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COMPETITIVENESS AND REGIONAL DEVELOPMENT IN GREECE[12]

Abstract

The aim of this paper is to examine the factors that influence the increase of GDP in the Greek regions. The paper examines the effect that six basic groups of variables have on the structure of GDP. Using factor analysis, the large number of variables decreases significantly, at the same time the descriptive ability of the formulated models increases considerably. Each Greek region is examined separately in order to find the specific factors that influence its competitiveness. The findings suggest that research and development plays an important role on the growth of GDP in all regions. In total, the factors that influence regional competitiveness are found to be regional infrastructure, human resources, production environment, knowledge capital and the ability for innovative activity.

Key words:

Competitiveness, Regional Development, Greece.

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1. Introduction

Regional policy initiatives in Greece increasingly targeted the promotion of new business activity under the principle that new firms add to the dynamism of the economy (Liargovas, Daskalopoulou: 2007). Entrepreneurship is a key factor determining the economic performance of regions (Acs, Audretsch: 2003). New enterprises are essential to the economic output of regions because not only appropriate existing resources, but also harness new ideas and generate innovations (Baumol: 2002). Therefore, increased entrepreneurial activity concurs with the existence of competitive and dynamic economies. On the other hand, a thorough understanding of the drivers of entrepreneurial activity at regional level is still missing. Research findings offer unclear conclusions as regards the driving forces of entrepreneurship (ECORYS: 2003).

Cunningham (1993) used a standard production function model to investigate the relationship between economic growth and some other variables. $Y = (K, LF, DS)$ where Y, K, LF and DS represent GDP, capital stock, labour force and debt servicing, respectively. Moreover, Cunningham (*op.cit.*) argued that when external debt is significant, this affects adversely both capital and labour efficiency. Furthermore, domestic investors cannot have any benefits arising as a consequence of increases in these factor productivities. Karagol (2002) extended the Cunningham model to engulf Romer's (1996) approach to human capital. With an additional human capital (H) variable, the new production function takes the following form: $Y = (K, LF, DS, H)$ (Wijeweera, *et. al.*: 2005).

The present study aims to determine the factors that influence regional GDP in the Greek economy given the difference characteristics of the Greek regions. Such findings might contribute to a better understanding of theoretical model and can be used for policy planning in the greek regions. The derivation of both theoretical and policy related conclusions is possible, as they enrich our knowledge of the mechanisms underlying the attractiveness of regions as location destinations and thus of the formation of regional clusters.

2. Theoretical Framework

Traditionally, neither economists nor economic geographers have reached a unanimous conclusion about the effects of competitiveness on regional growth (Gardiner, *et.al.*: 2004). Only recently has this state of affairs begun to change (Steinle: 1992; Cheshire, Gordon: 1995; Duffy: 1995; Group of Lisbon: 1995; Storper: 1995, 1997; Jensen-Butler: 1997; Begg: 1999, 2002; Urban Studies:

1999; Camagni: 2003; Porter: 1998a, 1998b, 2000, 2001, 2003). However, all the research findings are far from any common consent about the nature and measurement of regional competitiveness. A not unusual theme, though, is that regional (and urban) competitiveness has to do with the success with which regions and cities compete with each other over shares of national and particularly global export markets. This concept would seem to support the European Commission's interpretation of the term: [Competitiveness is defined as] «the ability to produce goods and services which meet the test of international markets, while at the same time maintaining high and sustainable levels of income or, more generally, the ability of (regions) to generate, while being exposed to external competition, relatively high income and employment levels» (European Commission: 1999, p. 4).

Given that regional economies have the tendency to be more open to trade than the national economies of which they are a part, this focus on export performance would seem to be warranted. The «export base» of a region or city has long been viewed as key to regional and urban prosperity, as recently re-emphasised by Rowthorn (1999): «The success of a region is determined chiefly by the strength of its export base … all those activities which bring income into the region by providing a good or service to the outside world…. The alternative term 'tradables' is also used to indicate such manners» (*ibid*: pp. 22–23).

