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The Role of Knowledge Intensive Business Services on Romania's Economic Revival and Modernization at the Regional Level

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Abstract: Knowledge intensive business services have recently become one of the most important themes addressed by researchers in the field. Their interest in such a subject is due primarily to the impact they have in terms of growth rate, especially for the economies of emerging countries. The literature in the field brings a series of persuasive arguments about the role that these services have both at national and regional levels. In this paper, the authors make a radiography of the Romanian research system which is passing through a transition phase from the ruins of communism to the challenges of globalization. Moreover, the authors analyse the role of performance-based services in Romania's regional development in correlation with the economic growth target at the national scale. Quantitative methods used during the present paper highlight the disparities between Romania's geographic regions in terms of technological development and research. In addition, the econometric model developed in the study emphasizes the cohesion degree corresponding to the European Union Member States.

Keywords: knowledge intensive business services; regional cohesion; economic growth; strategy; technological innovation; entrepreneurship

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1. Introduction

The role of innovation in the economic development of a nation has been highlighted in the economic doctrine formulated by Joseph Schumpeter since 1934. In contradiction with Keynesian theories as well as with neoclassical ones where innovation was understood as a process independent of the economic growth targets, Schumpeter [1] revealed that innovation was essential for industrial activities.

In taxonomy presented in the literature, technological process is structured in three phases: the first phase, invention, involves the results of fundamental research; the second phase is represented by innovation, respectively the applied research which allows the transfer of invention to industrial activity, and finally, the third phase, which is called diffusion, enables the mass transfer of innovation knowledge to an industrial sector.

Schiller [2] presents a variety of models corresponding to innovation typology, each of them depending on the pursued purpose. Design innovations, as they are entitled, are those referring to the system of architectural improvements; they modulate the system's shape, its external appearance, but not its content or functionality.

Radical innovations are those with a maximum degree of novelty, unlike incremental or marginal innovations which bring improvements to the existing product or services.

In relation to their subject, innovations may be related to the product, when the added value is incorporated into the goods themselves, or linked to the process, if innovation brings an important contribution to the production or management process by incorporating the added value into the provided services, with visible results in increased efficiency, lower costs, higher production volume, or higher working speed.

In a close relationship with the innovative process, knowledge is the result of information processing through experience accumulation [3]. In a more extensive vision, knowledge may be equated to a product derived from applied market research [4]. Knowledge-based services incorporate these results and distribute them to the industry for capitalization purpose [5]. The impact of these knowledge services on regional economic development is assumed to be a positive one in correlation with the economic growth target [6].

The current paper evaluates the Romanian research system after the fall of communism until today and analyses the role of the knowledge intensive business services in the modernization of the country at the regional level. The development and research disparities between the country's regions were assessed in a socio-economic context and the data was analysed through linear regression models.

This paper is structured as follows. Firstly, we present the evolution of the Romanian research system after the fall of communism. Then, a description of the regional disparities is discussed. After that, the research hypotheses are presented and tested. The econometric model starting from the Cobb-Douglas production function with a constant scale rate is analysed. The application results show the promising computational advantage of the regression model.

2. The Romanian Research System—Between Communism Ruins and Globalization Challenges

The collapse of communism has resulted in the change in the mentality of Romanian society, putting in the forefront the accumulation of private property through constitutional recognition of individual rights. A functional market economy requires a diverse and strong foundation of social capital due to the acquired experience in managing private property which constitutes the premise for formulating and implementing an industrial policy in Romania. After 27 years from the Decembrist moment, the Romanian research system has been built on the state organizational model in national research and development institutes and public institutes under the coordination of the Romanian Academy, the National Authority for Scientific Research and Innovation, and of some ministries, such as: the Ministry of Economy, Trade and Tourism, the Ministry of Public Administration and Regional Development, the Ministry of Information Society, the Ministry of Labour, the Ministry of Environment, Water and Forests. A lot of incubators as well as information and technological transfer centres function without legal personality within universities, chambers of commerce, or research institutes. According to the data issued from the Registry of Accredited Entities, which are under the management of Technological Transfer and Infrastructure Direction within the Ministry of Education, there are at present 42 accredited research centres and incubators. Their funding is mainly provided by the state budget. In parallel, there are also innovative enterprises holding private capital; they ensure a bridge between the fundamental research, carried out particularly in the university centres, and the applied research, which holds a high utilization degree at the industrial level. State resources are complemented by European funds designated for the funding of research activities which are encouraged by the allocation of structural funds, which are distributed to projects in accordance with the established priority axes. However, because of the lack of funding from the structural funds, the level of expenses related to salaries and investments in research field allocated from the state budget remains modest compared to the indicators registered at the level of the EU Member States [7].

