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## Evaluation of the effects of European regional policy in the diminution of regional disparities

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**“EVALUATION OF THE EFFECTS OF EUROPEAN REGIONAL POLICY IN THE  
DIMINUTION OF REGIONAL DISPARITIES”**

**ABSTRACT:** One of the EU objectives is economic and social cohesion, which is a necessary step for the success of European integration. A key factor for cohesion is the implementation of the adequate regional policy in order to reduce regional disparities. This objective can be reached in two different ways. The first one is through leveling transferences from rich to poor regions. The second one would tend to locate peripheral regions in conditions of developing production activities so as to reach an economic development similar to that of the richest ones. This second way, which consist of “equalizing opportunities”, is the one we prefer.

In this paper, we analyze at which extent European regional policy has allowed to reach the conditions needed in order to stimulate endogenous development in the less developed regions. In this connection, we reckon that the main factors in order to reach this development are geared in stimulating both industrial investment and research and education. We analyze whether or not this elements have been adequately addressed within European policy.

## 1. INTRODUCTION

In this paper, we analyze the regional disparities in the European Union, specially in the distribution of research and development expenditure. Our main emphasis is in analysing the impact of R&D expenditure on regional economic growth. For that purpose we distinguish between University and Non-University funds and also between NSE (Natural Sciences and Engineering) and SSH (Social Sciences and Humanities) expenditure, in order to achieve interesting conclusions for regional policy.

This paper is structured in 5 sections. In section 2, we present the main factors needed to achieve a European Union without regional disparities, such as industrial policy, education and quality of labour force and research and development policy.

In section 3, we analyze the distribution of R&D Expenditure on the European Regions both by sectors of performance and by fields of science. The figures show that EU stays behind both USA and Japan and that there are very important regional differences between the poorest and the richest regions.

In section 4, we present the estimation of some Econometric Models for explaining the relations between the GDP per head and the R&D Expenditure by head, differencing both the sector of performance and the type of expenditure. From the results it stands out that SSH expenditure at the Universities has the main positive impact on regional growth and the existing differences in the distribution of SSH expenditure play an important role in explaining regional economic disparities.

The European policy does not help to overcome the difficulties to reach a more even regional distribution of the expenditure on research in economics and other social sciences that has great influence in regional economic growth.

In section 5, we present the main conclusions of this study. We also include an annex with the Statistical sources and the bibliographic references.

## 2. ECONOMIC POLICY AND REGIONAL CONVERGENCE

In this section, we want to stand out that EU has not had a real convergence policy. Very few regions of peripheral Europe have experienced a GDP's rate of increase over the average of EU countries in the last years. Ireland and the region North of Portugal are two examples of industrial investment and growth over mean rates but there are not many other examples.

We must ask what is wrong with European Regional Policy if we think that real convergence is a goal to be reached.

Following the paper by Guisán (1996) we can distinguish the following policies that have an important effect on real convergence:

1) Industrial policy. Many peripheral regions of Europe are paying a price for their geographical situation as it has been shown in our model of industrial growth in European regions in which we estimated a "peripheral effect", negative, and a "central effect", positive (see Guisán, Cancelo and Díaz; 1997). This means that real convergence is only possible if there are measures that encourage, directly or indirectly industrial development in peripheral regions, since a basis of industry is generally needed to stimulate growth in other sectors such as services and building, as well as to avoid unwished emigration.

It is very important to reformulate the European industrial policy. Following the interesting studies by Mayes and Begg (1994), Mayes (1997) y Hartley at al (1997) we should take into account the regional or local factors which influence the firm costs, including the access to markets and suppliers, the quality of labour force, the amount and type of policy incentives obtainable by producers and advisory services of high level at low cost. This can be reached if the EU policy includes helps for the improvement of the socio-economic collaboration of Universities with firms.

2) Education and quality of labour force. Many regions of the southern periphery have a high percentage of active population without secondary studies. The figures are really impressive (see Guisán and Frías, 1997, and Cancelo and Guisán, 1998) and something should be made to change this lack of opportunities for growth. The first step should be a policy for

adult education, with a participation of second cycle teachers and the advice of University experts, being this crucial issue more important than a bureaucratic question of resources allocation among social agents. This population can not reach a good quality education, in the sense of both formation and information, if European funds are allocated without taking into account the opinion of qualified teachers and professors.

### 3) Research and development policy.

The regional differences are still very important in the European Union in spite of the fact that one of the Community objectives is to achieve economic and social cohesion.

As we have stated above, policy measures aimed at diminishing the regional disparities must be oriented to stimulate their own regional capacities and not be only based on external transferences which increase the dependence of the poor regions on the rich ones.