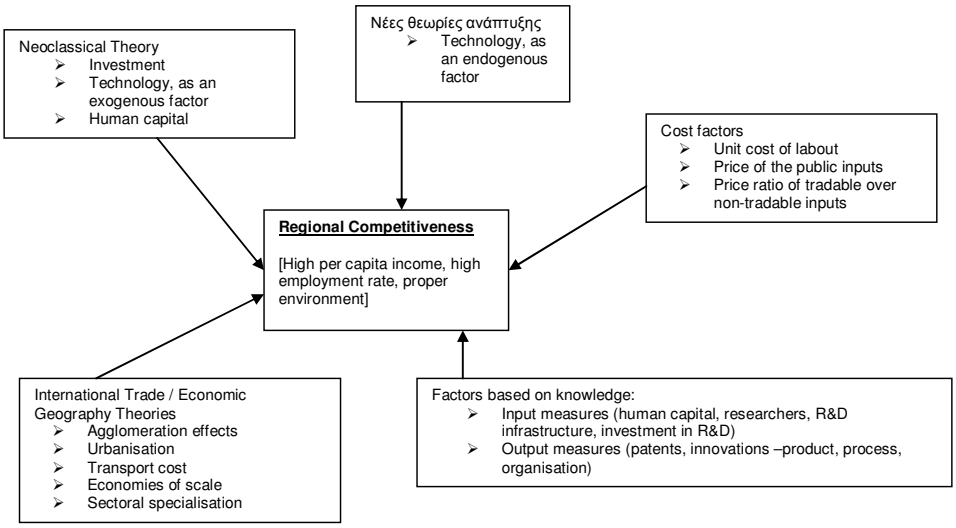
Porter, who has been amongst the most significant writer on «competitive advantage» of firms, industries, nations and regions and cities also, argues that the best measure of competitiveness is productivity: Competitiveness remains a concept that is not well understood, regardless of widespread acceptance of its importance. To comprehend competitiveness, the starting point must be the sources of a nation's prosperity. A nation's standard of living is determined by the productivity of its economy, which is measured by the value of its goods and services produced per unit of the nation's human, capital and natural resources. Productivity depends both on the value of a nation's products and services, measured by the prices they can command in open markets, and the efficiency with which they can be produced. True competitiveness, then, is measured by productivity. Productivity allows a nation to support high wages, a strong currency and attractive returns to capital and with them a high standard of living (Porter, Ketels: 2003).

Figure 1 suggests that productivity may differ between regions for a lot of different reasons. But similarly important is how such differences are predicted to evolve over time. In the typical neoclassical model the growth of productivity (output per worker) hinges on the growth of capital per worker and the (exogenous) rate of technical progress (or total factor productivity). Therefore, regional differences in productivity growth are explained by regional differences in the rate of (exogenous) technical progress and by regional differences in the growth of the capital labour ratio. But given that the model also assumes constant returns to scale, diminishing returns to labour and capital, and complete factor mobility – including the unrestricted diffusion of technological advance – regional productivity disparities are predicted to narrow over time, as in the beginning low

productivity regions draw near with initially high productivity ones (Table 1). Neoclassical growth models of regional convergence have been much researched in recent years with varying empirical results (Martin-Sunley: 1998).

Figure 1

Theoretical background for examining regional competitiveness



Source: Gardiner *et.al.*, (2004)

The importance of factors that increase GDP at regional level is a well established result in the literature. These parameters are almost always of a systemic investigation (Kline-Rosenberg: 1986; Kaufmann-Wagner: 2005), comprising networks at international, national (Lundvall:1992; Nelson: 1993) and regional levels (Cooke *et. al.*:2004). Regional technological innovativeness itself is perhaps most directly addressed in the «regional innovation systems» approach employed by Cooke and his European associates over the past decade (Braczyk *et. al.*:1998; Wood: 2005). This, in effect, produces many other approaches and draws together a range of regional innovation terminologies, including regional «innovative milieux», «innovation and technology policies», «innovation networks», «high technology complexes» and «technopoles» (Cooke: 1998).

