Chapter 4

Scientific Cooperation between the European Union and Latin American Countries: Framework Programmes 6 and 7

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Abstract

In this chapter we analyse the main trends in scientific cooperation between the European Union (EU), and the leading Latin American countries (LAC) by studying the structure of the cooperative projects funded by the EU through the most recent Framework Programmes (FPs) that include Latin American groups and institutions, e.g. all of the projects funded by FP6 and FP7 up to April 2010. The analyses focus on total number of projects, funding, relative contribution made to the project funds by the different countries, geographical distribution and other general features. The analyses also focus on the thematic structure of this type of scientific collaboration, the concentration of projects in specific urban areas, such as capital cities, the existence of dominant elites or institutions in each field that may explain the greater involvement of a country or a city in a higher number of projects and other specific features. We have chosen this approach taking into account the availability of information sources. The advantage of our selection of sources of information is the existence of their time series and the scope of their programmes, which cover many disciplinary fields not covered by the most active institutions working with Latin America (NIH, NASA, US and private foundations) whose initiatives are restricted to research in fields such as health, space, biomedical research or other specific subjects.

Introduction

On broad lines, the perception of international cooperation has changed over the last few decades, moving from a basically positive and often naive view highlighting values related to the cosmopolitanism and internationalism of science to more critical analyses that take into account the different types of potential consequences (not just the "positive" ones) of the scientific activities[2]. This said, the observations are highly dependent on the methodologies of the different approaches, since, in general, the quantitative approaches, and particularly the bibliometric methods, are useful in the study of some dynamics and trends but are less suitable for studying social and institutional structures, the role played by the various local

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[2] For the first point of view, see (Katz Martin, 1997) and for a more critical outlook (Gaillard, 1994; Kreimer, 2010b; Velho, 2002)

elites, including the scientific communities, and the changing paradigms of Science and Technology (S&T) policies.

Literature makes two significant distinctions in the analysis of scientific collaboration. The first one refers to the difference between formal collaboration, institutionalised through projects, programmes and cooperation agreements, and informal collaboration, through interpersonal and – increasingly – intergroup relationships (Kreimer 2010a; Velho 2002). The second distinction is between collaborations, whether formal or informal, that are either assumed as "horizontal" in the relationships established between the partners or classified within the category of "help", which is usually aimed at creating or strengthening capabilities in the less developed countries (Gaillard 1996; Wagner, Brahmakulam, Jackson, Wong and Yoda, 2001), and assumes an asymmetrical relationship from the outset.

There are a number of precedents in the analysis of international cooperation in Latin America. Several of them use bibliometric methods for the observation of both formal and informal collaborations (Cardoza and Fornés 2011; Fernández Gómez and Sebastián 1998; De Filippo, Morillo and Fernández 2008; Gómez, Fernández and Sebastián 1999; Miguel and Moya-Anegón 2009), but are naturally restricted to recording key indicators such as co-authoring, which is actually an indirect indicator of existing cooperation, since cooperation is a multidimensional phenomenon: to appear as a co-author of an article may reflect many different circumstances, from well-structured collaboration to a sporadic or incidental relationship.

Other texts have focused on formal networks, (Bonfiglioli and Mari 2000; Cuadros, Martínez and Torres 2008; Sebastian 2007). These studies, like those of the preceding type, take Latin America as their object, but are explicitly restricted – as we already mentioned – by leaving aside informal collaborations. Even more important is the fact that they, like the previous ones, are mainly based on an uncritical perspective of the practices of international cooperation, and assume that the greater the flow of cooperation, the more positive the consequences will be, particularly for the less developed countries. This is even clearer in the analysis of actions framed within "aid" from rich countries to peripheral ones, since it is assumed that the "degree of internationalization" of the research is, by definition, a dynamic factor for scientific development and hence should be valued as such.

Therefore, there are comparatively few contributions that consider international scientific cooperation as a constituent of scientific research that may or may not benefit the scientific groups of non-hegemonic countries. For example, Velho (2002) pointed out that “there are a number of examples of projects undertaken under the merit-based category which create exactly the same problems of asymmetry of all kinds of Research-for-Aid and which contribute only to the excellence of the Northern partner”. Vessuri and Kreimer (Kreimer and Zabala 2007; Vessuri 1996) reached similar conclusions in the analysis of the Venezuelan and Argentinian cases, respectively, while Gaillard (1998) and Waardenburg (1997) proposed other typologies that cover a greater variety of situations that do not involve immediate benefits for the Southern countries (Gaillard 1998, Waardenburg 1997). Gaillard focused on the difficulties of cooperation between unequal partners, noting, for example, that “Another problem is that mathematics and the basic natural sciences, which must be developed to a sufficient level in any country in order to support health, are often not included among the cooperative projects. A main reason is that the researchers in these fields in the North generally find the reward for cooperation with other researchers in the

North much more rewarding". As discussed below, this latter aspect seems to have changed in recent years.

Beyond the assessment that might be made about its consequences – an issue to be addressed empirically later on in this chapter – international scientific cooperation, whatever the methods used to measure it, has been increasing significantly during the last decades, both in formal and informal terms, although the informal increases are more difficult to identify.

The increase in international scientific cooperation in recent decades can be seen, for example, by looking at the total number of research articles published in a set of international peer-reviewed journals: the figure rose from about 460,000 in 1988 to an estimated 760,000 in 2008[3]. Further, in 1988 only 8% of the world's Science and Engineering (S&E) articles had international co-authors; by 2007, this share had grown to 22% (N.S.F. 2010). EU policies to increase intra-European research integration appear to be having their desired effect, as intra-EU collaboration index values increased substantially over the period. According to Sebastian (2009), international co-authored publications have multiplied fivefold in the European countries in the last twenty years and have now reached almost 50% of their national output, while in countries like the U.S.A. or Japan, this percentage reached 25% (Sebastian 2009). This increase is due, among other factors, to the promotion and encouragement that this type of collaboration has received from government initiatives, such as bilateral and multilateral cooperation agreements and treaties signed among countries and regions as well as intergovernmental research programmes established with the explicit aim of promoting global and regional cooperation by supporting projects (Velho 2002).

Other authors have also shown that international collaboration improves the scientific impact of publications in certain disciplinary fields (Glanzel *et al*. 1999; Katz and Martin 1997). Therefore, the determination of which potential partners will allow a country to reach a higher research potential (more and better results in terms of visibility) is not a trivial issue in designing the countries' cooperation policies.

According to Leydesdorff and Wagner (2008), as co-authorship increased linearly, the number of institutions involved increased exponentially (Leydesdorff and Wagner 2008). Persson *et al.* (2004) pointed out that this situation created an "inflation", due largely to the purported high correlation between the *co-authorship* and the *citation impact* (though this hypothesis is controversial at the moment) (Persson, Glänzel, and Danell 2004). This trend has become even more pronounced through the exponential increase in the participation of Chinese authors, a trend that is expected to grow in the future (Royle, Coles and Williams 2005). However, most of the perspectives discussed above analyse the increases in international scientific cooperation without exploring the qualitative aspects that vary, depending on the context and, in particular, between the centres and the peripheries, in order to analyse the 'real' practices of scientific cooperation among different partners.

Since these increases will be included in the issues that we discuss later, it is worth considering and briefly discussing the factors underlying the increase in international

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[3] Bibliometric issues are discussed and presented in greater détails in chapter 4.

collaborations. In their report Wagner *et al.* (2001) suggest the main reasons for enhanced international cooperation:

Geographic proximity: Neighbouring countries often have similar research projects or complementary interests and common publication profiles;

History: Common elements that represent human, linguistic or other sorts of ties, formed as a result of historical interactions (including colonial relationships) support present day collaborations;

Common language: A shared language facilitates collaboration;

Specific problems and issues: Common problems, such as disease control or natural disaster mitigation;

Economic factors: Factors include investments in a particular field because of research priorities set by scientists and policymakers, individual scientists collaborating with particular universities, and the need to share facilities and equipment;

Expertise: Collaborations can be driven by the need for the best, or most appropriate, expertise to pursue the objectives of the scientific query. Many developing countries have institutions and individuals with world-class expertise;

Research equipment, databases, and laboratories: The presence of particular research equipment, databases, and laboratories in a country can give rise to international collaborations.