Starting with the year 2014, the Romanian government has adopted some measures in order to revive the failing research system in the country together with the adoption of the research and development strategy for 2014–2020 ("The 2014–2020 Research, Development and Innovation Strategy approved by the Government Decision No. 929/2014") which is implemented by means of two action plans: the National Plan for Research and Development as well as the Competitiveness Sectoral

Operational Programme. The priorities for intelligent specialization grouped in different fields, were determined in 2014. They were a result of a substantial analysis of the answers received at the questionnaire addressed mainly to the academic environment and, last but not at least, to the innovative enterprises. The extent to which these programmatic documents will be properly implemented will represent an assessment indicator for the role of the state. It will point out whether this indicator is extended or at least accomplished, if by means of the measures adopted, they have succeeded in recovering the structural handicaps, and if the transition to the applied market research is facilitated or not.

The precarious situation of the Romanian national research system was described in a series of papers and reference studies [8–10]. A relevant example is the study conducted by the International Economy Institute and the Romanian Centre of Economic Policies [11] in which a number of problems were identified, among the most serious ones standing out being the obsolete infrastructure as well as the remuneration of the researchers employed in the state system being below the subsistence level.

The research system's failures are due to different causes, such as: demographic, social, and economic ones. Demographic factors refer to the aging of the population employed in this field as well as to the diminution process of the number of researchers, as a direct consequence of the reduction in the number of active population as a whole. The statistical reports for the last twenty years show a decline in the birth rate; by contrast, the emigration phenomenon has escalated since 1989. In particular, the European Union membership has allowed the free movement of human capital employed in the research field towards the industrialized states belonging to the Union.

At the social level, the status of Romanian researchers does not enjoy adequate recognition, in terms of offering a reward for those that bring added value to the innovative utility process. At present, the public wage system does not sufficiently stimulate Romanian researchers; for example, it does not reward researchers with outstanding inventions that could be used in the industrial sector. At the national level, there are significant gaps regarding the quality of infrastructure and technological process compared to the European average [12].

In the macroeconomic context, financial services designed for crediting innovative enterprises are not matched to entrepreneurship needs. Most of the time, the small and medium-sized enterprises do not have the opportunity to get the necessary resources on the monetary market in order to fund the production of new technologies or to provide knowledge-based services [13].

The reports issued by the Organization for Economic Co-operation and Development (OECD) show a series of other different factors as having significant impacts on regional disparities from the perspective of the innovation degree. Two of them deserve to be mentioned: the protection of intellectual property rights and the quality of management. Therefore, we state that institutional barriers may exist, for example, in the form of bureaucracy or low involvement in the process of the policy makers. This is a product of both the registration of intellectual property rights and in regards to the management of some entities operating in the research field.

The action of positioning the Romanian research system should be correlated with the developments occurring in the international context. The EU Innovation Index is ranked below the level met in China, in the United States of America, and in Japan. Asia occupies the first place, being followed by North America, and finally by the Old Continent. Thus, Europe holds the third place in the innovation ranking in terms of the number of solicited patents, as they are registered at the international level [14]. Industrialization and innovation are key factors for economic growth, as demonstrated in the field studies [15]. By reducing the geographical area, from the international level to the European one, the European Commission's reports on innovation [16] place Romania in the last positions in terms of the level of research-development and innovation budgets allocated to the private sector. However, Scoreboard Reports published by the European Commission highlight that Romanian exports of knowledge-based services have registered positive development.

The standard indicators used by the European Commission classify the EU Member States in four categories: leaders (1), performant (2), moderate (3), and modest (4). The comparative analysis conducted at the EU level places Romania in the last category, together with Bulgaria and Latvia.

3. Quantitative Analysis on Regional Disparities in Romania

3.1. Estimating a Model for Services Based on Performance, Entrepreneurship, Innovation and Economic Growth

At the level of the European Union, there are 28 Member States which joined EU at different time intervals. In our analysis, we will take as a basis for our research the year 2007, which is the year of Romania's EU accession.

The relationship between economic growth and the degree of technological innovation has previously been studied in many research papers. It was found that there is a high correlation between technological innovation, entrepreneurial rate, and economic growth [17,18]. Other authors [19,20] found that, at the EU 28 level, entrepreneurial rate and technological innovation had a positive impact on economic growth.

Starting from the empirical studies mentioned above, we will focus on addressing the research question: "What are the economic factors that could explain the economic growth in Romania?" Besides what is already known in this area, we will try to estimate which of the two factors, technological innovation and entrepreneurial rate, has a greater impact on the dependent variable in the regression model.

Therefore, the statistical hypotheses that we will test are as followings:

- Hypothesis 1: Countries with a high degree of technological innovation have higher levels of economic growth.
- Hypothesis 2: Countries with a higher entrepreneurial rate have higher levels of economic growth.
- Hypothesis 3: The estimated coefficient of technological innovation degree in the regression model will be higher than that of entrepreneurial rate.

For testing all of these statistical hypotheses, we will build an econometric model starting from the Cobb-Douglas production function with a constant scale rate, as it will be described below.