Table 1

Three Theoretical Perspectives on Regional Productivity Growth

Theory	Explanation of regional productivity differences	Evolution of regional productivity differences
Neoclassical Growth Theory	Regional differences in productivity due to different factor endowments, and especially differences in capital/labour ratios and technology.	Assumes constant returns to scale; diminishing returns to factors of production; free factor mobility and geographical diffusion of technology, so that low productivity regions should catch up with high productivity one; *i.e.* regional convergence in productivity.
Endogenous Growth Theory	Regional differences in productivity due to differences in capital/labour ratios, knowledge base and proportion of workforce in knowledge producing industries.	Implications for regional productivity evolutions depends on the extent to which low technology regions catch up with high technology regions, and this on the degree of geographical diffusion of technology and knowledge, and flows of knowledge workers. The more knowledge/technology spillovers are localised, and the more knowledge workers move to leading technology regions the more productivity differences between regions will persist, or even widen.
«New Economic Geography» Models	Spatial agglomeration/ specialisation/clustering are key sources of externalities and increasing returns (labour, knowledge spillovers, specialist suppliers, etc) that give local firms higher productivity.	Economic integration (trade, factor flows) increases tendency to spatial agglomeration and specialisation of economic activity, leading to «core-periphery» equilibria and persistent regional differences in productivity.

Source: Gardiner *et.al*., (2004), Bassiakos *et.al.* (2009)

The most common explanation in this literature encompasses a range of economic, social, cultural and institutional influences, but focuses on the importance of the quality of regional knowledge exchange, the interactivity of skills, and global market awareness (Simmie: 2001). Such «service» qualities are also subsumed, for example, within the economists' regional external economies and «knowledge spillover» effects (Krugman: 1991, 1995; Audretsch: 2002). They are more obviously recognised by advocates of «knowledge» and «learning» regions (Lundvall: 1992; Lundvall-Maskell: 2000; Feldman: 2000; Asheim: 2000); and in ideas about social «embeddedness» and «untraded interdependencies» (Grabher: 1991; Storper: 1997). The recent interest in the institutional and relational basis of economic development also reflects service qualities (Thrift: 2000; Barnes: 2001; Yeung: 2003). Even Porter's competitive diamond incorporates a

good deal of «service support» into what is basically an agglomeration-based cluster model (Porter: 1998; 2000). These various interpretations all derive from the experience of economically successful regions. They also underpin recent interest in the regional potential of the globalising «cultural economy» (Scott: 2000). In all of these approaches, competitive innovativeness is interpreted more widely than technological innovation alone, also including success in financial, business service, media, cultural and consumer markets.

The endogenous nature of the relationship between spillovers and agglomeration, however, has been rarely acknowledged in the existing literature (*ibid*). The development of a comprehensive framework of regional economy will not only enrich theoretical discussions on regional development but also have practical implications for policy debates. Research and development (R&D), innovations, and subsequent technological changes and spillovers are the most important factors of regional economic development (*ibid*). The growing popularity of the new growth theory (Romer: 1986, 1990), emphasizing the role of technology in economic growth, shows increasing attention to this topic. Influenced by such theoretical development, many cities and states have introduced policy initiatives to promote R&D activities in their regions.

3. Data Description

From the above analysis variable and/or indexes can be identified as possible factors that affect regional competitiveness, *i. e.* regional GDP growth.

These factors can be grouped into the following categories:

1. INFRASTRUCTURE
   - 1.1. Road safety (injuries and deaths) (var 1)
   - 1.2. Total of transport vehicles (excluding trailers and motor scooters) (var2)
   - 1.3. Motorways (var3)
   - 1.4. Other roads (var4)
   - 1.5. Total Length of Railway Lines (var5)
2. HUMAN RESOURCES
   - 2.1. Percentage of Net Immigration (= Net Immigration/Average Population) (var 7)
3. PRODUCTIVE ENVIRONMENT
   - 3.1. Employees (NUTS, second level), (1000) (var10)
   - 3.2. Percentage of primary sector in total employment (var12)

3.3. Percentage of Industry in total employment (var13)

3.4. Percentage of Services in total employment (var14)

3.5. Added Value in Primary Sector, Million of Euros (from 1.1.1999)/Million of ECU (until 31.12.1998) (var15)

3.6. Value Added in Industry, Million Euros (since 1.1.1999)/Million ECU (until 31.12.1998) (var16)

3.7. Value Added in Services, Million Euros (since 1.1.1999)/Million ECU (until 31.12.1998) (var17)

3.8. Formation of Fixed Capital in all sectors, NUTS second level, Million Euros (since 1.1.1999)/Million ECU (until 31.12.1998) (var18)