Some of these possible reasons may seem original and explanatory although not empirical. For example, geographical proximity is not a frequent "strong" reason for collaborations; in Latin America, as well as in other regions, research groups are more frequently associated with groups from “the North" than with groups that are akin or geographically close to them. The "common language" does not seem to be decisive either, though combined with other factors could enhance collaborations; the Spanish-speaking countries of Latin America, for instance, have more collaboration with Spanish research groups because of the language (see data in EULARINET 2010). But the intensity of these links is clearly less than that of collaborations established with the United States or with other leading European countries, though the scenario is different for each field. In Medicine, for instance, the main partner is UK, in Biomedical Research the main partners are UK and France, while in Physics the preferred partners are France and Germany (EULARINET 2009, 2010).

Many studies indicate that "specific problems and issues" can be quite challenging since the work agendas are often strongly influenced by the more advanced countries (Bradley 2007; Gaillard 1994; Kreimer and Meyer 2008; Vessuri 1996).

Other causes seem more plausible, such as "*Economic factors"* or "*Research equipment, databases*, *and laboratories*," and can better explain the motivation of the groups located in non-hegemonic contexts, on the condition that their access to resources is, indeed, seriously limited. However, as we shall see below, this does not seem to be the case in Latin America, where funding has increased steadily in recent years in the countries that cooperate most actively (Brazil, Argentina, Mexico and Chile), although still far below the funding level available in the more advanced countries. Perhaps, – and this issue is less frequently addressed – the resources available in these countries are sufficient for scientific research, but not for the industrialisation processes stemming from knowledge generated by such research (Kreimer and Zabala 2007).

We agree with Katz and Martin (1997) who pointed out that "... the list of possible contributing factors is almost endless. Even though some of these factors may occur more frequently than others, collaboration is an intrinsically social process and, as with any form of human interaction, there may be at least as many contributing factors as there are individuals involved." However, it is worth briefly considering one of the aspects pointed out by Wagner *et al*., since it will help us to articulate our hypotheses. We are referring to the role that the local researchers' *expertise* plays in collaboration projects. "Many developing countries have institutions and individuals with world-class expertise". This, of course, has several aspects that the authors do not consider in detail. On the one hand, the so-called "world-class expertise" is defined by the dominant groups, at an international level, for each field of science or problems and on the other, this expertise is often related to two aspects qualitatively different: in a sense, this expertise relates to the ability to carry out research with the same capabilities and quality standards that are applied by their peers in the more advanced centres. This might be called *location of global expertise*. But considered from another vantage point, this expertise can take the form of knowledge – and its accumulation over decades – of local problems or issues that may be of general or universal interest, as is the case for research on particular sites on native species, or specific conditions that can only be observed in a certain *locus*[4].

In sum, it seems evident that in order to reach a deeper understanding of the forms of international cooperation today, and the changes that have occurred more recently, it is necessary to complete the analysis based on aggregate data with a socio-historical perspective that could provide a framework for interpretations and micro-level studies that might explain the case-specific peculiarities. But, above all, it is necessary to break the preconception, often taken for granted by several authors and, even worse, in many policies of non-hegemonic countries, that "all scientific cooperation has positive effects"[5].

1-Background, object and methodological aspects of the study

In this section we analyse the main trends in scientific cooperation between the European Union (EU), and the leading Latin American countries (LAC). We included all the projects funded by the FP6 and FP7 up to April 2010. The analyses focus on total number of projects, scope of funding, relative contribution made to the project funds by the different countries, geographical distribution and other general features. But we are also interested in specific features such as the thematic structure of this type of scientific collaboration, the concentration of projects in specific geographical areas, such as capital cities and the existence of dominant elites or institutions in each field that may explain the greater involvement of a country or a city in a higher number of projects.

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[4] For an excellent analysis of this, several elements of local/global research referred to the research in Tierra del Fuego (Argentina), see Albarracín, 2011.

[5] For a further discussion about the internationalization of Latin American science and its consequences, see Kreimer (2010b)

As was observed by some authors who have been studying the patterns of cooperation in science from a bibliometric perspective (where the co-authorship rate and the percentage of works in collaboration are the more widely used indicators), Latin America seems to follow some patterns that can be perceived internationally (Sancho 1990). Although there are disparities across disciplines, the U.K., Italy, France, Spain and Germany are the European countries with the largest participation in the collaboration. They are second after the United States, which is the main partner of most of the countries of the world[6].

To support a conceptual approach focused on the magnitude and characteristics of international scientific cooperation in Latin American countries, we propose to reduce the scope of these relationships to the links established between Latin American groups and European scientists, as institutionalised through the EU 6 and 7 Framework Programme. This reduction leaves out an important part of international scientific relations, since Latin America researchers have developed, as noted above, strong links with their American colleagues. Therefore, a future study that is complementary to this one, will compare EU/LAC and LAC/US patterns of cooperation to determine the extent of differences. This practical exercise will be supported by the existence of databases that facilitate this kind of analysis, and by the increasingly institutionalised EU science, technology and innovation 'Liaison Offices', which collect and analyse data at the various national i.e. federal, provincial, state, levels in Latin America, thereby allowing for some kind of inter-country comparisons.[7] Moreover, scientific cooperation between Europe and Latin America only became really strong after the establishment of FP6 in 2001.

In sum, the object of our study can be defined as the links of scientific cooperation between Latin American countries and their European counterparts implemented through FP6 and FP7.

The corpus of data was obtained from CORDIS, the public database of the European Union and from CORDA, an internal database of the European Commission, which provided updated and complete data (http://cordis.europa.eu/home_es.html). The FP7 data correspond to the programme's first three years, ending on April 9, 2010. These data were supplemented with data provided by the various Liaison Offices.

To quantify EU-LAC collaboration, we took account of the number and cost of projects involving Latin American countries and studied the structure of LAC and EU participation. Groups belonging to European countries are 'natural' participants in the FPs. The participation of third countries is partly funded by the EU, usually with counterpart funding, depending on the country. Further, the funds that each third country invests in the EU projects can come from a variety of sources. For this reason, there are many categories that need to be explained.

The 'total cost of the project' refers to the total amount disbursed for project implementation.

The 'contribution of the EU' refers to the total contribution provided by the EU member countries together with the EU central body to third countries.

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[6] See the chapter 3 by Jane M. Russel and Shirley Ainsworth in this volume .

[7] For instance: ABEST (Argentina), CHIEP (Chile), EUMEXCYT2 (Mexico), B. Bice (Brazil)

The ‘Latin American total cost’ is a compound of the European contribution to Latin American countries plus the contribution made by each (Latin American) country.

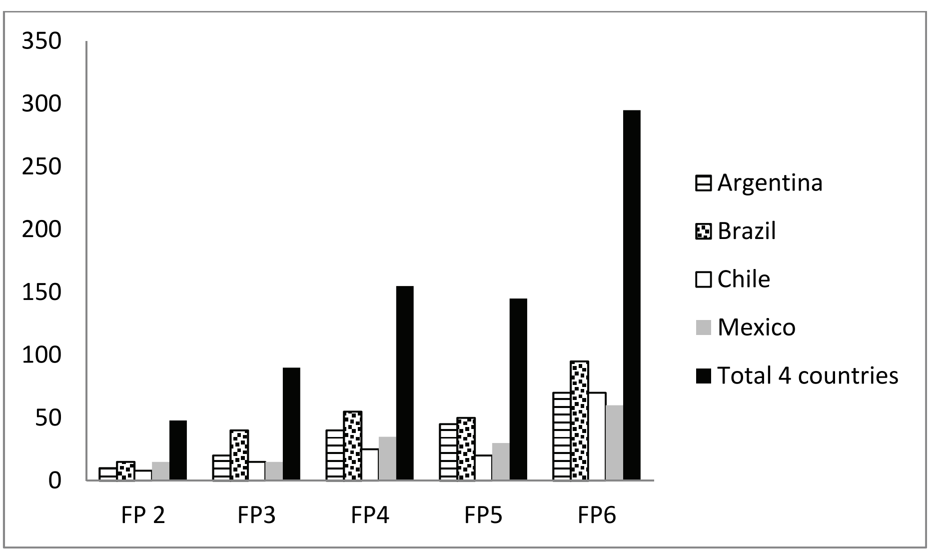
The ‘European contribution to Latin America’ refers to the European contribution.

Another key point in the analysis of international scientific cooperation is the thematic classification of projects. Each FP is structured around different subjects and areas of knowledge. Moreover, the institutions and groups in the participating countries feel that access to their disciplinary fields and areas of knowledge is facilitated through participation in the FP. To overcome these differences, we have used the information available about each project: title, subject of research, the framework programme it belongs to, institutions involved, and categories (primary and secondary): Agriculture, Biology, Chemistry, Earth Sciences, Engineering, Medicine, Social and Human Sciences and Physics.