With this function, we will create an econometric model in which the exogenous variables will be the number of created enterprises and the innovation degree. These are representative variables that determine the economic growth at the national level and represent the performance-based services of analysed states. In addition, the creation of new companies as well as information technology may be considered as production factors. In such a case, information technology represents knowledge capital and the creation of new enterprises represents a form of entrepreneurial capital.

An econometric model with growth rate as dependent variable should use control variables and prediction variables as independent variables [21]. The model has a simple parametric structure, but it is designed to accommodate a wider range of applications, mean structure, covariance structure, and constraints on the parameters. Due to the restricted number of observations (27 countries according to 2007 levels), the independent variables in this model were divided into control variables (GDP/capita and capital increase/capita), as well as into prediction variables (creation of new firms and information technology intensity).

The regression analysis uses a full panel dataset. The results from panel analysis and sample selection model are consistent [22,23]. Therefore, we could conclude that the sample size used in the regression analysis is large enough.

Thus, the regression model is the following one:

$$\begin{matrix}\text{Growth}\\ \text{rate}\end{matrix} = \underbrace{b_0 + b_1 \frac{\text{GDP}}{\text{capita}} + b_2 \frac{\text{Capital}}{\text{increase}}}_{\text{control variables}} + \underbrace{b_3 \begin{matrix}\text{Creation of}\\ \text{new firms}\end{matrix} + b_4 \begin{matrix}\text{Information tehnology}\\ \text{intensity}\end{matrix}}_{\text{prediction variables}} \quad (1)$$

where:

i) The Growth Rate, the dependent variable, is measured as the increase of GDP per capita;
ii) The Base Year of GDP/Capita is introduced into the model to describe the effect of "conditional convergence", as presented by Barro [24]; in this case, in the regression model, high-income countries have lower increases. In such a situation, we expect the coefficient to be negative. In the estimated model, we will transform this variable by taking the natural logarithm.
iii) The Capital Increase/Capita expresses the economic growth due to the increases in capital as they are seen as production factors. It is expected that the coefficient of this variable will be positive.
iv) Setting up of the New Firms belongs to control variables; we expect the coefficient of this variable to be positive as well.
v) The Information Technology Intensity is calculated as a ratio between the number of patents and GDP over a period of five years. Also in this case, we expect the coefficient of the variable to be positive.

The data calculated for all these variables have been collected with the support of Eurostat.

3.2. Analysis of Regional Cohesion in Romania

Over time, given the geographical and historical aspects, the four regions of Romania have known different degrees of economic development [25]. After the revolution in December 1989 and especially after joining the European Union, a lot of efforts have been made in order to decrease the divergences between these regions.

In recent years, the disparities between Romania's economic regions have represented an important topic for study. Thus, Capello [26] and Cojanu et al. [27] consider that, for eliminating disparities between regions, it is necessary to follow two lines: one that maximizes the competitive impact and the other intending to balance territorial specificities. In exchange, Iancu [28] and Moisescu [29] believe that only the action of EU internal competitive market forces, without the economic policies, would be able to guarantee the real convergence process of the Union's countries and regions.

Romania's geographical regions, as they have been defined by Eurostat, are divided into four macroregions:

- Macroregion 1: North West and Central region;
- Macroregion 2: North East and South East;
- Macroregion 3: South-Muntenia and Bucharest- Ilfov;
- Macroregion 4: South West Oltenia and West;

In order to highlight the disparities between Romania's economic regions, we will test the following statistical hypothesis:

- Hypothesis 4.1: There are significant differences between Macroregion 1 and Macroregion 2 in terms of the number of employees in the research field, the number of patents, and research and development expenses.
- Hypothesis 4.2: There are significant differences between Macroregion 1 and Macroregion 3 in terms of the number of employees in the research field, the number of patents, and research and development expenses.
- Hypothesis 4.3: There are significant differences between Macroregion 1 and Macroregion 4 in terms of the number of employees in the research field, the number of patents, and research and development expenses.
- Hypothesis 4.4: There are significant differences between Macroregion 2 and Macroregion 3 in terms of the number of employees in the research field, the number of patents, and research and development expenses.

- Hypothesis 4.5: There are significant differences between Macroregion 2 and Macroregion 4 in terms of the number of employees in the research field, the number of patents, and research and development expenses.
- Hypothesis 4.6: There are significant differences between Macroregion 3 and Macroregion 4 in terms of the number of employees in the research field, the number of patents, and research and development expenses.

Figures 1–3 give us an overview regarding the regional development of Romania in terms of knowledge-based services.

Figure 1 offers an image of the evolution of the number of employees in research and information technology (IT) fields during 2010–2015.