3.9. Exports/Total (Intra-European Trade) (var21)

3.10. GDP/employee (1000) (var22)

3.11. Moran index of geographic adjacent[3] (var23)

4. KNOWLEDGE CAPITAL

4.1. Human Resources in Research and Technology (% of Active Population) (var 27)

4.2. Personnel in Research and Development in all sectors, per capita (var 28)

4.3. Personnel in R&D in government owned sector per capita (var32)

4.4. Personnel in R&D in higher education per capita (var34)

4.5. Percentage of employment in education (% of the Total Employment) (var36)

4.6. Percentage of employment in Knowledge Intensive Business Services (KIBS) (% of Total Employment) (var38)

5. ABILITY FOR INNOVATIVE ACTIVITY

5.1. Total Investment in Research and Development, Million Euros (since 1.1.1999)/Million ECU (until 31.12.1998) (var39)

6. R & D OUTPUT

6.1. Total Number of Patent Applications, per million of employees (var44)

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[3] Moran index is calculated by the following formula: $I = \frac{\sum_{i}^{N}\sum_{j}^{N} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i}^{N}(x_i - \bar{x})^2}$ where x_i and x_j is productivity in region *i* and *j*. w_{ij} are the elements of a matrix *W* taking the value of 1 if regions are adjacent and 0 if regions do not share common geographical borders.

The initial data file contained observations for variables that covered the period between 1990 to 2002, for 13 regions of Greece: Eastern Macedonia – Thrace, Central Macedonia, Western Macedonia, Thessaly, Ipiros, Ionian Islands, Western Greece, Sterea Hellas, Peloponnese, Attica, Northern Aegean, Southern Aegean, and Crete. It was expected therefore, that the total observations would be 169 (13 x 13). The file however, presented an important problem of missing values. Consequently, only 13 observations had complete data. This sample, with 13 observations was selected in order to estimate the missing values. In order to estimate the parameters of the estimated models, the least square method was employed with dependent variable the variable under investigation and independent variable, the time (year). Consequently, missing values were filled in by the use of regression interpolation.

As it appears from the variables, it is obvious that their size constitute inhibitory factor for an effective analysis, where the depended variable is the annual percentage change of regional GDP. For this reason, it was decided some groups of variables to be created with the method of factor *analysis*, and moreover to exclude some variables that did not explain satisfactory the dependent variable.

The variables that were grouped are the following: *Road Safety (var 1), Total of transport vehicles (var2), Motorways (var3), Other Roads (var4), Total Length of Railway Lines (var5),* in one or two factors (roads 1 and roads 2), depending on the result of factor analysis, *Value Added in Primary Sector (var15), Value Added in Industry (var16), Value Added in Services (var17)*, in one or two factors (value added and value added_2), depending on the result of factor analysis, and *Human Resources in Research and Technology (var27), Personnel in Research and Development per capita (var 28), Personnel in R&D in government owned sector per capita (var32), Personnel in R&D in higher education per capita (var34), Percentage of employment in education (var36), Percentage of employment in KIBS (var38)*, in one or two factors (research and development and research and development_2), depending on the result of factor analysis.

The variables that were excluded are the following: *Percentage of Industry in total employment (var13)*, because it was completely dependent with the variables: *Percentage of primary sector in total employment (var12), and Percentage of Services in total employment (var14)*, and *the Moran index of geographic adjacent (var23)*, because of the analysis did not focus in the comparative study between regions. Moreover, this variable, in order to be analyzed, would be supposed «to break» into 78 variables-indexes, and this is something that would stiffen the analysis. Further, it was chosen to ignore the factor from the factor analysis of the variables relative to the road and railway network. Finally, variable *GDP/Employee (var22)* was excluded, because of the probably powerful relation that had with the dependent variable, which can overshadowed the relation of the rest of the variables with the dependent variable.