The FP is an essential tool designed by the EU to support the competitiveness of the European economy through strategic partnerships with third countries. The FPs seek to promote the production of knowledge by establishing links between European universities and research centres, on the one hand and partners in third countries, on the other. At the programmatic level, the declared aim is to try to find answers to specific or global problems on the basis of mutual interest and mutual benefit (CORDIS 2009). The FPs are structured as sets of projects carried out by research teams from Europe, Latin America and other regions. The EU determines which nations are eligible for each programme and activity.

Prior to FP4, no specific programme was devoted to scientific cooperation with third countries, but starting with the 1994-1998 period, a specific FP was set up for "Cooperation with Third Countries and International Organizations" (INCO), with clearer guidelines and more specific measures. Thereafter, Latin American countries started participating more actively.

Figure 1: Evolution of number of projects involving four leading LA countries (FP2 to FP6)



Source: CORDIS

2-Results

2.1 General funding structure

In Table 1 we can see the number of projects that have been funded by both FP 6 and FP 7 up to the time of this study. Since FP7 is still underway, the total number of projects to be funded up to the time of completion, obviously, will greatly exceeds the total number of projects funded by the previous programme. However, the trend indicates that, for the same number of projects, the average total cost per project has fallen to slightly over 50%.

(2) Average cost (€) of projects involving at least one Latin American country.
(3) Total cost (€) of Latin American participation.
(4) Europe's contribution (€) to participation of Latin American countries.
(5) Contribution of Latin American countries (€).

The decrease in the average cost per project (in projects involving at least one Latin American country) can be explained partly by a greater relative participation of SHS (Social and Human Sciences) projects (as will be discussed in Section 2.2.3), whose costs are significantly lower than projects in other knowledge areas that involve, for example, the purchase of sophisticated equipment. However, this is only a partial explanation: except in the field of Physics, the average cost per project is significantly lower in FP6 than in FP7 in almost all disciplinary fields, with some major drops, e.g. Earth Sciences and Chemistry where the average costs are about half[8].

Table 1: Total costs and regional contributions for the FP6 and FP7 EU-LAC projects (€)

	Number of Projects	Total Cost of LA Projects (1)	Average Project Cost (2)	LA Total Cost (3)	EU contribution to LA (4)	LA contribution (5)
FP6	221	1,078,753,038	4,881,235	56,755,734	48,117,373	8,638,361
FP7	226	606,283,223	2,682,669	73,007,101	50,156,106	22,850,995

(1) Total cost (€) of projects involving at least one Latin American country.

The explanation above may suggest that the resources received by each FP7 participant (except in the Physics groups) are lower than those received under FP6. But this is not so, because there are additional data to be considered such as the lower average number of participants per project in FP7 (under 11) than in FP6 (close to 18): In fact, over 22% of the FP6 projects had more than 30 participating groups (and some projects with as many as 70 participants). In FP7, only 4% of the projects have 30 or more participants involved, and the largest project only has 38. Thus, if the distribution of resources per project were homogeneous among every participant group (regardless of the disciplinary field, country, project type, etc.) each of them would receive more money under FP7 than under FP6:

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[8] An additional explanation may be found in the EU decision to limit the funding of 'huge' projects, since they are more difficult to manage (Hubert, Chateauraynaud and Fourniau 2012)

respectively about 327,000 euros and 280,000 euros. These figures hide a lot of heterogeneity and dispersion within the programmes, which we will briefly discuss.

From the above data, it is evident that, although the total European contribution to projects involving at least one Latin American country is similar in both FPs – about 70% – the total cost of Latin American participation (consisting of the European participation plus the Latin American participation) shows a significant increase. While in FP6 the Latin American share was 5.26% of the total project costs, in FP7 the figure is more than double, 12.04%. An important part of this relative increase comes from the funds supplied by the Latin American countries themselves. While in FP6, the EU funded almost 85% of Latin America's total costs, in FP7 (until now), this percentage has dropped to 68%. The difference can be explained by the fact that the countries of this region are investing, in relative terms, more money to participate in the same number of projects.

The increase in the Latin American contribution can be traced to the following factors: a) a higher concentration of Latin American groups in the more expensive projects; b) an increase in the number of Latin American countries in each project; c) Latin American policies that encourage the participation of their research groups in European programmes, as a part of their internationalisation strategies, based on the assumption that Latin American countries may benefit from them.

It is interesting to observe the cost distribution of projects in which LA groups participate. Figure 2 shows that the majority of projects in the two FPs cost about the same. Approximately 30% of the projects cost less than one million euros, while 47%s of FP6 and 64% of FP7 cost between 1 and 10 million euros. This indicates that the high average cost observed in FP6 is due, mostly, to the existence of a very small number of projects costing over 40 million euros, and a certain number costing between 20 and 30 million euros, while in FP7 there is no project with LA participants that costs over 15 million euros[9].

Since these projects also involve other countries it is interesting to observe the consequences of the increase observed in the LAC contribution. To evaluate this, we analysed the relative share of 'other countries' on given projects (see Table 3). We define "other countries" (OC) as all those countries that have participated in the FP and that are neither EU nor LAC.

Our analysis of OC participation in given projects that involved at least one Latin American country, assumed that a bias may have been introduced in favour of projects that addressed 'regional issues', thematically or geographically. But the trend was not exactly what we expected. During FP6, the OC contributed almost 10.61% of the total investment, while in FP7 (until April 2010), that percentage rose to just over 11.19%. Meanwhile the LACs contributed, as noted before, more than double the amount they contributed to FP6, thus exceeding the OC contribution.

[9] On the whole, LAC financial participation per project in FP7 was lower than in FP6. During our study period, some FP6 projects cost up to 40 million euros, while in FP7 there were no projects with a total cost exceeding 15 million euros. Despite a small number of expensive projects, we found that the majority of projects funded by the two FPs cost between 1 and 10 million euros.

Figure 2: Distribution of projects involving LA, by total cost (in million €) in FP 6 and FP7

