

**UNIVERSITIES AND RESEARCH EXPENDITURE IN
EUROPE AND THE USA, 1993-2003: AN ANALYSIS OF
COUNTRIES AND REGIONS**
GUISAN, Maria-Carmen*

Abstract

A comparison between University Expenditures on Education and Research shows a great advantage of the United States regions in comparison with the majority of the European regions and countries. Only a few European regions receive enough support for these important activities which have a highly positive impact on socio-economic development. Here we present an econometric model which relates expenditure on RD and teaching in Higher Education with regional development in the USA at regional level. The main conclusion of this study is that it that European Economic Policies should be improved in order to follow the positive example of the United States in this regard.

JEL classification: C51, H52, O18, O3, O51, O52, R1

Key words: Universities, RD, Research Expenditure, Education, Human Capital, Regional Development, European Union, United States.

1. Introduction

The role of universities on economic development is usually recognized as important, both at regional, national and international level, depending on the type of activity. Here we analyse the effects of university expenditure on education and research on regional development. We show our concern for the low level of support that European Union authorities, and several national governments of EU countries, show towards university research, in comparison with the United States. Besides the EU research policies usually highlight the technology-profit-oriented research, with the aim to promote more

* Maria-Carmen Guisan is Profesor of Econometrics at the University of Santiago de Compostela, Spain, and Director of Master on International Sectoral Economics, e-mail: eccgs@usc.es

technological improvements in order to increase firm profits, but we disagree with this approach because it does not have into account many relevant contributions to socio-economic well-being which may arise both from technological and non technological research.

During the last two decades several qualified voices have declared a high degree of dissatisfaction among university researchers with the situation in the European Union, particularly in some countries, such as Spain, Greece and Portugal, which show the lower levels of support in this regard. The problems of lack of support to university research in the European Union are analysed in Guisan and Cancelo(2006) and other studies.

The aim of this article is to present a comparison between higher education expenditure in the United States and the European Union, and to analyse the positive consequences that an improvement in EU support to university research, both technological and non technological, would have on economic development, with special reference to its regional effects. Section 2 compares expenditure on Higher education in the EU15 countries with the states of the USA. Section 3 presents the estimation of some econometric models which have into account the impact of research expenditure in higher education on regional development in 51 regions of the United States and compares this result with related models estimated for the EU and OECD countries. Finally section 5 presents the main conclusions.

2. Expenditure on Higher Education in EU15 and the USA.

Table 1 presents a comparison of European Union countries with the USA in year 2002, regarding expenditure per student in Higher Education, enrolment of students and teaching staff in tertiary education. This comparison is based on several interesting sources from OCDE, World Bank and UNESCO. Definitions of variables and sources of data appear at the bottom of the table. Data are measured in dollars at Purchasing Power Parities (PPPs). Some results are only provisional estimations due to incomplete data.

Table 1. Expenditure, Enrolment and Teachers in Higher Education, 2002

Country	exp1	exp2	enr1	enr2	% enr1 /pop	teachers
Austria	7781	12701	223.7	230	2.77	28.7
Belgium	8302	12019	366.9	375	3.55	25.4
Denmark	11604	15183	196.2	202	3.65	na
Finland	7332	11833	283.8	292	5.46	18
France	7302	9132	2029.2	2119	3.30	134.1
Germany	6617	11860	2255.0	2335	2.73	284.1
Greece	4372	5646	529.2	561	4.82	23.8
Ireland	7721	9809	176.3	182	4.49	12.7
Italy	7708	8649	1854.2	1913	3.19	87.2
Luxembourg	9768	14141	3.0	3	0.67	na
Netherlands	7977	13163	516.8	527	3.20	44.1
Portugal	4693	6080	396.6	401	3.83	36.2
Spain	6030	8074	1832.8	1841	4.44	136.4
Sweden	7832	15715	382.9	415	4.29	36.4
UK	8966	11822	2240.7	2288	3.78	101
EU15	8812	10249	13287.3	13684	3.47	982.8
USA	18574	20545	15928.0	16612	5.53	1167.3

Notes: 1) exp1: Expenditure per student in higher education without RD; and exp2: Expenditure per student in higher education with RD, data in dollars at PPPs, source OECD *Education at a Glance*. 2) enr1: enrolment in tertiary education in 2001-2002, source World Bank. 3) enr2= enrolment in tertiary education in 2002-03, source Unesco. 4) % enr1/pop: percentage of enr1 on total population. 5) teach: teachers in tertiary education in 2002(thousand), source Unesco. 6) Data for the EU15 average of this variable is a provisional estimation. 7) Not available data is indicated by na.