The investment in research and development is one of the main factors required to avoid this dependence and to stimulate endogenous capacities of innovation and adaptation. It is necessary that the less favoured regions have both infrastructures and resources to develop their own R&D capacities and mechanisms to maintain a continuous contact with groups of researchers from other regions.

We are going to analyze the regional impact of the European R&D policies. The main Community R&D activities have been included in 4 Framework Programmes. The last is about to finish (1994-98). For this reason the European Commission is working in the design of the next one (1998-2002).

The funds directed to these Framework Programmes have been increasing from 3.750 millions of ecus in the 1st Programme to 5.400 in the 2nd, 6.600 in the 3rd, and 13.215 in the 4th. The budget of 5th Programme proposed by the Commision is 16.300 millions of ecus.

In spite of this increase, the Framework Programmes have not influenced the reduction of regional disparities, because of both the financial scheme and the nature of the research granted.

In relation to the financing of the Community R&D Projects, the aid is, in general, the 50% of total costs for enterprises and the 100% of marginal costs for Universities or Public Institutions. With this kind of assistance, as Ogando and Calvo (1996) pointed out, Public Institutions need previously to dispose of infrastructures and equipments for developing the research. In case of enterprises, the possibilities of including expenditures in infrastructures and equipments is too reduced in the majority of the Programmes. Therefore, it is clear that the developed regions are more favoured since they have the necessary equipment. This is not the case of the less developed regions, where one of the problems is precisely the necessity of R&D infrastructures, and the aid above mentioned does not solve it.

With regard to the nature of the research, Framework Programmes are mainly aimed to “high technology” and “high quality” research. These objectives favour again to the more developed regions which have both the resources required by this type of research and the mechanisms to be in contact with groups of researchers from other regions. Besides, this kind of research does not pay attention to the different characteristics of the regions.

The 1st Report about social and economic cohesion by the European Commission (Comisión Europea, 1996b), confirms the above mentioned points. Around half of the contracts carried out in the 2nd and 3rd Framework Programmes (1987-1994) were directed to 9 regions where is the named “Archipelago Europe” which is composed of 12 “innovation islands” (London, Milano, Amsterdam/Rotterdam, Ile de France, Ruhr, Frankfurt, Stuttgart, Munich, Lyon/Grenoble and Torino), although the cohesion countries have increased their participation in the Framework Programmes but very slowly. In the mentioned report we can observe that, in the cohesion countries, the participation is mainly due to Universities and Public Institutions.

We also want to criticize the Maastrich Treaty emphasis in only "high technology" as the European priority in research policy. Many other fields should be emphasized in our view, even over the "high tecnology", including the economic research in order to improve real convergence and employment at regional level.

The emphasis placed on technological research by the Framework Programmes leads to forget that as important as generate new scientific and technological discoveries is to

develop an environment which allows the assimilation of the innovation by every productive sector.

Some of the factors considered as relevant in the economic literature to create this environment are: a dynamic business culture; a productive structure interrelated spatially and sectorally; a qualified labour force; capacity to select and adapt the results of the research to the specific local necessities; and the participation of all the agents in the innovation processes.

Taking into account the relevance of the economic and social factors in the success of the innovation and technological policies, we have to point up the importance of the socio-economic research. This kind of research allows to improve the knowledge of the socio-economic context in which those policies are going to be implemented and also provides orientation in the decision-making processes at all levels analyzing the effects of the different technological options on the economic growth, the employment, the competitiveness, and the quality of life. Technological progress should not lead to a development pattern which causes new types of unemployment, of social disintegration or of regional inequalities.

One of the novelties included in the 4th Framework Programme was to introduce a new key area oriented to socio-economic research.. The amount directed to this research was only the 1% of the overall 4th Programme budget. Surprising enough if we consider that European integration has given rise to a new subject of study which needs to be analyzed in order to understand the future challenges of this new socio-economic context (considering European regional diversities).

The Commission's proposal concerning the 5th Framework Programme for Community research only includes a key action, in the 4th activity, named "improving the socio-economic knowledge base" which has the objective of improving our understanding of the structural changes taking place in the European society. Despite this proposal underlines the relevance of the socio-economic research, the amount foreseen for this key action is clearly insufficient.

As we have pointed out the Framework Programmes have not helped to stimulate the R&D in the less developed regions. In order to compensate these disparities the European Union gives some aid to R&D through its Structural Funds which programmes for the period 1994-99 have been oriented more to stimulate the R&D demand in the market than to the scientific and technological supply.

In the Annual report on research and technological development activities in the European Union (Comision Europea, 1997), the Structural Funds directed to R&D activities in objective 1 regions are the 5% of the overall Community funds for objective 1 in the period 1994-99. It is necessary to point out that the credits assigned to R&D for 3 of the cohesion countries (Spain, Greece and Portugal) are under the mean of objective 1 regions (Comisión Europea, 1996a). This shows the little interest of some Governments in R&D investment.