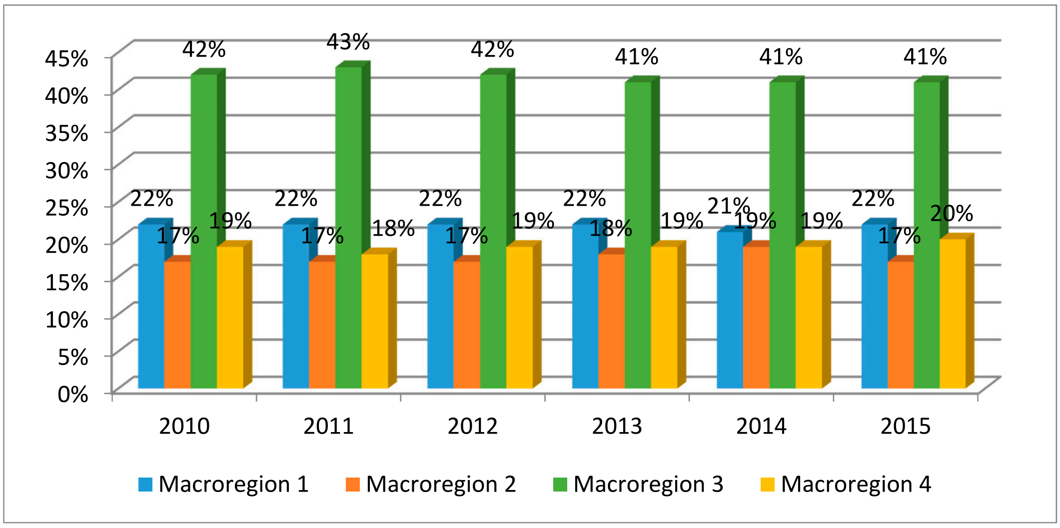

Figure 1. The distribution of employees in research and information technology (IT) fields, expressed as percentage in active population. Source: Authors' calculations on the basis of the data provided by Eurostat.

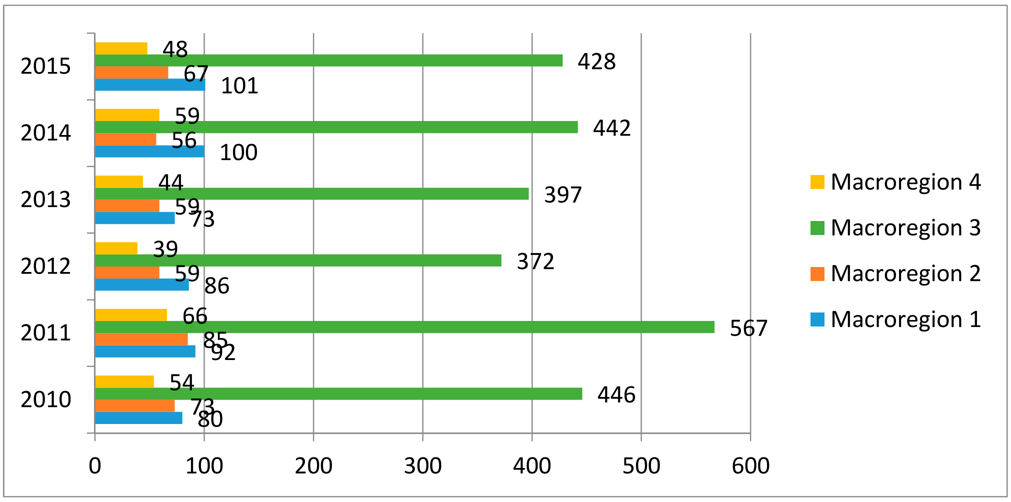

Figure 2. The evolution of research and development (R&D) expenses, calculated in thousands of euros. Source: Authors' calculations on the basis of the data provided by Eurostat.

From this figure, we can notice that the distribution of employees in research and IT fields has been relatively constant during the last five years, the largest share belonging to Macroregion 3 which also includes Bucharest, with this share covering 41–43% of research and IT employees, while the smallest share belongs to Macroregion 1, with values of 19–20%. This fact shows that the number of employees in research and IT fields is concentrated in the capital area.

Figure 2 provides a glimpse of research and development (R&D) expenses.

In terms of the research and development expenses, we may notice an even more acute discrepancy between the central region and the rest of the country. Thus, the R&D expenses corresponding to the central area, which also includes Bucharest, are greater than those of all the other three Macroregions put together, the latter having approximately equal expenses in the mentioned field. In Figure 3 we can notice the evolution of the number of R&D and IT patents corresponding to Romania's geographical regions.