Moreover, due to powerful cross-correlation between the variables *Total Investment in Research and Development (var39)* and *Exports/Total (Intra-*

European Trade) (var21), we have applied the least square method on the second variable, having as an independent variable the first one. The residuals of this regression were used as an independent variable in main regression under the name *residual of exports on R&D investment*.

The main regression analysis was made for each region separately with a the stepwise regression method and the results are reported in the next section. The results for each region begin with a small paragraph that contains the results of factor analysis and the variables that resulted from this analysis, as well as the corresponding information on the initial regression and similarly, the variable that resulted from this analysis. The rest is dedicated in the presentation of the main results, *i.e.* the results of the regression of the GDP increase on the secondary variables (factors and residuals of regression) and all primary variables they were not used in the construction of the secondary variables.

4. Results and Discussion

1. Region of Eastern Macedonia and Thrace

   a. *Factor Analysis*: Applying factor analysis on value added resulted a factor that contains 91% of total variability. From the factor analysis of relative variables with research and development a factor that contains 90% of total variability was resulted. Finally, from the regression of exports on total investments in research and development a model with a coefficient of determination R^2 (adjusted) equal to 0,604 and a significant level equal to 0,001 was resulted. Both values are satisfactory, and the residuals of this regression are used as independent variable in exports. Therefore, the new variable represents the additional effect of exports (except the part that was correlated with investments in research and development).

   b. *Regression Analysis*: The only variable that was statistically significantly different from zero and had negative relation with the change of GDP is the stochastic trend of regression. The model had high adjusted R^2 (equal to 0,916) and a significance level equal to 0,000.

2. Region of Central Macedonia

   a. *Factor Analysis*: Applying factor analysis on value added resulted a factor that contained 83,9% of total variability. From the factor analysis of variables relative to the research and development results a factor that contain 66% of total variability. Finally, from the regression of exports on total investments in research and development results a model with R^2 (adjusted) equal to 0,165 and level of statistical significance equal to 0,093. Both values are rather prob-

lematic, and consequently the residuals of this regression were not used as an independent variable in the exports place.

b. *Regression Analysis*: The variables Percentage of immigration, total employees in Research and Development, number of applications of patents and added value had statistically significant negative relation with the rate of increase of GDP (p – values: 0,0067, 0,0004, 0,0015, 0,0029, and 0,0035). The variable: employees in rural sector had statistically significant positive relation with the rate of increase of GNP (p – value = 0,0048). The model had high adjusted R^2 (equal to 0,867) and level of statistical significance equal to 0,002.

3. Region of Western Macedonia

a. *Factor Analysis*: Applying factor analysis on value added resulted in a factor that contained 74% of total variability. From the factor analysis of variables relative to the research and development resulted a factor that contains 64,1% of total variability. Finally, from the regression of exports on total investments in research and development results a model with R^2 (adjusted) equal to 0,939 and a level of statistical significance equal to 0,000. Both values are particularly satisfactory, and consequently the residuals of this regression were used as independent variable in exports place. So, this variable represents the additional effect of exports (except the part that had relation with investments in research and development).

b. *Regression Analysis*: The variables fixed capital, number of patent applications and value added had statistically significant negative relation with the rate of increase of GDP (p – values: 0,0036, 0,0002, and 0,00003). The variables: Percentage of immigration, employees in rural sector, employees in services, investments in Research and Development, and the residuals of regression (that is to say the effects of exports except the research and development), had statistically significant positive relation with the rate of increase of GDP (p – values: 0,0021, 0,0254, 0,0002, 0,00003, and 0,0025). The model had high adjusted R^2 (equal to 0,984) and a level of statistical significance equal to 0,0003. (Note that the negative relation of number of patent applications could have caused by a high value of this variable for 1996, which had as a result, a declining – in time – sequence of estimated values from the process of interpolation of missing values, while at the same time the expenses for Research and Development increased).

4. Region of Thessaly

a. *Factor Analysis*: Applying factor analysis on value added resulted in a factor that contains 44,5% of total variability. From the factor analysis of the variables relative to research and development re-

sulted a factor that contains 83,8% of total variability. Finally, from the regression of exports on total investments in research and development results a model with R^2 (adjusted) equal to 0,566 and a level of statistical significance equal to 0,002. Both values are satisfactory, and consequently the residuals of this regression were used as an independent variable in exports place. Therefore, this new variable represents the additional effect of exports (except the part that had relation with investments in research and development).

b. *Regression Analysis*: The variable number of patent applications had statistically significant positive relation with the rate of increase of GDP (p – value= 0,016). The model had adjusted R^2 equal to 0,372 and a significance level equal to 0,016.