In spite of the above mentioned efforts to encourage the R&D activities in EU, a detailed analysis of the available data reveals that the R&D regional differences are still important, as we show in the next section.

In our view EU should encourage a rise in the amount devoted to R&D applied to regional growth with colaboration with Higher Education Institution even directly, avoiding the cumbersome national bureaucratic procedures.

### 3. R&D EXPENDITURE IN THE EUROPEAN UNION.

In this section we analyze the distribution of R&D Expenditure in the European Regions both by sectors of performance and by fields of science.

In next tables, we present GDP per head data in 1995, and the acumulated R&D expenditure per head (1990-94), differenciating 3 sectors of performance: Business Enterprise, Government and Higher Education. Besides we present the R&D expenditure on Higher Education differenciating between two fields of science: Social Sciences and Humanities (SSH) and Natural Sciences and Engineering (NSE). R&D Expenditure data are acumulated



for the period 1990-1994, and are expressed in per head terms (in relation to 1995 population). Data are expressed in 1990 dollars per head (using exchange rates and GDP deflator of 1990; sources and methodology are presented in the Annex).

In table 1, we present data of USA, Japan and the average of the EU, for the above mentioned variables. EU countries have a high expenditure on R&D, but less than USA and Japan, in spite of the fact that the EU GDP of 1995 is similar to that of Japan.

The shares of the 3 sectors in total R&D expenditure in these countries are similar, but in the EU the Government has a bigger percentage than USA and Japan. In the distribution of the High Education expenditure the differences are bigger: while Japan devotes the 39% of its expenditure to Social Sciences, the EU only the 22%.

Table 1. Data from EU, USA and Japan

(all variables are expressed in 1990 dollars per head)

	EU15*	USA	Japan
GDP95H	18405	23377	18736
RDH 1990-94	1357	2987	2625
RDH B.E. 1990-94	881	2186	1940
RD GOV 1990-94	225	326	204
RD H.E. 1990-94	251	475	481
RD in SSH 1990-94	64	N.A.	188
RD in NSE	224	N.A.	293

Source: Own Elaboration based on OECD and Eurostat data

Note: \*EU15 data related to R&D expenditure do not include Luxembourg data.

R&D Expenditure on SSH and NSE only includes the countries with available data.

Europe needs to increase its R&D Expenditure, and in particular its SSH R&D expenditure, because these variables are important factors in the GDP growth.

But, if we analyze these figures for individual countries and regions, we see that the differences are very high between countries and regions, not only in quantity but in their regional, sectoral and scientific distribution.

In next tables, we present 1995 GDP per head, and R&D expenditure per head accumulated for the period 1990-94 (in the Business Enterprise, Government and Higher Education, and the last one subdivided in Social Science and Humanities and Natural Science and Engineering) for the countries of the EU, with the mean, maximum and minimum values in their regions.

TABLE 2. GERMAN AND AUSTRIAN REGIONS

(data are expressed in 1990 dollars per head)

	Germany			Austria		
	Mean	Maximum	Minimum	Mean	Maximum	Minimum
GDP95H	24957	38574	19506	21043	24564	17459
RDH	3008	4468	1395	1383	1911	1052
RDH B.E.	2055	3518	315	825	1066	690
RD GOV	474	734	312	99	182	49
RD H.E.	479	742	316	459	663	284
RD in SSH	105	163	69	96	139	60
RD in NSE	374	579	246	362	524	225

Source: Own Elaboration based on OECD and Eurostat data

TABLE 3. BELGIAN, DUTCH AND BRITISH REGIONS

(data are expressed in 1990 dollars per head)

	Belgium			Netherland			U.K.		
	Mean	Max	Min.	Mean	Max.	Min.	Mean	Max.	Min.
GDP95H	22638	30751	16237	16827	21959	17957	16537	20768	14294
RDH	2262	3194	1572	1976	2204	1756	1922	4584	659
RDH B.E.	1527	2157	1062	1135	1266	1009	1275	3330	274
RD GOV	140	197	97	367	409	326	271	654	63
RD H.E.	595	840	414	474	529	421	376	740	225
RD SSH	n.a.	n.a.	n.a.	142	159	126	56	111	34
RD NSE	n.a.	n.a.	n.a.	332	370	295	320	629	192

Source: Own Elaboration based on OECD and Eurostat data; n.a.: data not available

TABLE 4. SPANISH, ITALIAN AND FRENCH REGIONS

(data are expressed in 1990 dollars per head)

	Spain			Italy			France		
	Mean	Max	Min.	Mean	Max.	Min.	Mean	Max.	Min.
GDP95H	13599	17420	9423	19393	25629	11551	19342	33529	16502
RDH	389	1899	72	972	4275	92	1299	6085	109
RDH B.E.	224	1141	9	541	3291	38	960	4652	297
RD GOV	79	556	19	216	1686	27	233	927	14
RD H.E.	99	297	11	214	1670	19	106	506	5
RD SSH	32	95	4	47	367	4	n.a.	n.a.	n.a.
RD NSE	67	202	8	167	1302	15	n.a.	n.a.	n.a.