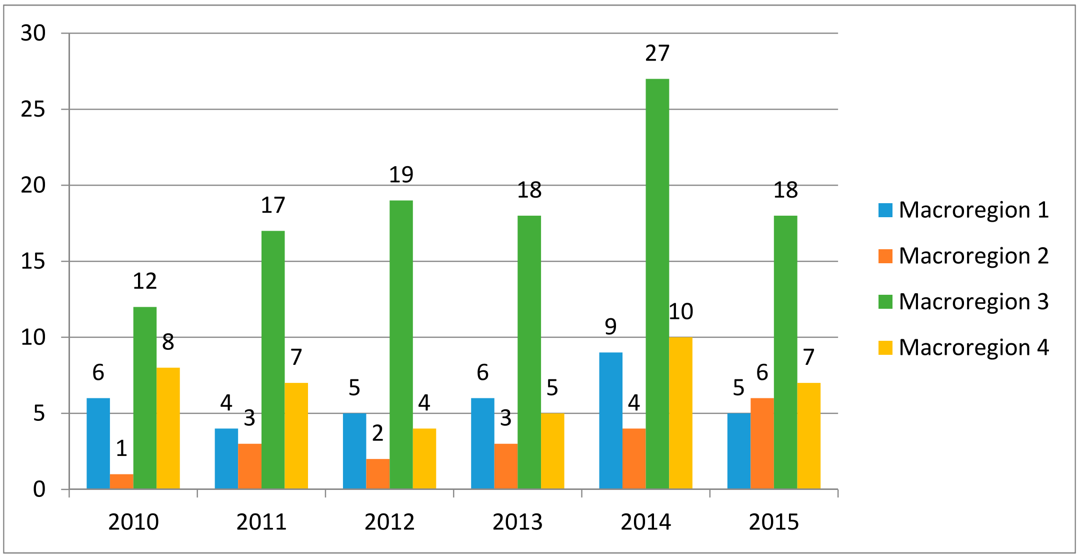

Figure 3. The evolution of the number of registered patents. Source: Authors' calculations on the basis of the data provided by Eurostat.

From the above chart, we notice that the number of patents was influenced by the economic crisis. Thus, the number of registered patents experienced a constant increase from 2010 to 2012, followed by a decline mainly due to the economic crisis, then followed by a new increase in 2014, with this year being the most prolific one of the last five years in terms of the number of registered patents. Macroregion 3 again holds the supremacy; the maximum number of patents was reached in 2014 when this geographical area had 27 patents registered. The other three regions had relatively similar outputs, the with the cohesion degree between these geographical areas increasing from year to year. Therefore, we can state that, although there is an increase trend in the regional cohesion in terms of research and development, the territorial centralization further puts its mark on this issue. In order to verify the robustness of the above statements, we will make an econometric analysis of differences between the four geographical regions in terms of the mentioned indicators with the support of the data analysis post-hoc Tukey test. Tukey HSD test is a single-step multiple comparison procedure and statistical test. It can be used on raw data or in conjunction with an ANOVA (post-hoc analysis) to find means that are significantly different from each other [30]. According to Table A1 in the Appendix A, based on *p*-values resulting from the Tukey HSD Test, we may formulate the following conclusions:

i) There are significant differences between Macroregion 3 and the other three geographical areas in terms of the three analysed indicators *Sig.* < 0.05). According to Table A1, the *p*-values calculated for the differences between these macroregions, in terms of the number of employees in research field, the number of patents, and research and development expenses, are very small (*Sig.* = 0.000). This result corresponds to our expectations, given that Bucharest is located in Macroregion 3.

ii) Between the other three macroregions, there are not significant differences in terms of the number of employees in the research field, the number of patents, and regarding the R&D expenses (*Sig.* > 0.05). According to Table A1, the p-values calculated for the differences between these macroregions, in terms of the analysed indicators, are greater than 0.05 (p-values are between 0.05 and 0.99).

Hence, we conclude that Hypotheses 4.2, 4.4, and 4.6 are valid, while 4.1, 4.3, and 4.5 are not. Table 1 shows which hypotheses are valid and which ones are not, out of the six statistical hypotheses tested.

Table 1. Validation of statistical hypotheses. Source: Authors' calculations on the basis of the data provided by Eurostat.

Hypothesis	Validated (Yes/No)
Hypothesis 4.1	No
Hypothesis 4.2	Yes
Hypothesis 4.3	No
Hypothesis 4.4	Yes
Hypothesis 4.5	No
Hypothesis 4.6	Yes

Therefore, we can say that there are significant differences between the central area and the other areas of the country. However, it has been proven that between the other regions, there are not differences in terms of the number of employees in research field, the number of patents, and the research and development expenses.

3.3. Estimation of the Economic Model

In 1956, the economists Robert Solow [31] and Trevor Swan [32] developed the macroeconomic model of long-term economic growth, based on certain variables, such as: accumulation of capital, changes in the number of employed population, and variation of technologized labour force, the latter being an expression of technological innovation and entrepreneurial rate. A Cobb-Douglas function stands at the basis of the model.

