463.2	15097.3	17831.8	17752.8
West	2824.2	3723.4	5608.6	7629.5	10182.8	13020.8	15064.7	18570.1	22341.9	26173.2	25602.4
North - West	2334.5	3322.3	4912.3	6690.7	8639.7	10901.2	12538.6	14946.6	18610.5	21542.1	21297.4
Center	2523.9	3729.3	5388.2	7332.0	9425.5	11458.8	13097.6	15920.2	19579.5	22707.7	22618.8
Bucharest - Ilfov	4503.2	7821.3	10751.3	14149.1	18276.5	22908.7	29572.6	35012.1	43037.3	59680.2	55079.3

(EUROSTAT)

The international standard for measuring GDP is in the book System of National Accounts from 1993, which was prepared by representatives of the International Monetary Fund, European Union, Organization for Economic Co-operation and Development, United Nations and World Bank. The publication is normally referred to as SNA93 to distinguish it from the previous edition published in 1968 [6].

SNA93 provides a set of rules and procedures for the measurement of national accounts. The standards are designed to be flexible, to allow for differences in local statistical needs and conditions.

Within each country GDP is normally measured by a national government statistical agency, because private sector organizations normally do not have access to the information required [7, 8].

Table 2 presents the GDP at regional level for the period 1999-2009:

4. GVA AT REGIONAL LEVEL IN ROMANIA

Gross value added (GVA) is a measure in economics of the value of goods and services produced in an area, industry or sector of an economy.

In national accounts GVA is output minus intermediate consumption;[9] it is a balancing item of the national accounts' production account [10].

GVA is linked as a measurement to gross domestic product (GDP), as both are measures of output. The relationship is defined as:

GVA + taxes on products - subsidies on products = GDP

As the total aggregates of taxes on products and subsidies on products are only available at whole economy level, [11] gross value added is used for measuring gross regional domestic product and other measures of the output of entities smaller than a whole economy. Restated, the relation becomes:

GVA = GDP + subsidies - (direct, sales) taxes

Over-simplistically, GVA is the grand total of all revenues, from final sales and (net) subsidies, which are incomes into businesses. Those incomes are then used to cover expenses, savings, and taxes.

Gross value added (GVA) after another definition represents the gross value of final goods and services produced by a firm over a period of time; it can be determined in two ways:

- as the difference between the output and intermediate consumption: GVA = O - C;
- as the sum of the following items: amortization of fixed assets (A); salaries, bonuses, compensation, without tax (S); contributions to social security; to the unemployment fund; expenses that are deducted from income; due taxes; financial income (subtract); financial expenses; taxable profit [3, 4].

Analysis of regional gross value added (GVA) allows outlining of a more detailed picture of regional performance. The Bucharest-Ilfov region is a leader with 24.8% of total GVA produced nationally, while the South-West Oltenia and West is at last place, registering only 8% and 9.8% of total GVA in 2011.

Table 3 presents the ranking of development regions according to GVA:

GVA offers the possibility of analyzing economic productivity generated in an economy by producing goods and services.

5. THE CORRELATION BETWEEN THE R & D SPENDING AND GDP AT REGIONAL LEVEL (2009)

In this chapter we present the correlation between the research and development spending and the gross domestic product in Romania at regional level for 2009.

Table 3

Ranking of development regions according to GVA (lei)

Sector	2009	2005	Annual growth rate
Romania	106 365.5	70 488.7	10.3
North-West	12 271.9	8 367.8	9.6
Center	12 103.8	8 092.2	10.1
North-East	11 527.5	8 103.9	8.8
South-East	11 205.5	8 001.4	8.4
South-Muntenia	13 863.1	9 029.6	10.7
Bucharest-Ilfov	26 371.3	15 846.7	12.7
South-West-Oltenia	8 492.7	5 897.5	9.1
West	10 436.7	7 099.9	9.6

(EUROSTAT)

Table 4

R & D expenses and GDP in RO 2009 (lei)

Region	R&D expenses (lei)	GDP (lei)
Bucharest –Ilfov	1 357 602	55 079.3
Center	170 057	22 618.8
South Muntenia	220 772	19 913.7
South-West-Oltenia	75 738	17 752.8
West	89 026	25 602.4
North-West	194 256	21 297.4
North-East	175 865	14 649.3
South-East	91 591	1 738.2

The correlation of the above mentioned indicators represents a novelty in the domain, as it is determined for the regional level.