Source: Own Elaboration based on OECD and Eurostat data; n.a.: data not available

TABLE 5. GREEK AND PORTUGUESE REGIONS

(data are expressed in 1990 dollars per head)

	Greece			Portugal		
	Mean	Maximum	Minimum	Mean	Maximum	Minimum
GDP95H	8606	8849	8239	7373	9654	6437
RDH	259	300	177	168	338	47
RDH B.E.	43	96	12	51	87	9
RD GOV	132	219	56	42	144	4
RD H.E.	84	98	69	75	113	28
RD SSH	n.a.	n.a.	n.a.	17	26	7
RD NSE	n.a.	n.a.	n.a.	58	87	22

Source: Own Elaboration based on OECD and Eurostat data; n.a.: data not available

TABLE 6. DENMARK, IRELAND, FINLAND AND SWEDEN

(data are expressed in 1990 dollars per head)

	Denmark	Ireland	Finland	Sweden
GDP95H	27316	16829	25442	26552
RDH	2398	716	2386	3741
RDH B.E.	1382	423	1422	2504
RD GOV	444	128	465	149
RD H.E.	572	165	498	1087
RD SSH	149	35	174	163
RD NSE	423	130	324	924

Source: Own Elaboration based on OECD and Eurostat data

In these tables we can observe that the mean of R&D expenditure in the cohesion countries is under the EU15 mean: Ireland (716), Spain (329), Greece (259) and Portugal (168). France (1299) and Italy (972) are also under the mean. Austria (1383) is around the mean, and the rest of the countries are above the mean. The highest figures correspond to Sweden (3741) and Germany (3008).

We have to point out that the regions with minimum value in Belgium, Netherland and Germany have higher R&D expenditure than the mean of some countries (Spain, Italy, France, Ireland, Greece and Portugal).

We can also observe that the disparities are not only among regions of different countries but also among the more and less developed regions of each country. In relation to this, we can point out that the biggest expenditure on research and development is made in the regions where the capital town is located. The only exception is Germany where the reunification of Berlin reduces the figures in per capita terms.

With regard to the sector of performance, about the 50-75% of the R&D expenditure is made for the Business Enterprise sector, with the exception of Portugal and Greece. The expenditure on research and development made by the Higher Education sector is clearly insufficient taking into account that this kind of expenditure has a great influence over the GDP per head, as we will show in next section.

In the less developed regions of Spain, Italy, Greece and Portugal the Higher Education sector acts as core of the research and development activities, so that it is very important to stimulate this kind of expenditure which is too low in comparison with other European regions.

Regarding the R&D expenditure on Higher Education we differentiate between two fields of science: Social Sciences and Humanities (SSH) and Natural Sciences and Engineering (NSE). In general, about 78% of the expenditure is targeted to the research in NSE and only the 22% in SSH. In Guisán, Cancelo and Díaz-Vázquez (1998) we compared this type of expenditure with the relative size of SSH and NSE (measured by the number of students in Public Universities) in the Spanish regions. There we found that the R&D expenditure on SSH is clearly lower than its relative size. Excluding Humanities, the group SSH represents only the 14% of the R&D grants and the 54% of the relative size.

#### 4. ECONOMETRIC MODEL

In many pieces of research, we observe that the R&D Expenditure is one of the variables used to explain the GDP growth or the competitiveness in the OECD countries (for example, see: Guisán, Cancelo, and Díaz-Vázquez, 1998; Cancelo, 1998 or Cancelo and Guisán, 1998).

In this section we analyze the European Regions GDP in 1995 with several Econometric Models in which GDP95H as dependent variable that includes the R&D Expenditure as explanatory as well as the educative level of population, the lagged value of the dependent variable and some dummy variables to collect other factors which have a particular influence explaining GDP.

We distinguish between Higher Education and Non-Higher Education R&D expenditure and we separate the Higher Education expenditure on two fields of science: Social Science and Humanities (SSH) and Natural Science and Engineering (NSE), in order to study their influence in the GDP of 1995.

The main variables used are:

GDP95H = Gross Domestic Product of the European Regions per head in 1995 (in US dollars per head, in 1990 prices and exchange rates).

GDP90H = Gross Domestic Product of the European Regions per head in 1990 (in US dollars per head, in 1990 prices and exchange rates).