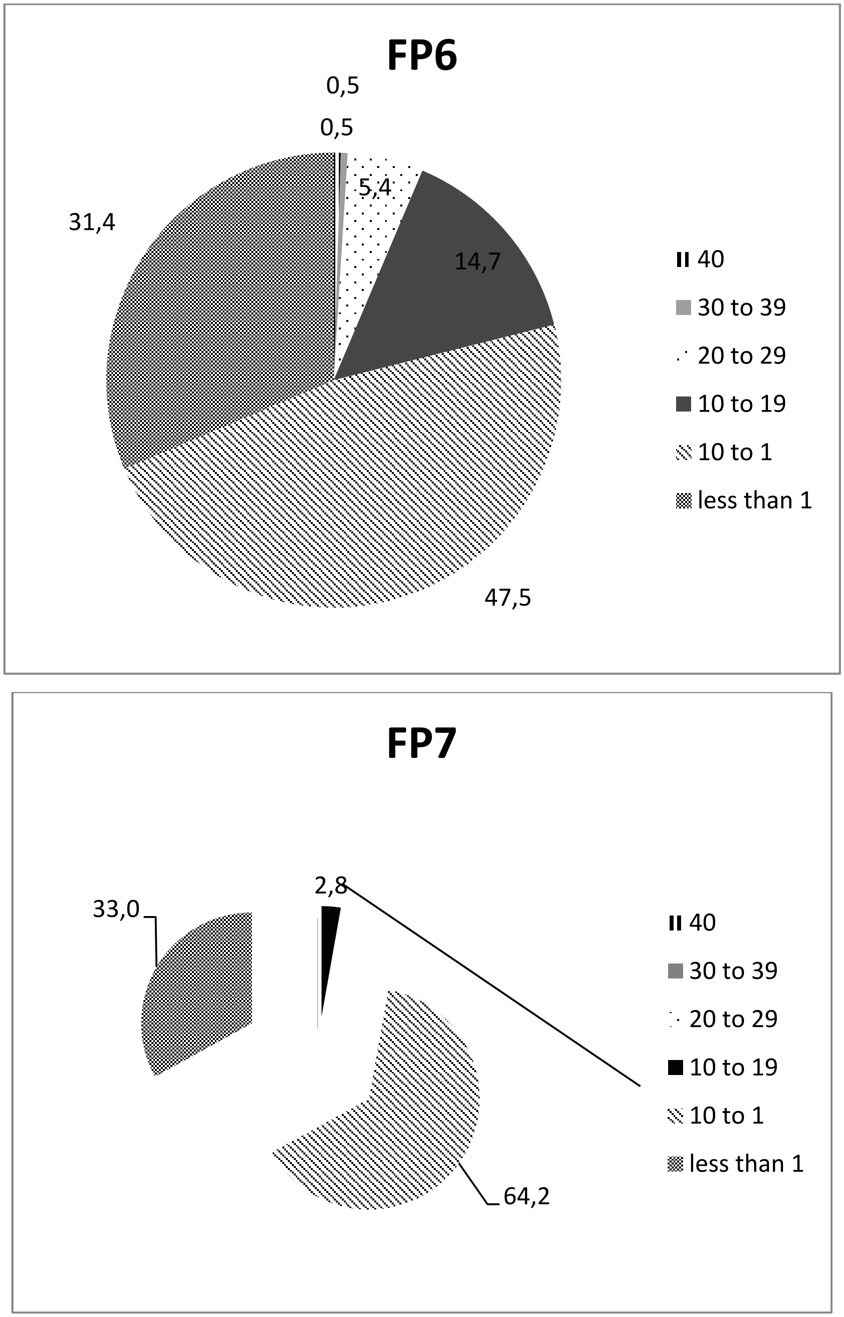


Table 2: Distribution of participation cost by region (LAC and OC) in the FPs

	Number of Projects	Total cost of projects	LAC total cost	% LAC	OC Total cost	% OC
FP6	221	1,078,753,038	56,755,734	5.26	14,511,313	10.61
FP7	226	606,283,223	73,007,101	12.04	67,901,413	11.19

The LACs participate in more projects, provide more funds in absolute terms and, as we mentioned, now consider the distribution of their contribution as a major component. The OC, on the other hand, are contributing less, a situation that is offset by a concomitant increase in European funding.

Table 3: Distribution of the amount of EU contributions to the FP projects by region

	LAC	%	OC	%
FP6	48,117,373	85	66,691,306	58
FP7	50,156,106	68	49,242,126	72

If, indeed, the projects had some sort of regional bias, one would expect two things. First, a greater show of interest by the countries belonging to the project's region, which should mean increased participation in the number of projects and in each project and more funding for each project. This trend is apparent, but, if these projects were actually "region-dependent", we would also see some indication of greater Latin American participation, with a subsequent increase in the European contribution (or, at least, no decrease in the relative contribution). What is happening is exactly the opposite: the European contribution in the region is going down, while the Latin American participation fallaciously seems to be going up, a theory not supported by the data because a larger number of the projects focus on regional issues. In conclusion, and in spite of other influences, the more plausible explanation corresponds to factor c) under 2.1 above, that purports that Latin American policies are indeed encouraging the participation of their research groups in European Programmes.

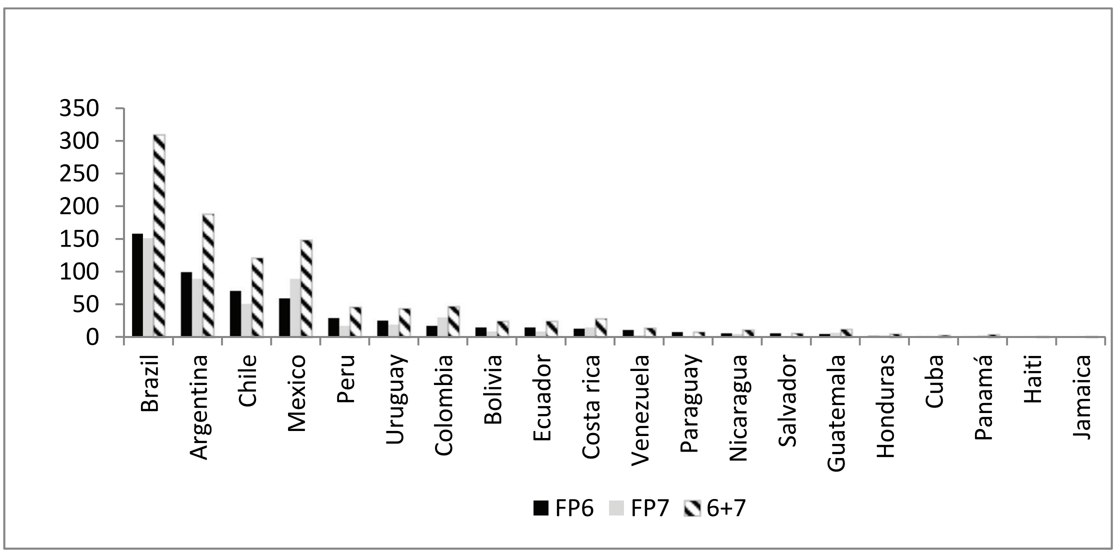
2.2 LAC Trends

The above data indicate that, on the whole, LAC participation in scientific collaboration with EU has increased significantly, both in terms of number of projects and project funding. We were interested to know how these funds were allocated in the various Latin American countries.

2.2.1 Breakdown by country

As a general rule, the countries with the more established scientific institutions and the more powerful scientific elite had a higher level of international cooperation, as measured by the number of FP projects. In Latin America, this referred to Brazil, Mexico, Argentina and Chile. We could qualify this group of countries as "very active", followed by a second group, with moderate but important participation, composed of Colombia, Uruguay, Peru, Bolivia, Ecuador and Costa Rica and a third group with little or no participation in FPs, composed of Venezuela, Paraguay, Nicaragua, Salvador, Guatemala, Honduras, Cuba, Panama, Haiti and Jamaica.[10]

Figure 3: LA participation in number of FP projects



As we can see Colombia increased its participation (measured in number of projects), by 70% (17 projects in FP6 and 30 in FP7), Mexico by 50% (59 and 89), while Costa Rica increased it by 15%, but with a lower number of projects (13 and 15 respectively).

[10] We established the following classification: “Very active” meant participation in more than 50 projects, “moderate” meant participation, in 10 to 49 projects incl., and “little or none” meant participation in less than 10 projects. This included the average number of projects in both programmes.

Table 4: Costs per country for FP6 projects (€)

FP6						
Participating Country	**Number of projects**	**Total Project Cost**	**EC Contribution to project**	**Total Cost EU + LAC Participants**	**ParticipingEC Contribution**	**ParticipingLAC countr contribution**
Brazil	158	886,241,078	590,286,827	17,784,246	13,836,655	3,947,591
Argentina	99	465,918,348	320,798,797	9,325,017	8,081,881	1,243,136
Chile	70	274,491,789	199,289,722	8,424,923	6,693,055	1,731,868
Mexico	59	203,378,242	153,756,253	6,266,814	5,819,527	447,287
Peru	29	86,534,429	68,560,776	3,239,820	2,866,609	373,211
Uruguay	25	88,556,629	67,867,337	2,249,265	2,139,103	110,162
Colombia	17	73,309,572	55,489,646	2,140,880	1,711,853	429,027
Bolivia	15	44,302,003	31,036,167	1,339,936	959,809	380,127
Ecuador	15	62,893,902	55,681,002	1,921,148	1,981,368	-60,220
Costa Rica	13	39,007,314	29,477,534	1,139,892	1,139,892	0
Venezuela	11	16,607,792	14,503,913	1,518,867	1,518,861	6
Paraguay	8	7,064,415	6,526,212	430,405	430,405	0
Nicaragua	6	17,719,036	14,950,409	489,335	454,835	34,500
Salvador	6	7,715,743	7,604,239	210,540	210,540	0
Guatemala	5	22,058,072	17,066,696	184,780	184,780	0
Honduras	2	530,000	530,000	46,200	46,200	0
Cuba	1	1,886,475	1,700,000	43,666	42,000	1,666
Panama	1	0	201,714	0	0	0
Haiti	0	0	0	0	0	0
Jamaica	0	0	0	0	0	0
Overall Total	540	**	**	56,755,734	48,117,373	8,638,361

** These columns cannot be added to obtain the total because there are repetitions, since several participating LAC may be involved in the same project.

Measured in total project costs, Brazil, Argentina, Bolivia and Ecuador increased their participation most.

As noted above, the Latin American share is higher in FP7 than in FP6. This growth, however, depicts specific features for the different countries. In terms of number of projects, Mexico and Colombia stand out since their FP7 participation has already exceeded their FP6 participation by, respectively, 50% and 70% although FP7 is only midway. If we consider total project costs, except for Mexico all the LA countries are participating in projects whose cost is below the average.