Data in table 1 show that the USA, with a value of 18574 in exp1, has a level of expenditure on higher education per student more than twice the average of EU15. Denmark is the most outstanding European Union country with 11604 dollars per inhabitant, almost double than Spain (6030) and nearly three times the low averages of Portugal (4693) and Greece (4372). The United States with 288.2 million inhabitants in year 2002 had more university teachers than the EU15 countries with 382.4 million inhabitants in the same year, what also reveals the highest support universities receive in the USA.

Table 2 presents a comparison between RD expenditure on Higher Education per inhabitant (rdheh), and Educational expenditure on Higher Education per inhabitant (eduheh) among EU15 and the USA, together with the value of Gdp per inhabitant in year 2003. Data are valued in dollars at prices and Purchasing Power Parities of year 2000.

Table 2. Expenditure on Higher Education (RD and Education), 2003
(dollars per inhabitant at 2000 prices and PPPs)

Country	RD in HE Per inhabitant Total (1)	Educational Expenditure Per inhabitant(2)	(1)+(2) = (3)	Gdph (4)	%(1)/ (4)	%(2)/ (4)	%(3)/ (4)
Austria	140	215	355	29247	0.48	0.73	1.21
Belgium	97	294	391	27262	0.36	1.07	1.43
Denmark	181	422	603	29048	0.62	1.46	2.08
Finland	162	399	561	27124	0.60	1.47	2.07
France	93	248	341	26542	0.35	0.93	1.28
Germany	98 (136)	181	317	25756	0.52	0.71	1.23
Greece	35	210	245	18313	0.19	1.15	1.34
Ireland	80	341	421	32256	0.25	1.06	1.31
Italy	72	237	309	25453	0.28	0.93	1.21
Netherlands	113	254	367	28327	0.40	0.90	1.30
Portugal	31	178	209	17166	0.18	1.04	1.22
Spain	48	264	312	22122	0.22	1.19	1.41
Sweden	246	335	581	28209	0.87	1.19	2.06
UK	103	338	441	27039	0.38	1.25	1.63
EU15	92	253	345	25634	0.36	0.99	1.35
USA	153	1016	1169	35279	0.43	2.88	3.31

Note: Elaborated from Eurostat (RD) and OECD (Education expenditure and Gdph) statistics. In the case of Germany there are two estimations for (1) and we use the higher value for (3). Luxembourg is not included and available data show a good level of HE expenditure per inhabitant since 2004. The EU15 average is a provisional estimation. Gdph=Gross Domestic Product per inhabitant. RD in HE = Research and Development Expenditure in Higher Education. The last three columns present, respectively the percentages of (1), (2) and (3) on Gdph.

The most outstanding countries of EU15 in expenditure on Higher Education per inhabitant are Denmark, Finland and Sweden, where the last column of table 2 reaches a little more than 2% of Gdp per inhabitant, above the low value of 1.35% in the EU15 and below the high level of the USA with 3.31%.

The stressed life of many researchers in Europe in the search for research funding, pointed out by Sajarava(2005), has been particularly deep in countries with the lower levels of Higher Education Funding per student (what usually implies more educational work for teachers and less funding per researcher), which, as seen in table 1 are Greece, Portugal and Spain.