Table 4 presents the research and development expenses and the gross domestic product in Romania in 2009:

Figure 2 presents the correlation between the research and development spending and gross domestic product in Romania in 2009:

As presented in Fig. 2 there is a correlation of high intensity between the research and development spending and the GDP in Romania for 2009.

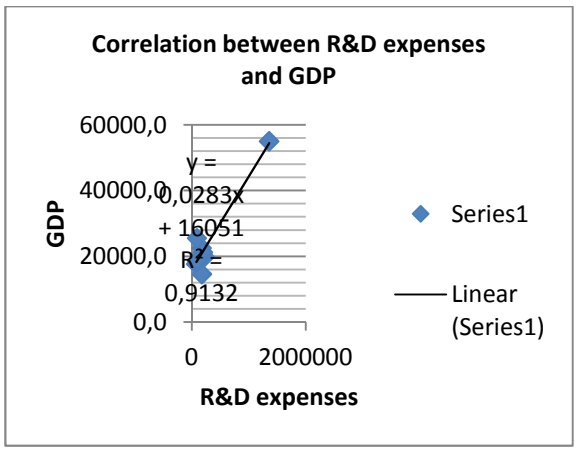

Fig. 2. Correlation between the R&D spending and the GDP (2009).

6. THE CORRELATION BETWEEN THE R & D SPENDING AND GVA AT REGIONAL LEVEL (2009)

Chapter VI presents the correlation between the research and development spending and the gross value added at regional level in Romania for 2009.

However there are statistical data referring to the GVA at regional level its correlation with the R&D spending is new.

Table 5 presents the research and development expenses and the gross value added in Romania in 2009:

Figure 3 presents correlation between the research and development expenses and the gross value added in Romania in 2009:

Considering the literature, we can say that there is a close link between R & D expenditure and gross value added, if we consider the GVA, as a quantified, measured result, of investments in R & D. This is proved by Fig. 3.

Table 5

R & D expenses and GVA in RO 2009 (lei)

Bucharest - Ilfov	R&D expenses (lei)	GVA (lei)
Center	1 357 602	26 371.3
South Muntenia	170 057	12 103.8
South-West-Oltenia	220 772	13 863.1
West	75 738	8 492.7
North-West	89 026	10 436.7
North-East	194 256	12 271.9
South-East	175 865	11 527.5
Bucharest -Ilfov	91 591	11 205.5

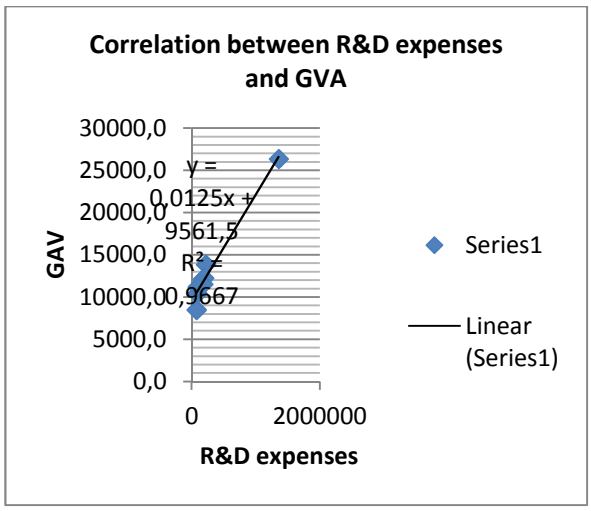

Fig. 3. Correlation between the R&D spending and the GVA (2009).

Knowing that research and development spending, GVA and GDP in the Romania in 2009 were as shown in Table 4 and 5, we extract values from these tables. With Microsoft Excel Corel function, we calculated the coefficients, that are close to 1 (0.91 - R & D spending to GDP and 0.96 - R & D spending to GVA), which means direct connection of high intensity.

7. THE INDICATORS USED AT EUROPEAN, COUNTRY AND REGIONAL LEVEL TO MEASURE DEVELOPMENT AND INNOVATIONA

The need to evaluate R&D processes exists not only at macroeconomic level but at microeconomic and regional level as well. The indicators for measuring these processes however are different with a few common points only.

At European level the research is carried out by the Innovation Union Scoreboard. They are making analyzes both for Europe and non member countries of the EU.

At global level the indicators used to measure development and innovation are presented in table 6 [12].

In Romania the indicators presented in Table 7 are applied to measure innovation.