Table 5: Costs per country for FP7 projects (€)

Participating Country	Number of projects	Total Project Cost	EC Contribution to project	Total Cost EU + LAC participants	Participing EC Contribution	Participing LAC contribution
Brazil	151	355,094,914	264,091,206	22,458,471	15,946,748.74	6,511,722
Argentina	89	194,843,888	146,823,353	10,015,559	7,666,589.21	2,348,970
Mexico	89	249,978,962	150,138,042	13,930,231	5,406,059.23	8,524,172
Chile	51	140,346,775	104,576,933	4,536,355	3,433,215.78	1,103,139
Colombia	30	68,158,466	49,747,572	4,913,691	3,862,842.20	1,050,849
Uruguay	19	46,103,621	32,170,325	2,120,256	1,629,175.20	491,080
Peru	17	59,024,061	43,042,222	3,181,789	2,435,643.30	746,146
Costa Rica	15	44,557,936	34,306,329	3,126,475	2,420,316.00	706,159
Bolivia	9	24,296,257	18,778,846	1,796,916	1,354,542.10	442,374
Ecuador	9	27,841,928	19,787,087	2,146,341	1,624,524.60	521,817
Guatemala	7	18,735,445	14,509,843	869,954	611,171.00	258,783
Nicaragua	5	13,215,756	11,137,348	1,131,702	776,888.00	354,814
Honduras	3	11,282,948	8,793,852	474,793	369,304.00	105,489
Panama	3	6,171,330	4,503,633	331840	269,820.00	62,020
Venezuela	3	12,262,445	7,869,507	596,373	383,927.00	212,446
Cuba	2	5,756,244	2,677,000	38,180	28,580.00	9,600
Haiti	1	2,669,987	1,490,171	96000	72,000.00	24,000
Jamaica	1	17,162,412	12,949,264	1242174	1,864,760.00	-622,586
Paraguay	0	0	0	0	0.00	0
Salvador	0	0	0	0	0	0
Total	504	**	**	73,007,101	50,156,106	22,850,995

** These columns cannot be added to obtain the total because there are repetitions, since several LACs may be involved in the same project

In terms of fund allocations, Figures 5 and 6 show that the following countries increased their share of total funding most: Mexico, Brazil, Colombia, Uruguay and Argentina. The first two made particularly remarkable increases (This comparison does not include countries that were inactive during FP6).

As was to be expected from the general trends presented above, the average cost of projects with Latin American participation has diminished in most cases although a notable increase has been observed in the case of Mexico and, to a lesser extent, Costa Rica (see Figure 7).

Figure 4: Total cost of LA participation (millions €)

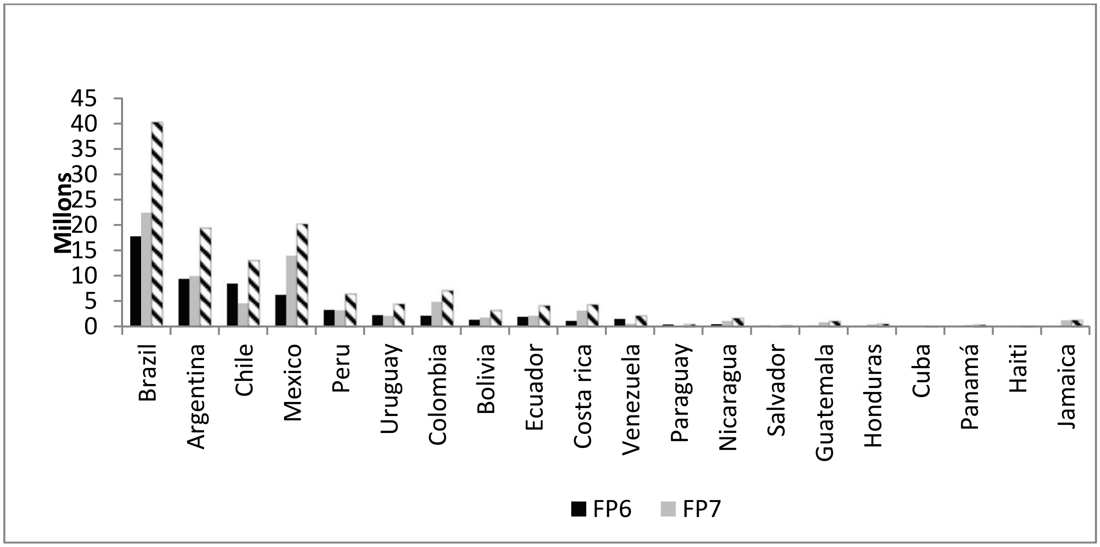
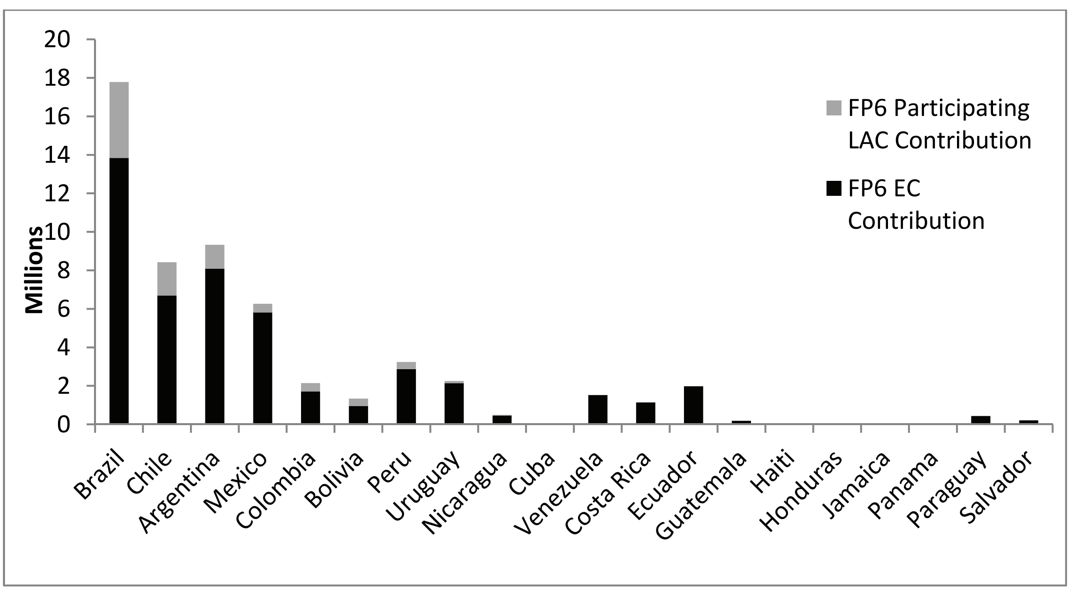


Figure 5: Distribution of cost for each of the LAC in FP6 (millions €)

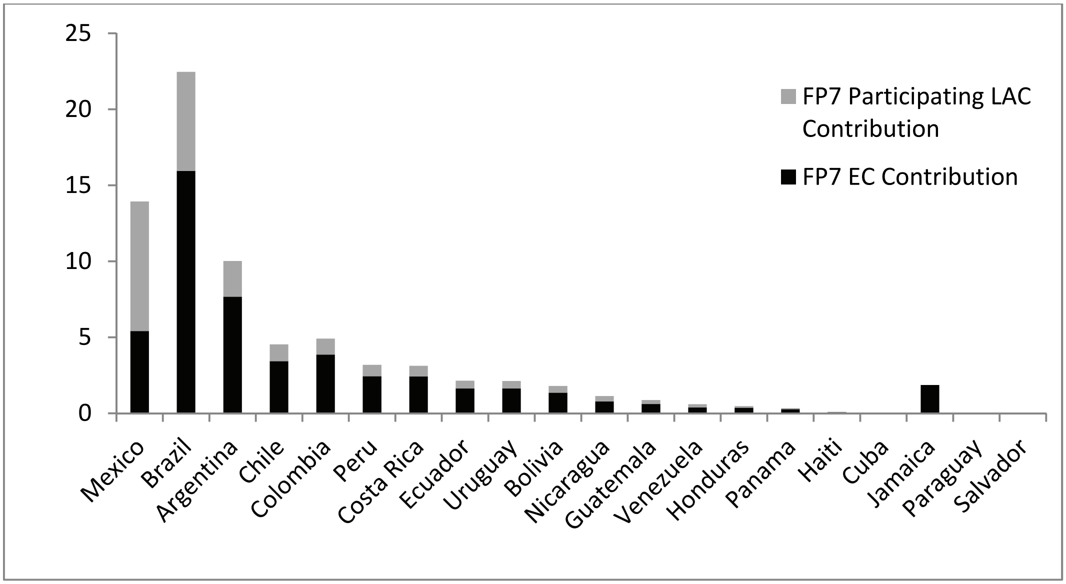


Note: Data are presented in decreasing order of European contribution to each participating Latin American countries

Although the three very distinct groups of countries we established above still remain, the gap between the most active seems to be shrinking, thus consolidating two groups: those who regularly participate and those who do so only sporadically.