5. Region of Iriros

a. *Factor Analysis*: Applying factor analysis on value added resulted to a factor that contained 87,8% of total variability. From the factor analysis of the variables relative to research and development two factors resulted that contained 84,6% of total variability. Finally, from the regression of exports on total investments in research and development resulted a model with R^2 (adjusted) equal to 0,925 and a significance level equal to 0,000. Both values are satisfactory, and the residuals of this regression were used as an independent variable in exports place. Thus, this variable can represent the additional effect of exports (except the part that had a relation with investments in research and development).

b. *Regression Analysis*: The variables: Research and Development, and residuals of regression (that is to say the effect of exports excluding research and development), had statistically significant positive relation with the rate of increase of GDP (p – values: 0,00006, and 0.0018). The model had high adjusted R^2 (equal to 0,83) and a significance level equal to 0,000.

6. Region of Ionian Islands

a. *Factor Analysis*: Applying factor analysis on value added resulted to a factor that contains 77,1% of total variability. From the factor analysis of variables relative to research and development two factors were resulted that contained 77% of total variability. Finally, from the regression of exports on total investments in research and development results a model with R^2 (adjusted) equal to 0,844 and level of statistical significance equal to 0,000. Both values are satisfactory, and the residuals of this regression were used as independent variable in exports place. Hence, this variable represents the additional effect of exports (except the part that was correlated to the investments in research and development).

b. *Regression Analysis*: The variable total employees had statistically significant negative relation with the rate of increase of GDP (p – value = 0,0019). The variable fixed capital had statistically significant positive relation with the rate of increase of GDP (p – value=0,000006). The model had high adjusted R^2 (equal to 0,876) and a significance level equal to 0,0003.

7. Region of Western Greece

a. *Factor Analysis*: Applying factor analysis on value added results in a factor that contained 77% of total variability. From the factor analysis of variables relative to research and development develops a factor that contained 64,9% of total variability. Finally, from the regression of exports on total investments in research and development results a model with R^2 (adjusted) equal to 0,955 and level of statistical significance equal to 0,000. Both values are satisfactory, and the residuals of this regression were used as an independent variable in exports place. Accordingly, this variable represents the additional effect of exports (except the part that was correlated to investments in research and development).

b. *Regression Analysis*: The variable Research and Development, had a statistically significant positive relation with the rate of increase of GDP (p – value = 0,0755). The model had high adjusted R^2 (equal to 0,192) and a significance level equal to 0,0755.

8. Region of Sterea Hellas

a. *Factor Analysis*: Applying factor analysis on value added results in a factor that contains 97% of total variability. From the factor analysis of variables relative to the research and development resulted two factors that contains 76,1% of total variability. Finally, from the regression of exports on total investments in research and development resulted in a model with a significance level equal to 0, 522. Consequently, the residuals of this regression were not used as independent variable in exports place.

b. *Regression Analysis*: The variable Research and Development had statistically significant positive relation with the rate of increase of GDP (p – value= 0,0321). The model had adjusted R^2 equal to 0,295 and significance level equal to 0,0321.

9. Region of Peloponnese

a. *Factor Analysis*: Applying factor analysis on value added resulted in a factor that had 68,7% of total variability. From the factor analysis of variables relative to the research and development resulted a factor that contains 83,2% of total variability. Finally, from the regression of exports on total investments in research and development comes a model with R^2 (adjusted) equal to 0,584 and a significance

level equal to 0,001. Both values are satisfactory, and consequently the residuals of this regression were used as an independent variable in exports place. Subsequently, this variable represents the additional effect of exports (except the part that was correlated to investments in research and development).

b. *Regression Analysis*: The variable Percentage of participation of employees in services had statistically significant negative relation with the rate of increase of GDP (p – value = 0,0028). The model had adjusted R^2 equal to 0,532 and marginal significance level equal to 0,0003.