It is surprising to find that the percentage of expenditure per inhabitant in Spain is slightly above the EU15 average in the two last columns of table 2, in spite of the low value of expenditure on Higher Education per student in this country. It is due to the high number of university students in Spain, but average resources for higher education per researcher are below the EU average. Protests against Government policies, due the lack of support to young researchers and the low levels of research funding in many subjects, have been frequent in this country during the period 1990-2005, as well as in other EU countries. European researchers generally need more support from their own governments and from the EU institutions, particularly in the regions with the lower levels of funding per researcher and per student. In this regard it should be pointed out that regional differences in Higher Education expenditure per student and per inhabitant are generally stronger in European Union than in the United States, not only among countries but sometimes even among regions within a same country.

Table 3 present data of RD expenditure on higher education in dollars per inhabitant in the United States, by state, together with some complementary data of RD expenditure on Social Sciences per inhabitant, Pop (Population in thousand inhabitants), Gdph (Gross Domestic Product per inhabitant in dollars), and the ranking position of each state in the values of these three variables.

Table 2. Expenditure on RD in Higher Education (HE): US 2003 (total and social sciences, dollars per inhabitant at current prices)

No.	State	RD in HE per inhabitant		pop	gdph	Ranking		
		total	social			gdph	total	social
1	Alabama	124	2.08	4504	29341	46	29	48
2	Alaska	217	2.12	648	48451	4	4	47
3	Arizona	111	5.70	5579	32658	37	37	20
4	Arkansas	67	1.43	2728	27689	49	48	49
5	California	151	5.84	35463	40787	12	20	19
6	Colorado	153	4.94	4548	41147	11	19	26
7	Connecticut	171	4.54	3487	49435	3	10	32
8	Delaware	128	6.80	818	60068	2	26	16
9	D. Columbia	472	24.18	558	125008	1	1	1
10	Florida	71	3.59	16999	32355	38	46	38
11	Georgia	136	7.30	8676	36882	21	25	11
12	Hawaii	148	4.91	1249	37690	19	21	27
13	Idaho	77	2.64	1367	29555	45	45	44
14	Illinois	128	5.12	12649	39486	14	27	25
15	Indiana	117	8.84	6200	34531	30	32	7
16	Iowa	170	7.15	2942	35028	28	11	13
17	Kansas	114	5.12	2725	34260	31	34	24
18	Kentucky	92	2.87	4118	31320	40	42	40
19	Louisiana	117	4.74	4494	31192	42	33	29
20	Maine	57	3.90	1309	31286	41	51	37
21	Maryland	368	14.29	5512	38540	16	2	3
22	Massachusetts	284	11.80	6420	46313	5	3	5
23	Michigan	138	14.57	10082	36229	26	24	2
24	Minnesota	102	3.90	5064	41622	9	41	36
25	Mississippi	113	2.84	2883	25079	51	35	42
26	Missouri	141	4.08	5719	34028	33	23	35
27	Montana	154	8.49	918	27784	48	18	9
28	Nebraska	173	8.77	1737	37867	18	8	8
29	Nevada	69	2.86	2242	39125	15	47	41
30	New Hampshire	196	5.22	1289	38059	17	6	23
31	New Jersey	86	6.41	8642	45991	6	43	17
32	New Mexico	163	7.43	1879	30088	44	15	10
33	New York	161	4.32	19212	42767	8	16	33
34	North Carolina	166	7.06	8421	37332	20	12	14