At regional level we can enumerate only a few indicators to measure development and innovation, as presented in Table 8:

We can conclude that as shown in the above tables the set of indicators for the three levels are different, there is only an indicator that is used both at European, country and regional level: the R&D spending as % of GDP.

8. CONCLUSIONS

In 2009 the R & D spending in the private sector in Romania was focused in Bucharest-Ilfov, Center and South-Muntenia.

Analysis of regional GDP and gross value added (GVA) allows us to outline a more detailed picture of R&D performance at regional level.

We can conclude that, there is an intense connection between the R&D spending and the GDP and GVA in Romania in 2009. Based on research and development

Table 6

The indicators used in the EU to measure development and innovation (Innovation Union Scoreboard, 2014)

New doctorate graduates (ISCED 6) per 1 000 population aged 25–34
Percentage population aged 30-34 having completed tertiary education
Percentage youth aged 20–24 having attained at least upper secondary level education
International scientific co-publications per million population
Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country
Non-EU doctorate students2 as a % of all doctorate students
R&D expenditure in the public sector as % of GDP
Venture capital investment as % of GDP
R&D expenditure in the business sector as % of GDP
Non-R&D innovation expenditures as % of turnover
SMEs innovating in-house as % of SMEs
Innovative SMEs collaborating with others as % of SMEs
Public-private co-publications per million population
PCT patents applications per billion GDP(in PPS€)
PCT patent applications in societal challenges per billion GDP (in PPS€)(environment-related technologies; health)
Community trademarks per billion GDP (in PPS€)
Community designs per billion GDP (in PPS€)
SMEs introducing product or process innovations as % of SMEs
SMEs introducing marketing or organizational innovations as % of SMEs
Employment in fast-growing firms of innovative sectors
Employment in knowledge-intensive activities (manufacturing and services) as % of total employment
Contribution of medium and high-tech product exports to the trade balance
Knowledge-intensive services exports as % total service exports
Sales of new to market and new to firm innovations as % of turnover
License and patent revenues from abroad as % of GDP

Table 7

The indicators used in Romania to measure development and innovation

The number of employees in R&D
The absorption of UE funds
R&D spending
The structure of R&D spending
R&D spending as % of GDP
R&D spending on fundamental, applied research and experimental development

Table 8

The indicators used at regional level to measure development and innovation

R&D intensity (R&D spending/GDP)
R&D spending
Absorption of EU funds

expenditure trends we can forecast trends in gross value added, which is important in the calculation of GDP.

Beside these indicators there are a few more that reflects the situation of R&D and innovation at regional level, however there are more indicators used at country and European level.

Considering the indicators used at European level we conclude that there are some that can be used at regional level as well:

- number of PhD student/region,
- number of international scientific publications/region,
- number of patents/region,
- R&D spending as % of turnover,
- number of firm that has introduced a new product, process or method,
- number of employees in firms from the innovative sectors.

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REFERENCES

[1] C. Constantin, S. Manuela et all, *Investiții în cercetare-dezvoltare- Clasament anual al companiilor din România* (Investments in research and development – Annual ranking of companies from Romania), Centrul Român de Modelare Economică, Institutul de Economie Mondială, Bucharest, pp. 1–30, 2011.

[2] N. Petcu, *Statistica în turism 2005. Teorie şi aplicaţii* (Statistics in tourism 2005. Theory and applications). Editura albastră, Cluj-Napoca, pp. 11–14, 54–60, 2005.

[3] M. Moga, G. Calefariu, *Some aspects of research and development at enterprises at regional, country and european level*, Review of the Air Force Acadamy, Brașov, 23, 2013, pp 117–120.

[4] Ministerul Dezvoltării, Lucrărilor Publice și Locuințe, Program Operațional Regional 2007–2013 (Regional Operational Program). Bucharest, 2007.

[5] World Bank, *Statistical Manual, National Accounts, GDP–final output*, 2009.

[6] Central Bureau of Statistics, *National Accounts*, 2011.

[7] E. Dickinson, "GDP: a brief history". ForeignPolicy.com. Accessed 25 April 2012.

[8] T. Watkins, San José State University, Department of Economics, *"Gross Domestic Product from the Transactions Table for an Economy"*, accessed November 2009.

[9]***`http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Glossary:Value_added`.

[10]***`http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Glossary:Production_account`.

[11] ***Office for National Statistics.*"Guide to Gross Value Added (GVA)"*. 2002-11-15. Accesed 2012-07-08.

[12] European Comission, *Innovation Union Scoareboard*, 2014.