GDP85H = Gross Domestic Product of the European Regions per head in 1985 (in US dollars per head, in 1990 prices and exchange rates).

RDH = R&D Expenditure per head, accumulated value from 1990 to 1994, in US dollars per head (in 1990 prices and exchange rates).

RDBEH = Business Enterprises R&D Expenditure per head, accumulated value from 1990 to 1994, in US dollars per head (in 1990 prices and exchange rates).

RDGOH = Government R&D Expenditure per head, accumulated value from 1990 to 1994, in US dollars per head (in 1990 prices and exchange rates).

RDHEH = Higher Education R&D Expenditure per head, accumulated value from 1990 to 1994, in US dollars per head (in 1990 prices and exchange rates). This variable is divided in:

RDSSH = Social Science and Humanities R&D Expenditure per head, accumulated value from 1990 to 1994, in US dollars per head (in 1990 prices and exchange rates). It is Based in the national percentage of OECD data.

RDNSH = Natural Science and Engineering R&D Expenditure per head, accumulated value from 1990 to 1994, in US dollars per head (in 1990 prices and exchange rates). It is Based in the national percentage of OECD data.

PS2 = % of active population with level of education  $\geq$  Second level Second cycle. Its definition and Statistical source is in Guisán and Frias (1997).

Several dummy variables have been defined so as to reflect the geographical situation and others characteristics of their growth and relative position. This variables have been defined in Guisán, Cancelo and Díaz-Vázquez (1997).

DCE = Dummy for the Central Regions.

DIN = Dummy for the Intermediate Regions.

DP = Dummy for the Periphery Regions.

Other particular dummies have been defined so as to reflect particularities of some regions or countries:

DPOR = Dummy for the Portuguese Regions.

DNORIT = Dummy for several regions on the North of Italy (regions n°: 23 to 25)

Di, i = 18, 40, 44, 45, 49, 58, 99 and 102

Model 1 relates the GDP95H at regional level, with the research and development expenditure (RDH) and the dummies to reflect the geographical location of the European

Regions. In a previous specification, we also include the lagged dependent variable, but this variable causes a high degree of multicollinearity in the model. This degree of multicollinearity caused in the model both several problems of selection of regressors and the impossibility of separating the influence of research and development expenditure on the GDP90H, and an incorrect sign (negative) for RDH.

For these reasons, we eliminate this variable from the model, but its influence is in part collected by the dummies.

Table 7. Results of the estimation of Model 1.

LS // Dependent Variable is GDP95H				
Sample: 1 103		Included observations: 102		
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15572.37	634.6829	24.53567	0.0000
RDH	1.900226	0.237695	7.994372	0.0000
DP	-2982.741	731.4517	-4.077837	0.0001
DCE	3338.722	697.4531	4.787020	0.0000
D40	13767.86	2757.670	4.992571	0.0000
DPORT	-5534.781	1439.663	-3.844497	0.0002
R-squared	0.790932	Mean dependent var	18262.89	
Adjusted R-squared	0.780043	S.D. dependent var	5773.527	
S.E. of regression	2707.759	Sum squared resid	7.04E+08	
Durbin-Watson stat	1.725017	F-statistic	72.63615	

All the variables have a significative effect, showing a great relation with the dependent variable. The model presents a good fit.

The results displayed show the positive influence of the R&D Expenditure per head on GDP per head in 1995. These results stand out the importance of a European Policy in research and development in order to diminish the disparities of the poorest regions. Other important influences on GDP95H are collected by the effects of the dummy variables of the geographical situation.



Nevertheless, this model shows that it is necessary to include other variables in order to explain the GDP per head in the European regions. For this reason, we present the estimation of an alternative model (Model 2) in which the GDP95H is explained by the GDP per head in 1985, a variable that includes the influence of the human capital (PS2), the R&D expenditure per head and some specific dummy variables: D49 (Berlin), D52 (Bruxelles), D58 (Ireland) and D102 (Finland). The estimation results, without the dummies coefficients, are shown in Table 8.

Table 8. Results of the estimation Model 2

LS // Dependent Variable is GDP95H				
Sample: 1 103		Included observations: 103		
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP85H	0.983027	0.032527	30.22165	0.0000
PS2	73.05904	10.12727	7.214087	0.0000
RDH	0.031675	0.166070	0.190735	0.8491
R-squared	0.928862	Mean dependent var		18405.02
Adjusted R-squared	0.924416	S.D. dependent var		5923.475
S.E. of regression	1628.515	Sum squared resid		2.55E+08
Durbin-Watson stat	1.460862	F-statistic		208.9151

These results show the important and significative influence of both the GDP per head in 1985 and the PS2 variable. The coefficient of the R&D expenditure per head has a positive sign but it is not significative due to the high degree of multicollinearity.