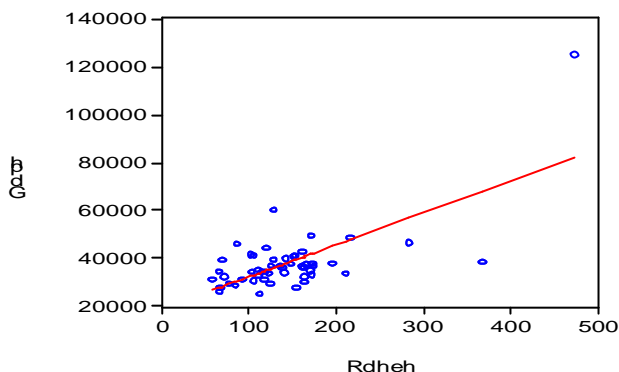
35	North Dakota	211	13.30	633	33731	35	5	4
36	Ohio	111	5.51	11438	35236	27	36	22
37	Oklahoma	84	7.03	3506	28628	47	44	15
38	Oregon	123	4.12	3564	33748	34	30	34
39	Pennsylvania	163	7.17	12371	36372	25	14	12
40	Rhode Island	174	6.00	1076	36771	23	7	18
41	South Carolina	105	4.70	4149	30672	43	39	31
42	South Dakota	65	5.55	765	34747	29	50	21
43	Tennessee	103	4.84	5845	34179	32	40	28
44	Texas	125	2.43	22103	36787	22	28	46
45	Utah	164	2.53	2352	32218	39	13	45
46	Vermont	172	0.23	619	33374	36	9	51
47	Virginia	105	2.80	7365	41333	10	38	43
48	Washington	142	4.74	6131	39945	13	22	30
49	West Virginia	67	0.88	1811	26088	50	49	50
50	Wisconsin	161	8.85	5474	36537	24	17	6
51	Wyoming	120	3.58	502	44343	7	31	39
	Total USA	138	-	-	37510	-	-	-

Source: Elaborated from NSF(2003) for RD expenditure at state level, and Bureau of the Census(2005) for Gdp and Population. Notes: average value of Rdheh in the USA is 138 dollars at current prices in year 2003, from this source of data, although the estimation for the USA from Eurostat RD statistics is higher: 152 dollars at 2000 prices in year 2003, what is equivalent to 162 dollar at current prices in year 2003).

The first column of table 3 shows, that expenditure in RD in Higher Education per inhabitant is above 50 dollars in all the regions, reaching more than 100 dollars in 44 out of 51 (86% of regions), and more than 200 in 5 regions (9%). Accordingly to the available information figures in this regard are worse in the European Union because there are many regions below 50 dollars and percentage of regions above 100 dollars per inhabitant is clearly below the USA value. In future studies we will analyse the differences among European regions in the Higher Education section. In Guisan and Aguayo(2004) and (2005) we have analysed the differences in total RD expenditure of 151 regions of EU25 and the consequences for regional development.

Graph 1 shows a positive correlation between Gdph and RD expenditure on Higher Education per inhabitant (Rdheh), which is due to a bilateral relationship between both variables: usually states with high level of Rdheh improve their value of Gdph, and states with high level of Gdph usually increase their support to research institutions. There are of course some particular features of special regions, which explain departures from the general behaviour.

Graph 1. Gdph and Rdheh across the states: USA 2003
(dollars per inhabitant at current prices)



In the next section we present some econometric models which measure the impact of Higher Education Expenditure on RD in the USA at regional level.

3. Econometric models: Relationship between RD expenditure in Higher Education and regional development.

We estimate the models with a cross-section sample of 51 US regions in year 2003. Model 1 presents the relationship between Gdp per inhabitant in year 2003 (GDPH03), its lagged value in year 2000 (GDPH00) and the intensity of Research Expenditure in Higher Education per inhabitant, including two variables in this regard (RDHTOT, as total value of RD per inhabitant in Higher Education, and RDHSOC as the RD expenditure per inhabitant on Socio-Economic Sciences research, with data for year 2003). Models 2, 3 and 4, presents the results including the difference among both RD

variables and each of them separately. We have included two dummy variables to have into account significant differences in cases of regions 9 (District of Columbia) and 51 (Wyoming). Table 4 presents the main results, and the tables in the Annex present more detailed results.

Table 4. Models estimation: Dependent variable GDPH03

Variable	Model 1	Model 2	Model 3	<i>Model 4</i>
GDPH00	1.07 (76)	1.07 (77)	1.08 (106)	<i>1.07 (76)</i>
RDHTOT	3.38 (0.88)			
RDHSOC	56.68(0.87)		89.05(1.67)	<i>60.06(0.96)</i>
RDHTOT- RDHSOC		5.30(1.62)		<i>3.38 (0.88)</i>
D9	13566 (10)	13921(11)	13512 (10)	<i>13566(10)</i>
<i>D51</i>	<i>5127(4.3)</i>	<i>5035(4.2)</i>	<i>5107(4.2)</i>	<i>5127(4.3)</i>

Note: Sample of 51 USA regions in 2003. Terms between brackets are t-statistics. Model 1 and 4 are two ways of expression of a similar relationship. More detailed results in the Annex.