2.2.2 Distribution of projects by LAC cities and institutions

Figure 6: Distribution of cost for each of the LAC in FP7 (millions €)



Note: Data are presented in decreasing order of the European contribution to the contribution of each participating Latin American country.

The increased LAC project funding is not accompanied, however, by a linear increase in the number of participating institutions (Table 6).

Table 6: Number of institutions participating in FP6 and FP7

	LAC Institutions		**EU Institutions**		**Institutions in Other Countries (OC)**	
FP6	366	13.53%	1757	64.93%	583	21.54%
FP7	298	18.53%	938	58.33%	372	23.13%

In FP7, the number of Latin American Institutions rose but is smaller than in FP6, which would indicate a somewhat higher concentration of projects in a smaller number of institutions. But, the concentration process, however, is less strong in LAC that in the OC (the representation of other Latin American institutions from one PF to the other), since the LAC receive less money for FP7 and yet, in terms of number of institutions, are better represented. LAC institutions that were participating on average in 0.6 projects per institution in FP6, are involved on average in 0.76 projects in FP7, while the figure for the OC rose from 0.38 to 0.61. Since this concentration process is also found in EU institutions, whose participation on average has risen from 0.13 projects per institution in FP6 to 0.24 in FP7, the situation perhaps is not inauspicious for LAC. The response of Latin America as a region to the widespread phenomenon of concentration of research in fewer institutions is somewhat more "moderate" than that of other regions.

Table 7: Concentration of cooperation in FP by cities

	LAC cities	Number of projects	Average projects per city	Cities with one project	Cities with 10 or more projects	Cities with 90% of the projects
FP6	147	540	3.67	87	11	94 (64%)
FP7	118	504	4.27	58	11	68 (58%)

This phenomenon of research concentration in LACs is not only connected to scientific institutions. The number of Latin American cities involved in FP projects has also declined. During FP6, 90% of the projects were implemented in 64% of the participating cities, but only 58% under FP7. Since the number of cities is the same for many projects, we concluded that the cities that had "disappeared" in FP7 were the ones that had participated in a small number of projects. This supports the theory that the scientific elite, who settled in the leading institutions in major cities, kept increasing their hegemony over the research being conducted in collaboration with international groups.

Table 8: Distribution of projects in LAC cities

FP6 Projects		FP7 Projects	
Buenos Aires	53	Buenos Aires	62
Santiago	44	Mexico D.F.	42
Rio De Janeiro	28	Santiago	34
Sao Paulo	25	Rio De Janeiro	30
Mexico D.F.	23	Sao Paulo	28
Montevideo	23	Bogota	23
Brasilia	22	Montevideo	19
Lima	20	Brasilia	16
Bogota	11	Campinas	13
Concepcion	10	Lima	13
La Paz	8	Porto Alegre	10

FP6 Projects		FP7 Projects	
Quito	8	Guatemala	7
Asuncion	7	Belo Horizonte	6
Cordoba	7	Sao Jose Dos Campos	6
Manaus	7	Cochabamba	5
Campinas	6	Cordoba	5
La Plata	6	Managua	5
Belo Horizonte	5	Nuevo Leon	5
Florianapolis-Sc	5	Quito	5
Guatemala	5	Sao Carlos	5
Managua	5	Valparaiso	5
Merida	5	Guanajuato	4
Sao Carlos	5	La Plata	4
Belem	4	Saltillo	4
Cali	4	San Jose	4
Caracas	4	San Luis Potosi	4
Cochabamba	4	Turrialba	4
Curitiba	4	Antofagasta	3
Mar Del Plata	4	Cali	3
Nuevo Leon	4	Manaus	3
San Salvador	4	Mar Del Plata	3
Turrialba	4	Pedro	3
Valparaiso	4	Piracicaba	3
Others (Less than 3 proj per city)	158	Recife	3
		Rosario Santa Fe	3
		San Nicolas De Los Garza	3
		San Pedro De Montes De Oca	3
		Valdivia	3
		Others (Less than 3 proj per city)	103
Total	**53611**	**Total**	**504**

From FP6 to FP7 we observed a growing concentration in several cities; the number of cities declined by 20% in some of the projects. If we combine the projects (see table below) with the percentage of cities in the total, that had only one project the figure was 60%, while in FP7 the figure dropped to 50%.

[11]There are four projects that did not indicate the name of the city where they were located.

Table 9: Number of projects in capital cities

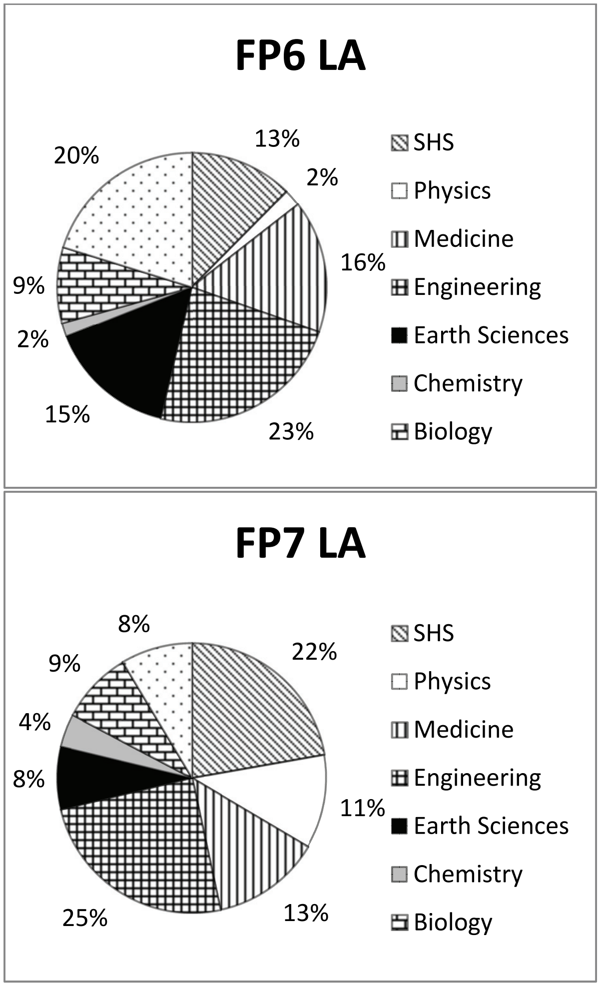
	FP6 Projects			FP7 Projects		
Country	In capital cities	In the rest of the country	In capital cities (% in the country)	In capital cities	In the rest of the country	In capital cities (% in the country)
Brazil (S.P)	25	133	15.82	28	123	18.54
Brazil (Rio + SP)	53	105	33.54	58	93	38.41
Argentina	53	46	53.54	62	27	69.66
Chile	44	26	62.86	34	17	66.67
Mexico	23	36	38.98	42	47	47.19
Peru	20	9	68.97	16	1	94.12
Uruguay	23	2	92.00	19	0	100.00
Colombia	11	6	64.71	23	7	76.67
Bolivia	6	9	40.00	1	8	11.11
Ecuador	8	7	53.33	5	4	55.56
Costa Rica	2	11	15.38	4	11	26.67
Venezuela	4	7	36.36	1	2	33.33
Paraguay	7	1	87.50	0	0	0.00
Nicaragua	5	1	83.33	5	0	100.00
Salvador	4	2	66.67	0	0	0.00
Guatemala	5	0	100.00	7	0	100.00
Honduras	2	0	100.00	2	1	66.67
Cuba	1	0	100.00	2	0	100.00
Panama	1	0	100.00	2	1	66.67
Haiti	0	0	0.00	1	0	100.00
Jamaica	0	0	0.00	1	0	100.00

We see a general tendency to concentrate projects in the capital or big cities. Brazil is a special case because, in spite of the particular weight of Sao Paulo and Rio de Janeiro, projects are dispersed throughout more than 10 cities. Bolivia is another special case, because of the weight of two cities, Cochabamba and La Paz. Montevideo is another interesting case; although Uruguay is not among the countries with the highest participation (due to its size), almost all the projects are concentrated in the capital.