Therefore, the model will be estimated starting from the Cobb-Douglas production function:

$$Y = AL^{\beta}K^{\alpha} \tag{2}$$

where:

- A = total factor productivity
- Y = output (total production)
- K = capital input
- L = labour input
- α and β = coefficients

After deriving the Cobb-Douglas production function (see Appendix B), to achieve the growth rate of Y/L, we will calculate the first order differential equation for the previous equation and we will get:

$$\Delta \ln\left(\frac{Y}{L}\right) = \Delta \ln A + \alpha\left[\Delta \ln\left(\frac{K}{L}\right)\right] \tag{3}$$

Further on, we will consider the total factor productivity (A) to be a linear function between technological innovation (number of patents) and entrepreneurship (total entrepreneurial activity rate):

$$\Delta \ln A = B + \phi \times Pat + \lambda \times Ant \tag{4}$$

where:

- B = the constant
- Pat = number of patents/GDP
- Ant = entrepreneurial rate
- ϕ and λ are the parameters of the regression equation

Substituting Equation (4) in (3), we will get:

$$\Delta \ln\left(\frac{Y}{L}\right) = B + \phi \times Pat + \lambda \times Ant + \alpha\left[\Delta \ln\left(\frac{K}{L}\right)\right] \quad (5)$$

In the context of interstate relations, we will also include in our model the base value Y/L in order to control for convergence effects associated with states with low levels of income that have rapid growth rates.

$$\Delta \ln\left(\frac{Y}{L}\right) = B + \delta \times \ln\left(\frac{Y}{L}\right)_{t-1} + \phi \times Pat + \lambda \times Ant + \alpha\left[\Delta \ln\left(\frac{K}{L}\right)\right] \quad (6)$$

When we run this model by means of the SPSS 21 statistic software, we will use:

- $\Delta \ln\left(\frac{Y}{L}\right)$ the percentage increase of $\left(\frac{Y}{L}\right)$ and
- $\Delta \ln\left(\frac{K}{L}\right)$ the percentage increase of $\left(\frac{K}{L}\right)$

In order to homogenize annual fluctuations, we will utilize the average of the past five years.

3.4. Estimation of the Results

The regression equation we have built in order to test the four above mentioned statistical hypotheses has been performed by means of the Least Squares Method. We have used this method for calculating the services based on performance, entrepreneurship, innovation, and economic growth.

Taken together, the regression equation is a significant one, with the value of the F Test and of R-squared Test adjusted by 60.8%. Moreover, the Durbin Watson Test indicates that there are no problems of multicoliniarity between the independent variables. Meanwhile, control variables are significant and they explain about 56% of the growth rate of the 28 Member States. The negative value of β_1 coefficient confirms our expectations in terms of the convergence effect of low-income states compared to high-income states. The capital increase per capita proves to be, as expected, significant and positive.

The regression equation resulting from the econometric analysis carried out in SPSS has led to the following equation:

$$Y = 214.171 - 0.02X_1 + 0.01X_2 + 0.25X_3 + 0.13X_4 \quad (7)$$

where

- Y = factor productivity
- X_1 = production rate
- X_2 = number of patents/GDP
- X_3 = entrepreneurial rate
- X_4 = capital/labour input

Thus, after the statistical analysis, the three statistical hypotheses have led to the conclusion that Hypothesis 1, 2 and 3 all valid (see Table 2).

Table 2. Validation of statistical hypotheses. Source: Authors' calculations on the basis of the data provided by Eurostat.

Hypothesis	Validated (Yes/No)
Hypothesis 1	Yes
Hypothesis 2	Yes
Hypothesis 3	Yes

A description of the variables of the regression model could be seen in Table 3.

Table 3. Descriptive statistics of the variables in the model.

	Mean	Std. Deviation	N
Y	252.9412	740.69390	34
X_1	18,873.5294	12,205.86816	34
X_2	18,488.2353	12,413.47666	34
X_3	1325.1471	3323.53476	34
X_4	1826.7941	4191.58067	34

Source: Authors' determined values by using SPSS 21 software package (IBM Corp., Version 21.0, Armonk, NY, USA).

4. Discussion of the Results

This section discusses the factorial analysis performed by Least Squares Method. The authors have used this method for calculating the impact of performance, entrepreneurship, innovation, and economic growth on productivity factor.

The relationship between economic growth and the degree of technological innovation has recently received considerable attention in the literature. The linear regression model used in our study was estimated using Ordinary Least Square Method (OLS) and the software used in the analysis was SPSS 21 statistic software.

Analysing the evolution of production rates at the EU 28 level, during 2010–2015, according to the independent variables (performance, entrepreneurship, innovation, and economic growth) the following results were obtained for the multiple linear regression function using the multifactorial linear regression model (see Table 4): $Y = 214.171 - 0.020X_1 + 0.013X_2 + 0.252X_3 + 0.133X_4$, with the standard error coefficients : (0.011), (0.011), (0.044), and (0.036).

Table 4. Estimation of regression coefficients [a].