Although the coefficients of the RD variables are not significant highly significant in these models, all the coefficients are clearly positive, with a higher value for RD on Social Sciences, which shows here, as in other studies, that Socio-Economic research has a very positive impact on regional development.

4. Conclusions

Here we have analysed the differences among EU15 countries and 51 regions of the United States, and we have found that the expenditure per inhabitant on Higher Education in the USA amounts to 3.3% of Gdp per inhabitant while this percentage is only 1.3% in the EU15. The main difference was found in general financing of higher education, with a value higher than 1000 dollars per inhabitant for the USA which is approximately four times higher than the EU average. The econometric models show a positive impact of RD expenditure on regional development, in a process that includes feedback because the increases in Gdp foster future

increases in RD. RD in Socio-Economic sciences in the USA seems to have a highly positive impact on regional development, which agrees with our previous studies of OECD countries, and the recommendations by Donovan(2004) and other authors. Accordingly to EU(2005) and other reports public opinion is in favour of a greater support RD in Higher Education, and it is important for economic development in EU to follow the positive example of the USA in this regard.

Bibliography

- Aguayo, E. and Guisan, M.C.(2004). "Employment and Population in European Union: Econometric Models and Causality Tests", Working Paper of the Series *Economic Development* n° 80, on line.^{1,2}
- Badinger, H. and Tondls, G.(2002). "Trade, Human Capital and Innovation: The Engines of European Regional Growth in the 1990s". Working Paper Ers02-043, on line.¹
- Barrio, T. and Garcia-Quevedo, J. (2003). "The Geography of Innovation: the Effects of University Research". Working paper of the series *Papers in Economics* no. 120.²
- Caruso, R. and Palano, D.(2005). "Regioni e Territori nello Spazio Europeo della Ricerca", *Regional and Sectoral Economic Studies*, Vol.5-1.^{1,2}
- Council of Europe(2000). Recommendation No. 8 of the Committee of Ministers to member states on the research mission of universities. <http://www.coe.int>
- Donovan, C.(2004). "Social Science in the Service of Science and Technology: A Case of Mistaken Identity within National Research Policy". TASA 2003 Conference, University of New England, on line.
- EU(2005). "European Science and Technology". Special Euro-barometer 224 EUROSTAT. *Statistics REGIO* and Main Regional Indicators.
- Freeman, Donald G.(2001). "Sources of fluctuation in regional growth". *The Annals of Regional Science*, 2001, Vol.35-2, pp. 249-266.
- Guisan, M.C.(2004). "Education, Research and Manufacturing in EU25: An Inter-Sectoral Econometric Model of 151 European Regions, 1995-2000". *Regional and Sectoral Economic Studies*, Vol.4-2.^{1,2}
- Guisan, M.C.(2005). "Employment, Wages and Immigration in the European Union: Econometric Models and Comparison with the USA, 1960-2003" *Economic Development* no.83, free on line.^{1,2}
- Guisan, M.C., Cancelo, M.T. and Exposito, E.(1998). Research Expenditure on Higher Education in OECD Countries (Spanish). Working Paper n° 24 of the series *Economic Development*, on line.^{1,2}

Guisan, M.C. and Aguayo, E.(2005). "Education, Research and Regional Economic Disparities in European Union after 2004 Enlargement: Econometric Models and Policy Challenges". En Korres, G. M. ed.(2005) *Regional Growth and Economic Integration*, forthcoming.

Jaffee, A. (1989). "Real Effects of Academic Research". *American Economic Review*. Vol. 79(5), pp. 957-70.