2.2.3 Disciplinary structure of the EU-LAC partnership

While the data shown above regarding the participation of LAC in the FPs are very informative, they need further analysis based on disciplinary field, to see how this kind of collaboration applies in other knowledge areas. The thematic structure of collaboration is shown in the Table 10 and Figure 7 below.

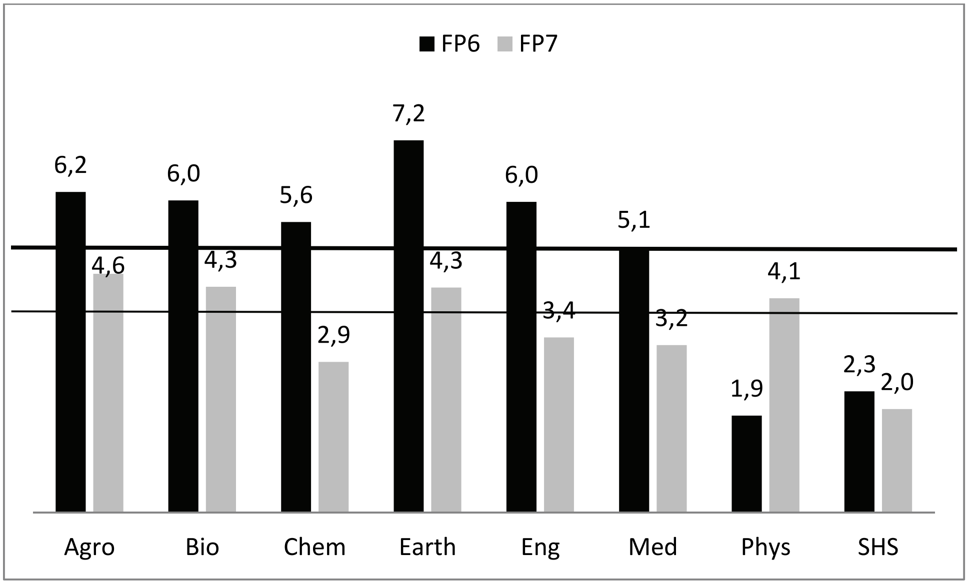
Figure 7: Distribution of projects with LAC participation, in % by disciplinary field



As mentioned above, the LAC increased their participation in the FPs, a fact that will become more apparent at the time of completion of FP7. This increase was not evenly spread across the different disciplines. Engineering remains the most important area, and increased slightly, now reaching 25% of all projects. The SHS projects show a significant 50% increase over their share in FP6, and account for more than 20% of all projects. The number of projects in the field of Physics, show a very strong percentage increase (over five times), but started from a very small base in FP6 (2% of the total).

One hypothesis about the relative prevalence of Engineering can be traced to the calls for projects, which require more applied research and even tend to set guidelines to orient methodologies. The EU documents specify that the overall objective is "to increase competitiveness and foster innovation" (EU 2006; Rouquayrol Guillemete and Herrero Villa 2007). Since projects are applied more and more to production processes, Engineering can be expected to play a major role[12].

Figure 8: Average cost per project with LAC participation, by discipline (millions €)



There are several explanations for the increase in the number of Social and Human Sciences (SHS) projects. Perhaps the most important one is the existence of specific subject areas within the calls for projects: in FP6 the SHS theme called "Citizens and Governance in a Knowledge-based Society" had a 247 million euro budget, and "Science in Society" (SIS), 88 million euros, which meant that these two areas together consumed 335 million euros, for projects distinctly belonging to SHS. In FP7, the "Socio-economic Sciences and the Humanities" programme has a total budget of 623 million euros, while SIS has 330 million euros, totalling 953 million euros, almost three times the amount allocated in the previous programme. The budget for SIS was nearly quadrupled. But this percentage of increase does not apply in all the fields. For example, Nanotechnology, which is one of the most active fields, had a budget increase, but a somewhat smaller one: in FP6 it had 1429 million euros and in FP7, 3475 million[13] (EU 2006).

[12] An exception to this trend is the lesser importance given to agricultural sciences, as we explain below.

[13] The comparison of thematic budgets between FPs is a complex matter because the subject areas are not the same in all of them. For example, in FP7, Health was a single broad subject, with a total budget of 6100 million euros, while in FP6, the field was divided into three major areas: Life Sciences, Genomics and Biotechnology for Health, with a budget of 2.514 billion; Advanced Genomics and its Applications for Health, 1.209 billion, and Combating Major Diseases, 1.305 billion, which led to a total of 5.028 billion, so that the increase from one programme to another is not so important. Budget increases in other areas were similar to that of SHS, e.g. ITCs whose budget was almost triplet (from 3984 million in FP6, to 9050 million in FP7).

Analysing SHS projects by disciplinary field does not produce a homogeneous representation. On the contrary, a substantial part of the budget is allocated to projects in Economics, especially projects on market analysis and changes, and management projects.

As was to be expected, the average cost per project in SHS is much lower than in all other fields: in both FP6 and FP7 the average cost per project in SHS, is about 50% below the overall average (see Table 11).

Table 11: Average cost in € per project involving LAC, by disciplinary field for FP6 and FP7

	FP6	FP7
Agric	6,175,994	4,598,944
Bio	6,012,607	4,349,024
Chem	5,596,167	2,902,262
Earth	7,171,649	4,334,728
Eng	5,985,521	3,374,485
Med	5,119,250	3,224,737
Phys	1,868,161	4,128,496
SHS	2,334,990	1,992,843
Average	5,033,042	3,613,190

In Physics, growth in the number of projects with LAC participation can be characterised, in order of importance, by: (a) the major increase of development projects in Nanoscience and Nanotechnology, (b) the Astronomy projects related to the installation of major international astronomical observatories in the region, (c) the rise in the average cost of the projects in this field.

As noted above, the total budget for Nanotechnology has doubled, which would explain an important part of the related project growth. But, at the same time, most of the LA scientific and technological systems created specific thematic areas to promote Nanotechnology projects, thus producing a double effect. On the one hand, the “classical” projects in the area actually increased. On the other hand, we can support the hypothesis of "functional adaptation" by research groups or consortia. Projects that in former times were presented in areas such as Biotechnology, Chemistry or even Biomedical Sciences, have been reformulated in terms of Nanoscience, so as to capture new funds (Meyer 2007; Schummer 2004). This is the case, for example, for the biosensors projects and could also explain a part of the slight decrease in Biology projects.

The Astronomy projects are related to the creation, maintenance and utilisation of international observatories installed throughout Latin America, like the Pierre Auger Observatory in Mendoza, Argentina, which benefited from the FP6 project "Integrating Auger Observatory and European Research Institutions Into a Worldwide Grid" and the FP7 project "Cherenkov Telescope Array for Gamma-ray Astronomy", just to mention two of them.

The FP7 projects in Physics are more than twice as expensive as those in FP6 and now have per unit costs essentially equal to those in Biology, Agriculture and Earth Sciences, as can be seen in Table 11.[14]

During this same period, the number of projects in Agriculture and Earth Sciences, decreased to less than half their FP6 level: 20% to 8% and 15% to 7% respectively.

The decrease in these two fields can be explained by the hypothesis that within the Latin American participation in European projects the "advantages of local issues" tends to be less important than it was in the past. Thus, the major importance of these two fields in the past, even in FP6, can be traced to the possibility of profiting from local conditions such as crops, soils, climate, native species, and so on. Today, they have given way to projects less dependent on "local conditions", projects whose applications can be globalised and become independent of their original contexts.

On the other hand, there is a sort of European restriction on project funding in Plant Biotechnology. In countries such as Argentina and, more recently, Brazil, where agricultural production of GMOs is very strong, there are research projects with enough weight and importance to attract a considerable percentage of the LA agricultural researchers, thus leaving less room for scientific cooperation in this field.

2.2.3 Breakdown by country

This section discusses the main features of the distribution of projects for each disciplinary field among the countries of the LA region (cf. figures 9 and 10).

The first relevant fact is the increased participation of Mexico and Colombia. In the case of Mexico, the increase is particularly important in Chemistry and SHS, which exceed the national average. Colombia increased its participation in the fields of Medicine and Engineering, and also in SHS.

Brazil is the country in the LA region that has increased its participation in Agriculture most. Chile and Mexico improved in Biology while Argentina increased its collaboration in the Earth Sciences. Interestingly, Brazil has increased its production of transgenic plants in recent years (the production of transgenic crops was only approved in 2005), while countries like Argentina or Mexico, which started producing transgenic plants earlier, did not. The FP7 expressly states that it will fund research in health-related biotechnology, but not in agriculture for food production (EC 2002, 2006), whereas in FP6 this condition was not so strongly expressed. On the other hand, Engineering received significantly more funding in all the countries but Brazil.