Model		Unstandardized Coefficients		Standardized Coefficients	t	*Sig.*	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	214.171	304.804		0.703	0.488		
	$X1$	−0.020	0.011	−0.381	−0.203	0.841	0.945	1.058
	$X2$	0.013	0.011	0.230	0.120	0.905	0.923	1.083
	$X3$	0.252	0.044	0.113	0.557	0.582	0.853	1.173
	$X4$	0.133	0.036	0.762	0.368	0.716	0.788	1.269

[a] Dependent Variable: Y. Source: Authors' determined values by using SPSS 21 software package (IBM Corp., Version 21.0, Armonk, NY, USA).

The model estimation results were statistically significant for a significance level of 5% for all four independent variables included in the model. OLS assumptions are checked for the same level of significance, except the hypothesis of errors autocorrelation, tested with Durbin-Watson test (see Table 5). The statistics value DW = 2.114, very close to 2, suggests that the errors are not autocorrelated. The software package SPSS 21 was further used to calculate the Variance Inflection

Factor (VIF) for each independent variable (see Table 4). All four values (1.058, 1.083, 1.173, and 1.269) are less than 3, so we can conclude that the independent variables are not correlated to each other. This is also relates to the results from Table 6, where all the Pearson correlation coefficients between the independent variables are very small. The intensity of the linear relationship between the variables of this model is measured by a multiple correlation ratio $R_{y/x1,\ x2,\ x3,\ x4}$ equal to 0.809 (see Table 5), which means that the relationship between the variables is direct and of high intensity. The independent variables included in the multiple linear regression model explain 65.4% of the variation of production rates at the EU 28 level (see Table 5, R square = 0.654), with the difference of 34.6% representing the influence of other factors. The correlation is depicted by a valid model. Our results are consistent with the work of Puigcerver-Peñalver [12] who developed a regression model of economic growth that partially endogenized the production rate at the EU level.

Table 5. The econometric model [b].

Model	*R*	*R* Square	Adjusted *R* Square	Std. Error of the Estimate	Durbin-Watson
1	0.809 [a]	0.654	0.608	780.12018	2.114

[a] Predictors: (Constant), X_4, X_1, X_2, X_3; [b]. Dependent Variable: Y. Source: Authors' determined values by using SPSS 21 software package (IBM Corp., Version 21.0, Armonk, NY, USA).

Table 6. The correlation matrix.

		Y	X_1	X_2	X_3	X_4
Pearson Correlation	Y	1	−0.06	0.044	0.137	0.116
	X_1	−0.06	1	0.157	0.116	0.202
	X_2	0.044	0.157	1	0.068	0.252
	X_3	0.137	0.116	0.068	1	0.38
	X_4	0.116	0.202	0.252	0.38	1

Source: Authors' determined values by using SPSS 21 software package (IBM Corp., Version 21.0, Armonk, NY, USA).

Checking the accuracy of the multiple regression models and of the multiple correlation ratios, based on the "Fisher" criterion leads to the following conclusion: because the p-value probability (*Sig.* F = 0.0343) is less than 0.05, the regression model is valid, with a significance level of 0.05 (see Table 7). Also, we consider that the independent variables included in the model have an influence on the variation of the dependent variable (EU 28 production rate) contributing to its average annual growth rate. The main conclusion of the regression model was that performance, entrepreneurship, innovation, and economic growth are influencing a significant share of 65.4% of the indices of production rate for the group of 28 countries.

Table 7. ANOVA [a] Model.

Model		Sum of Squares	df	Mean Square	*F*	*Sig.*
1	Regression	455,668.655	4	113,917.164	8.187	0.0343 [b]
	Residual	17,649,037.227	29	13,914.396		
	Total	18,104,705.882	33			

[a] Dependent Variable: Y; [b] Predictors: (Constant), X_4, X_1, X_2, X_3. Source: Authors' determined values by using SPSS 21 software package (IBM Corp., Version 21.0, Armonk, NY, USA).

In conclusion, we can say that the model is valid and correctly specified that performance, entrepreneurship, innovation, and economic growth are significant factors for production rate of the EU 28 countries, since the estimators are significantly different from zero and correctly identified as the model explains most of the variation for the production rate at the EU 28 level. Our study underscores previous assertions [4,6,10] that regional development is correlated with the economic growth target at the national scale.

5. Conclusions and Recommendations

The econometric analysis has given us the opportunity to prove that, at the national level, information technology and creation of new firms should be treated as two separate phenomena.

This statement contradicts the neo-classical model of economic growth which considers innovation as a proxy variable of entrepreneurship that is described by means of creation of new firms [33]. Moreover, both the lack of collinearity in the regression model of the two explicative variables and the lack of significance of the term given by the interaction between the named variables, demonstrate that there is not a substantial juxtaposition between the mentioned indicators.