Korres, G.M., Chionis, D. and Staikouras, C.(2004). "Regional Systems of Innovation and Regional Policy in Europe". *Regional and Sectoral Economic Studies*, Vol.3-2.^{1,2}

Martin, C., Mulas-Granados, C. and Sanz, I.(2004). Spatial Distribution of RD Expenditure and Patent Applications across EU Regions and its Impact on Economic Cohesion. Working paper of the series *European Economy Group* no. 32.²

Moreno-Serrano, R., Paci, R. and Usai, S.(2003). "Spatial Distribution of Innovation Activities. The Case of European Regions". Centre for North South Economic Research, University of Cagliari and Sassari, Sardinia, Working Paper CRENoS no. 200310.

OCDE(1998). University Research in Transition. OCDE. París.

Sajarava, K. (2005). "How to Survive when Money Is Not Sufficient?" Journal Acatiimi, Finnish Union of University Professors. http://www.acatiimi.fi/2000/8_00/8_00o.htm

¹ <http://www.usc.es/economet/ea.htm>

² <http://ideas.repec.org>

Annex. Models estimation.

Model 1.

Dependent Variable: GDPH03. Method: Least Squares. Sample: 1 51				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDPH00	1.071178	0.014067	76.14911	0.0000
RDHTOT	3.375328	3.837804	0.879495	0.3837
RDHSOC	56.68577	64.93832	0.872917	0.3872
D9	13566.39	1346.745	10.07347	0.0000
D51	5127.488	1201.113	4.268948	0.0001
R-squared	0.993457	Mean dependent var		38111.86
Adjusted R-squared	0.992889	S.D. dependent var		13997.03
S.E. of regression	1180.362	Akaike info criterion		17.07792
Sum squared resid	64089725	Schwarz criterion		17.26732
Log likelihood	-430.4871	Durbin-Watson stat		1.653190

Model 2.

Dependent Variable: GDPH03. Method: Least Squares. Sample: 1 51				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDPH00	1.073506	0.013841	77.55733	0.0000
RDHTOT-RDHSOC	5.298984	3.264636	1.623147	0.1112
D9	13920.76	1293.505	10.76204	0.0000
D51	5035.689	1196.163	4.209869	0.0001
R-squared	0.993328	Mean dependent var		38111.86
Adjusted R-squared	0.992902	S.D. dependent var		13997.03
S.E. of regression	1179.274	Akaike info criterion		17.05837
Sum squared resid	65362347	Schwarz criterion		17.20989
Log likelihood	-430.9885	Durbin-Watson stat		1.715525

Model 3.

Dependent Variable: GDPH03. Method: Least Squares. Sample: 1 51				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDPH00	1.079723	0.010147	106.4042	0.0000
RDHSOC	89.04804	53.37800	1.668254	0.1019
D9	13512.59	1342.109	10.06817	0.0000
D51	5107.168	1197.994	4.263101	0.0001
R-squared	0.993347	Mean dependent var		38111.86
Adjusted R-squared	0.992923	S.D. dependent var		13997.03
S.E. of regression	1177.515	Akaike info criterion		17.05538
Sum squared resid	65167423	Schwarz criterion		17.20690
Log likelihood	-430.9123	Durbin-Watson stat		1.628024

Model 4.

Dependent Variable: GDPH03. Method: Least Squares. Sample: 1 51				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDPH00	1.071178	0.014067	76.14911	0.0000
RDHTOT-RDHSOC	3.375328	3.837804	0.879495	0.3837
RDHSOC	60.06110	62.84329	0.955728	0.3442
D9	13566.39	1346.745	10.07347	0.0000
D51	5127.488	1201.113	4.268948	0.0001
R-squared	0.993457	Mean dependent var		38111.86
Adjusted R-squared	0.992889	S.D. dependent var		13997.03
S.E. of regression	1180.362	Akaike info criterion		17.07792
Sum squared resid	64089725	Schwarz criterion		17.26732
Log likelihood	-430.4871	Durbin-Watson stat		2.070030

Journal published by the Euro-American Association of Economic Development Studies: <http://www.usc.es/economet/ea.htm>