In order to analyze the differences in the R&D Expenditure over the GDP95H, in relation to the sector of performance, we estimate an econometric model in which we separate the effect of the Higher Education Expenditure on R&D.

Model 3 explains the GDP95H in relation to the skilled labour force (PS2), the GDP per head in 1990, the expenditure on High Education R&D per head (RDHEH), the expenditure on Non High Education R&D per head (RDNOHEH) and several dummy variables to collect some specific effects in the regions: D18 (Denmark), D49 (Berlin), D58 (Ireland), D99 (Österreich) and D102 (Finland).

The estimation results, without the dummies coefficients, are shown in Table 9.

Table 9. Results of estimation Model 3

LS // Dependent Variable is GDP95H				
Sample: 1 103		Included observations: 102		
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PS2	7.788978	6.357304	1.225202	0.2236
RDHEH	0.179636	0.413987	0.433918	0.6654
RDNOHEH	-0.192118	0.108448	-1.771523	0.0797
GDP90H	1.033935	0.017193	60.13523	0.0000
R-squared	0.981547	Mean dependent var		18262.89
Adjusted R-squared	0.979960	S.D. dependent var		5773.527
S.E. of regression	817.3152	Sum squared resid		62124379
Durbin-Watson stat	1.964900	F-statistic		618.3664

These results show that the influence of Expenditure of the Higher Education Sector is bigger than the Expenditure of the other sectors, Government and Bussiness Enterprise. Anyway, the big degree of multicollinearity may explain the lack of significativeness of all the coefficients but that of GDP90H.

Finally, we present four econometric models to analyze the influence of the expenditure on R&D in the Higher Education sector differentiating between two fields of science: Social Sciences and Humanities (SSH) and Natural Sciences and Engineering (NSE).

Models 4 and 5 relate the GDP95H with expenditure on Social Sciences and Humanities R&D per head (RDSSH) and with expenditure on Natural Sciences and Engineering R&D per head (RDNSH). Other variables included in these models are the location dummy variables presented above.

Table 9. Results of the estimation of Model 4 and Model 5.

Variable	Model 4	Model 5
C	16850 (20.9)	17042 (22.5)
RDSSH	24 (3.9)	
RDNSH		6.7 (4.2)
DP	-3461 (-3.9)	-3726 (-4.4)
DCE	4806 (5.3)	4660 (5.2)
D40	13075 (4.5)	13084 (4.5)
DPORT	-6430 (-4.3)	-6328 (-4.2)
Adjust. R-squared	0.78	0.78
dw statistic	1.81	1.93

t-statistic in brackets. Data not available for some countries (see annex)

In this table, we can observe that the influence of the Social Science and Humanities is higher than that of Natural Sciences and Engineering. This is an interesting result and it shows that the expenditure on SSH has a higher influence on the economic growth at regional level than the NSE expenditure. Therefore, it is more important to increase the R&D expenditure on Social Sciences, specially on research in applied Economics and social and legal questions related to regional growth.

Finally, models 6 and 7 include the R&D expenditure of the above mentioned fields of science, in the same equation, together with other two important explanatory variables: the percentage of active population with secondary studies (PS2) and the lagged value of the dependent variable (GDP85H in model 6, and GDP90H in model 7).

These models include several dummy variables to collect some specific effects in the regions: 18 (Denmark), 44 (Hessen), 45 (Rheinland-Pfalz), 49 (Berlin), 58 (Ireland), 99 (Österreich), 102 (Finland) and some regions of the North of Italy (23 to 25). The estimation results, without the dummies coefficients, are shown in Tables 8 and 9.

In all the models we test for heteroscedasticity using the White test, concluding that this problem does not arise.

Table 10. Results of estimation. Model 6

LS // Dependent Variable is GDP95H				
Sample: 1 103		Included observations: 74		
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PS2	92.21693	9.136380	10.09338	0.0000
RDSSH	30.04550	6.726258	4.466898	0.0000
RDNSH	-8.188467	1.765168	-4.638917	0.0000
GDP85H	0.931607	0.026215	35.53752	0.0000
R-squared	0.968149	Mean dependent var		18156.09
Adjusted R-squared	0.962498	S.D. dependent var		6004.017
S.E. of regression	1162.701	Sum squared resid		83816217
Durbin-Watson stat	1.684363	F-statistic		171.3246

Table 11. Results of estimation Model 7

LS // Dependent Variable is GDP95H				
Sample: 1 103		Included observations: 74		
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PS2	20.96330	6.583552	3.184193	0.0023
RDSSH	11.91186	4.250413	2.802518	0.0068
RDNSH	-3.249085	1.103729	-2.943734	0.0046
GDP90H	0.999063	0.017033	58.65402	0.0000
R-squared	0.987951	Mean dependent var		18156.09
Adjusted R-squared	0.985813	S.D. dependent var		6004.017
S.E. of regression	715.1316	Sum squared resid		31707619
Durbin-Watson stat	2.143782	F-statistic		462.1440

These results show, as it was expected, both the positive and significative effect of the coefficients of the three main explanatory variables: PS2, RDSSH and the lagged value of GDP per head.