At the same time, the impact of control variables on the dependent ones is much higher in the case of prediction variables than that in the case of control variables. This means that innovation as well as the creation of new firms does have a higher impact in terms of growth rate compared to the impact of GDP/capita and of capital increase/capita.

The regional econometric analysis has just proven that there are significant discrepancies in terms of innovation and research development between the Bucharest area and the other geographical regions in the country. If we exempt Bucharest, we notice that these differences do not exist. Therefore, one of the most important implications of the results of the research is that the economy should be decentralized, which could lead to an increase of the economic development convergences between the capital area and the other zones of the country.

The results of the econometric analysis strengthen the conclusions expressed in the European Commission Scoreboard reports on Innovation Index in Romania, at the country level, and also in the state's geographical regions, calculated according to the acknowledged classification. Beyond the worrying figures placing Romania in one of the last positions in the ranking of EU Member States, the recommendations for reducing bureaucracy, for increasing the awareness about the need for intellectual property protection, as well as for enhancing the absorption of structural funds by means of projects allocated to research and innovation, do remain true in terms of representing valid solutions. However, these measures depend largely on the organizational management at the micro level and, particularly, at the Romanian public administration level.

Given the fact that computations of the macroeconomic indicators that have been used in the regression analysis covered a period of six years, one of the main limitations of this research paper is in relation to the six year period used for the database in the factor analysis. It would be recommendable for future research studies to resort to considering a longer period of time, which may provide a more accurate picture of the regression model that was applied to macroeconomic indicators related to Romania.

This work could also be extended to other similar countries in terms of economic development, such as Bulgaria or Croatia. Bulgaria is a neighbouring country, who joined EU at the same time as Romania, in 2007, and has similar development of the economy, while Croatia, the newest country of European Union, also has many similarities with Romania, such as a similar demography and economy. This could be further investigated as part of a future research study.

Author Contributions: Cristian Busu contributed by presenting the discussion of the transition of the Romanian research system, the analysis of regional cohesion in Romania, and the conclusions. Additionally, Cristian Busu was responsible for organizing the numerical results, the main interpretations, and the writing of the paper. Mihail Busu contributed by gathering the data, creating the model for services based on performance, entrepreneurship, innovation, and economic growth, creating the economic model, and analysing the results.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Multiple Comparisons Tuckey HSD.

Dependent Variable			Mean Difference (I-J)	Std. Error	*Sig.*
Nr_empl_research (number of employess in the research area)	1	2	870.67	469.43	0.26
		3	−14,945.83333 *	469.43	0
		4	1244.92	469.43	0.05
	2	1	−870.67	469.43	0.26
		3	−15,816.50000 *	469.43	0
		4	374.25	469.43	0.86
	3	1	14,945.83333 *	469.43	0
		2	15,816.50000 *	469.43	0
		4	16,190.75000 *	469.43	0
	4	1	−1244.92	469.43	0.05
		2	−374.25	469.43	0.86
		3	−16,190.75000 *	469.43	0
Nr_patents (number of patents)	1	2	2.06	1.57	0.56
		3	−9.7800 *	1.57	0
		4	0.37	1.57	1
	2	1	−2.06	1.57	0.56
		3	−11.83750 *	1.57	0
		4	−1.69	1.57	0.7
	3	1	9.78000 *	1.57	0
		2	11.83750 *	1.57	0
		4	10.15083 *	1.57	0
	4	1	−0.37	1.57	1
		2	1.69	1.57	0.7
		3	−10.15083 *	1.57	0
R_and_D_expenses (expendures on research and development)	1	2	13.16	32.02	0.98
		3	−254.22500 *	32.02	0
		4	21.9	32.02	0.9
	2	1	−13.16	32.02	0.98
		3	−267.38708 *	32.02	0
		4	8.74	32.02	0.99
	3	1	254.22500 *	32.02	0
		2	267.38708 *	32.02	0
		4	276.12350 *	32.02	0
	4	1	−21.9	32.02	0.9
		2	−8.74	32.02	0.99
		3	−276.12350 *	32.02	0

* The mean difference is significant at the 0.05 level.

Appendix B. Estimating the Model Starting from the Cobb-Douglas Production Function

We will consider the particular case in which scale elasticity is constant:

$$\alpha + \beta = 1 \tag{A1}$$

Thus, the Equation (2) becomes:

$$Y = AL^{1-\alpha}K^{\alpha} \tag{A2}$$

Dividing both members by L, we will get:

$$\frac{Y}{L} = A\left(\frac{K}{L}\right)^{\alpha} \tag{A3}$$

To linearize this exponential equation, we will take logarithms of the two members of the equation:

$$\ln\left(\frac{Y}{L}\right) = \ln\left[A\left(\frac{K}{L}\right)^{\alpha}\right] \tag{A4}$$

$$\ln\left(\frac{Y}{L}\right) = \ln A + \alpha \ln\left(\frac{K}{L}\right) \tag{A5}$$

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