10. Region of Attica

a. *Factor Analysis*: Applying factor analysis on value added resulted in a factor that contained 93,7% of total variability. From the factor analysis of variables relative to research and development resulted a factor that contains 73,5% of total variability. Finally, from the regression of exports on total investments in research and development resulted a model with R^2 (adjusted) equal to 0,526 and a significance level equal to 0,003. Both values are satisfactory, and the residuals of this regression were used as an independent variable in exports place. So, this new variable represents the additional effect of exports (except the part that was correlated to investments in research and development).

b. *Regression Analysis*: The variable residuals of regression (that is to say the effect of exports except from research and development), had statistically significant negative relation with the rate of increase of GDP (p – value = 0,0295). The variables Employees, and investments in Research and Development had statistically significant positive relation with the rate of increase of GDP (p – values: 0,00005, 0,0005). The model had high adjusted R^2 (equal to 0,904) and a significance level equal to 0,00002.

11. Region of Northern Aegean

a. *Factor Analysis*: Applying factor analysis on value added resulted a factor that contained 80,4% of total variability. From the factor analysis of variables relative to research and development resulted in a factor that contains 80,4% of total variability. Finally, from the regression of exports on total investments in research and development resulted a model with R^2 (adjusted) equal to 0,679 and a significance level equal to 0,0003. Both values are satisfactory, and the residuals of this regression were used as an independent variable in the exports place. So, this new variable represents the additional effect of exports (except the part that was correlated to investments in research and development).

b. *Regression Analysis*: The variable employees in services had statistically significant negative relation with the rate of increase of GDP (p – value= 0,0007). The model had high adjusted R^2 (equal to 0,719) and a significance level equal to 0,0007.

12. Region of Southern Aegean

a. *Factor Analysis*: Applying factor analysis on value added resulted in a factor that contained 64,5% of total variability. From the factor analysis of variables relative to research and development two factors were resulted that contained 76,6% of total variability. Finally, from the regression of exports on total investments in research and development resulted a model with R^2 (adjusted) equal to 0,671 and a significance level equal to 0,0004. Both values are satisfactory, and the residuals of this regression were used as independent variable in exports place. So, this variable characterizes the additional effect of exports (except the part that was correlated to investments in research and development).

b. *Regression Analysis*: The variable employees had statistically significant negative relation with the rate of increase of GDP (p – value= 0,0025). The model had an adjusted R^2 (equal to 0,541) and a significance level equal to 0,0025.

13. Region of Crete

a. *Factor Analysis*: Applying factor analysis on value added resulted in a factor that contains 59% of total variability. From the factor analysis of variables relative to research and development resulted a factor that contained 72,2% of total variability. Finally, from regression of exports on total investments in research and development resulted a model with R^2 (adjusted) equal to 0,87 and a significance level equal to 0,000002. Both values are satisfactory, and the residuals of this regression were used as independent variable in exports place. So, this variable stands for the additional effect of exports (except the part that was correlated to investments in research and development).

b. *Regression Analysis*: The variables Research and Development and percentage of employees in rural sector had statistically significant positive relation with the rate of increase of GDP (p – values: 0,0005, and 0,0214). The model had an adjusted R^2 (equal to 0,663) and a significance level equal to 0,0018.

5. Conclusions

From the results presented in section 4 the following conclusions can be listed: regarding to factor analysis for all regions the following comments can be made. Initially, the change in the value added of three basic sectors (agriculture, industry and services) seems to influence considerably the total variability of GDP of regions in Greece. Similarly, the change of the group of variables that are related to research and technology had an equally important role for explaining the change in regional GDP. Finally, the regression of exports on total investment in research and development appeared to have different behavior from previous two. In the regions where the coefficient of determination were high in the first two models, the model of exports (third model) had low explanatory ability and reverse. In the case where the third model had high explanatory ability, the residuals of the third regression model present an important interest for investigation of the additional effects of exports.

Regarding the regression analysis the factor that affect regional competitiveness in Greece were found to be: (a) regional infrastructure, (b) human resources, (c) productive environment, including diffusion effects, (d) human capital and (e) ability to innovative activity.

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