The significative and negative effect of RDNSH at regional level it may appear surprising, but it is not so strange if we think that the results of technical research generally are not carried out in firms located at the same region. Obviously, this type of research may have positive contributions to economic growth at national or international level but it generally does not show a positive effect at regional level.

## 5. CONCLUSIONS

During the last decade regional disparities in EU are maintained, although with a very light trend to diminution. This paper analyses the role that education and scientific research plays in regional growth. From our analysis and our econometric models we obtain the following conclusions:

1.- The educative level of the active population (PS2) and the expenditure on socio-economic research (RDSSH) are the main explanatory variables that account for the increase in GDP per head at regional level. According to the results in Table 11 an increase of one unity in PS2 provokes, at short term, an increase of 20.96 dollars per capita and, at the same time, an increase of one dollar in RDSSH provokes an average increase of 11.91 dollars in GDP95H. High level of both variables favour a more dynamic society, the increase of productive investments, the quality of labour and a better socio-economic environment for innovation.

2.- European regional policy has not done too much to reduce the big differences between the more and less developed regions because of the main emphasis that European R&D Framework Programmes has placed in high technology, and thus being not adequate to other necessities of the poorer regions. On the other hand, universities of the less developed regions have received very few grants from the EU and, in general, the EU has given insufficient help to industrial development and education which is needed by these regions.

3.- The European Framework Programmes of R&D have not influenced on the reduction of regional disparities because of both the financial scheme, with excess of bureaucracy and conditioned to the possession of a previous high level of own resources, and the nature of the research granted (too high technology and very few funds for socio-economic research). The European Union policies place emphasis on technological research whereas, in our view, many other fields should be emphasized, including the economic research, to improve real convergence and employment in the European regions.

4.- We show how important is research in social sciences and thus we defend that the EU should reinforce its policy in this sense, eliminating excessive bureaucratic barriers and

making the grants accesible to all the research centres and teams that are enough qualified in all the regions.

5.- EU countries have a high expenditure on R&D but less than USA and Japan in spite of the fact that the EU GDP in 1995, in per head terms, is similar to that of Japan (see table 1). Therefore, Europe needs to increase its R&D expenditure and specially its expenditure on SSH R&D.

6.-There are high differences in R&D expenditure among countries. We had observed that the mean of R&D expenditure in the cohesion countries is much lower than the EU mean. The disparities are not only among countries but also among regions. The differences are both among regions of more and less developed countries and among different regions in the same country. The biggest expenditure is made by the regions where the capital town is located.

7.- In relation to sectors of performance more than 50% of expenditure on R&D is made by the Bussiness Enterprise Sector. The exceptions are the less developed regions of Spain, Italy, Greece and Portugal, where the Higher Education Sector plays the main role in R&D activities although this expenditure is still too low in comparison with other regions.

8.- In general the amount devoted to Higher Education is not very high. About 78% of the Higher Education expenditure on R&D is in Natural Sciences and Engineering (NSE) and only the 22% in Social Sciences and Humanities (SSH). It would be convenient to increase this expenditure taking into account its productivity.

## 6. ANNEX

Sources of data: the main variables have been elaborated using the Eurostat Statistics: *Regions*, “*Statistiques en bref*” and *R&D Statistics*. Other sources are OECD: *National Accounts* (for the Index Prices of the GDP, used to express the variables in real terms), and *Basic Science and Technology Statistics* (for calculating the SSH and NSE percentage on the overall Higher Education R&D expenditure; we have calculated the regional data using the national %, for the countries which data are available).

The 103 regions included in this study are:

1. Galicia	27. Toscana	53. Noord-Nederland	79. Picardie
2. Asturias	28. Umbria	54. Oost-Nederland	80. Haute Normandie
3. Cantabria	29. Marche	55. West-Nederland	81. Centre
4. País Vasco	30. Lazio	56. Zuid-Nederland	82. Basse-Normandie
5. Navarra	31. Campania	57. Luxembourg	83. Bourgogne
6. La Rioja	32. Abruzzo	58. Ireland	84. Nord-Pas de Calais
7. Aragón	33. Molisse	59. North UK	85. Lorraine
8. Madrid	34. Puglia	60. Yorkshire and Hum.	86. Alsace
9. Castilla y Leon	35. Basilicata	61. East Midlands	87. Franche-Comté
10. Castilla La Mancha	36. Calabria	62. East Anglia	88. Pays de la Loire
11. Extremadura	37. Sicilia	63. South East	89. Bretagne
12. Cataluña	38. Sardegna	64. South West	90. Poitou-Charentes
13. Com. Valenciana	39. Schleswig-Holstein	65. West Midlands	91. Aquitaine
14. Baleares	40. Hamburg	66. North West	92. Midi-Pyrenees
15. Andalucia	41. Niedersachsen	67. Wales	93. Limousin
16. Murcia	42. Bremen	68. Scotland	94. Rhone- Alpes
17. Canarias	43. Nordrhein-Westfalen	69. Northern Ireland	95. Auvergne
18. Danmark	44. Hessen	70. Norte Portugal	96. Languedoc-Rouss.
19. Piemonte	45. Rheinland-Pfalz	71. Centro Portugal	97. Prov.,Alpes, Côte A.
20. Vall d’Aosta	46. Baden-Wüttemberg	72. Lisboa,Vale do Tejo	98. Corse
21. Liguria	47. Bayern	73. Alentejo e Algarve	99. Ostösterreich
22. Lombardia	48. Saarland	74. Voreia Ellada	100. Sudösterreich
23. Trent-A.Adige	49. Berlin	75. Kentriki Ell., Atikki	101. Westösterreich
24. Veneto	50. Vlaams Gewest	76. Nisia, Aigaiou, Kritti	102. Finland
25. Friuli-Venezia Giulia	51. Region Wallonne	77.- Ile de France	103. Sverige
26. Emilia Romagna	52. Bruxelles	78.- Champagne-Ardene	

## 7. REFERENCES

- CANELO, M.T. (1998): “Oferta y demanda de la producción manufacturera en países de la OECD”. En prensa.
- CANELO, M.T. y GUISÁN, M.C. (1998): *Education, investment and competitiveness in OECD countries: 1964-94*. Working Papers on Applied Econometrics, nº 12. Publications Office. University of Santiago de Compostela\*.
- COMISIÓN EUROPEA (1996a): *8º Informe anual sobre los fondos estructurales*. Bruselas.
- COMISIÓN EUROPEA (1996b): *Primer informe sobre la cohesión económica y social*. Bruselas.
- COMISIÓN EUROPEA (1997): *Actividades de Investigación y desarrollo tecnológico en la Unión Europea. Informe anual 1997*. Bruselas.
- EUROPEAN COMMISSION(1998): *Proposal for Council Decisions concerning the specific programmes implementing the Fifth Framework Programme of the European Community for research, technological development and demonstration activities (1998-2002)*. Brussels.
- EUROSTAT (1995): *Research and Development Statistics*.
- EUROSTAT (1996): *Regions*.
- EUROSTAT (1998): *Statistiques en Bref*
- GUISÁN, M.C. (1996): “Regional Europe and Spanish convergence”. *Revista Galega de Economía*, vol. 5, nº 2, pp. 133-150. University of Santiago de Compostela. English version on request to the author.
- GUISÁN, M.C.; CANELO, M.T and DÍAZ-VÁZQUEZ, M.R. (1997): “Regional patterns of industrial sectors in EU countries: 1980-95”. Paper presented in 37th European Congress of the European Regional Science Association, held in Rome (Italy) in august 1997.
- GUISÁN, M.C.; CANELO, M.T and DÍAZ-VÁZQUEZ, M.R. (1998): “Gasto en investigación y su impacto sobre el crecimiento regional”. Paper presented in XII Congress of ASEPELT-España, held in Cordoba (Spain) in june 1998.



- GUISÁN, M.C. and FRIAS, I. (1997): *Economic Growth and Social Welfare in the European Regions*. European Regional Science Association. 36th Congress. Revised version published in: Working Papers on Applied Econometrics, nº 10. Publications Office. University of Santiago de Compostela\*
- HARTLEY, K., COX, A. and MAYES, D.G. (1997): “The impact of rules”. In: Mayes, D.G. (ed): *The Evolution of the Single European Market*. Edward Elgar Publishing.
- MAYES, D.G. (1997): *The Evolution of the Single European Market*. Edward Elgar Publishing.
- MAYES, D.G. and BEGG, I. (1994): “Rethinking industrial policy in Europe: A decentralised Approach”. Paper presented in: Fall Meeting of Project Link, held in Salamanca (Spain).
- OECD (1995): Basic Science and Technology Statistics.
- OECD (1996): National Accounts. Main Aggregates.
- OGANDO, O. and CALVO, M.Y. (1996): “La política industrial y de investigación y desarrollo”. En: Vega, I. (coord.): *La integración económica europea*. Ed. Lex nova, Valladolid.

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