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[14] The extremely low average cost per project recorded in FP6 in Physics compared with other fields and with FP7 values, suggests an effect generated by the low number of projects (a total of 11) with LAC participation in this field.

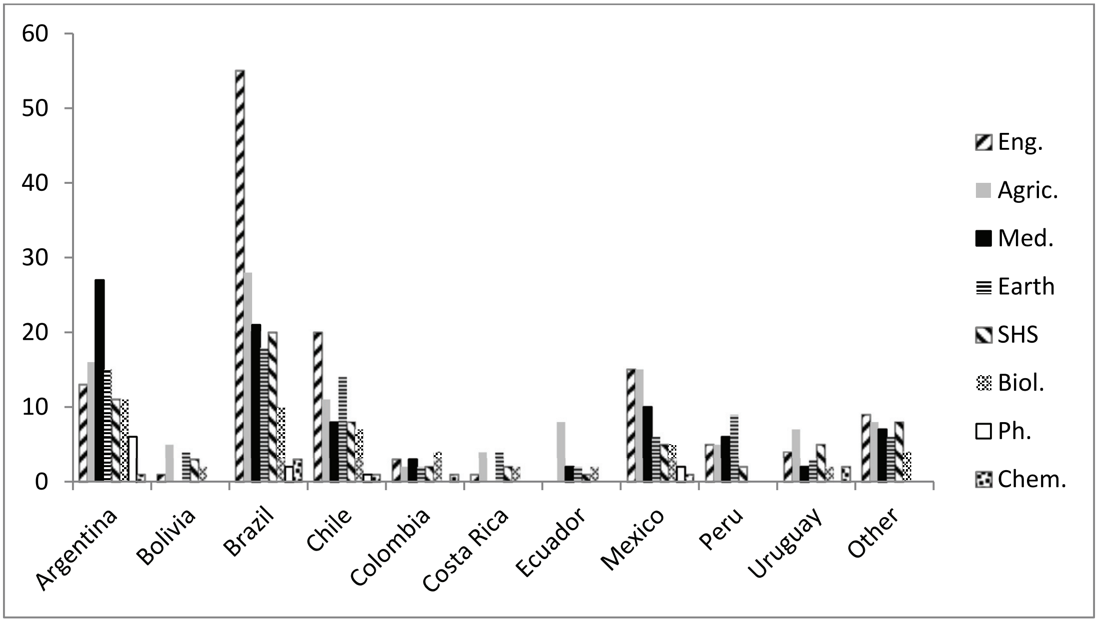
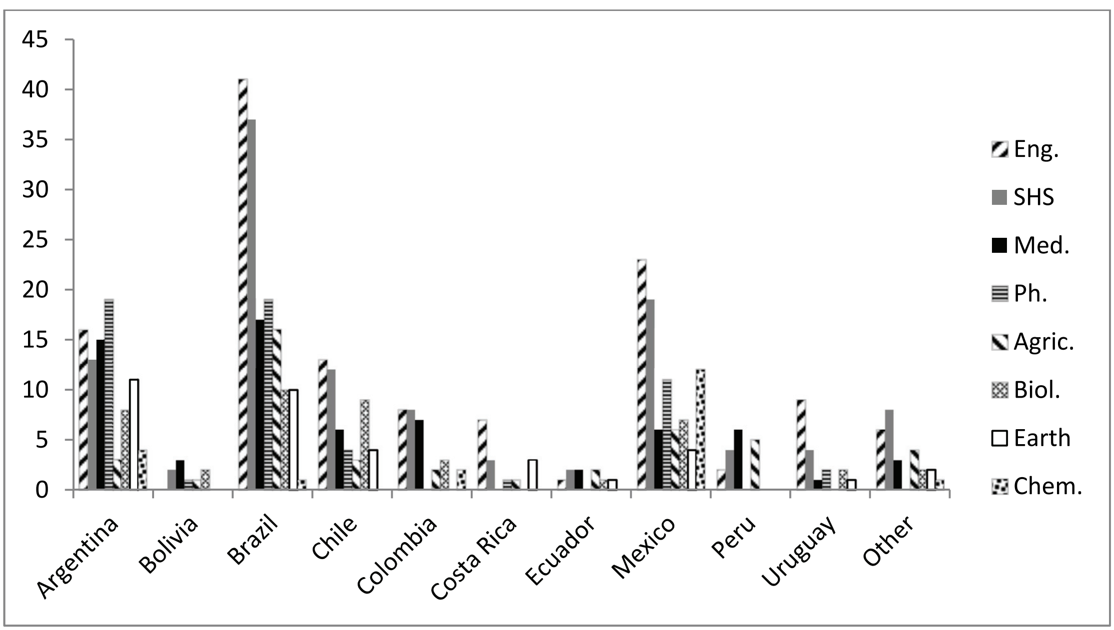


Figure 10: Number of projects by country and disciplinary field in FP7



3. Conclusions

A look at the participation, in terms of numbers of projects, of the leading Latin American countries shows that their role is especially important, far from being an ancillary phenomenon: Argentina, Brazil and Mexico together are involved in as many projects as Germany and France, the leaders (along with UK) in European research. Even more illustrative is the fact that Brazil, if measured by number of projects, would rank 6th among the 'European' countries and Argentina or México, 7th. Thus, the participation of Latin American research groups has become, from the European point of view, a very important component in efforts to strengthen the European Research Area (ERA).

We have shown that this participation is far from homogeneous throughout time, country or scientific discipline. On the one hand, the more scientifically developed countries of Latin America are the most active in collaborating with European projects: both in FP6 and in FP7 the four largest countries (Argentina, Brazil, Chile and Mexico) accounted for 75% of Latin America's participation, which correlates with these four countries' share in the total scientific production in the region, where they account for a similar percentage of the whole (see chapter 3 by Russel and Ainsworth in this book).

The disciplinary pattern shows an important increase (almost double) in SHS as a disciplinary field and, together with Engineering, accounts for almost half of Latin American participation in European projects. The basic disciplines (Chemistry, Biology, Physics) are also moving up and, together, represent almost a quarter (with a steeper increase in Physics), while the sharpest decrease is observed in Agricultural Research and Earth Sciences. This seems to contradict the "local advantage", centred on the capitalisation of the especially advantageous conditions in developing countries in terms of plant or animal species, soils, privileged observation points, etc. Furthermore, except for the social sciences, research seems to be directed more towards "universal themes" in which Latin American groups can make a contribution to the general cognitive objectives of the projects[15].

The situation described above needs more explanation and a further word on the increase in Engineering projects. Most of the related project themes are strongly oriented towards European priorities, which are increasingly geared to very specific and applied purposes that the European scientific communities and governments are defining with active input from, last but not least, the firms that might industrialise the knowledge produced from these projects. In sum, the Latin American groups would be producing knowledge for industrial application that could hardly benefit their societies.

This situation is paradoxical when considered along with the fact that Latin American institutions promote, through various mechanisms, the involvement of research groups in European projects, but do not analyse the consequences that such collaborations will have on their own societies. Thus, as we have shown, the contribution of Latin American countries to the European projects grew from 5% in FP6 to 12% in FP7 while the European contributions have remained more or less constant.

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[15] We do not have enough room to develop this hypothesis, since we would need to "enter the black box" of each project to be confirmed. Knowledge we obtained earlier, however, shows that this hypothesis is plausible (Kreimer 2010, Kreimer and Meyer 2008).

It is important to note the decrease, as we pointed out above, in both the per project unit costs and the average number of groups participating in each project (from 18 in FP6 to 11 in FP7). This means that each group in the Agriculture, Biology and Earth Sciences projects, whose average costs are the highest, (around 4.5 million euro), receives an average of around 400,000 euros. And in the Social and Human Sciences (SHS) projects, which have the lowest cost per project, each group receives around 180,000 euros. The figures are significant for a local group, but not enough to explain the strong attraction of Latin American groups to participate in these programmes *per se*.

Rather, in addition to the potential economic benefits, the continued participation of Latin American groups can be explained as part of their social and cognitive integration strategies, guided by a quest for greater visibility, better interchange opportunities and access to information and data, and, indeed, the best chance to publish in international journals. All of these highly valued achievements play a leading role in each local situation.

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International collaboration has become increasingly important in carrying out research activities. This book, written by a large group of scholars from Europe and Latin America, maps, analyses and discusses research collaboration between the two continents during the last twenty years. The empirical material underlines the richness and the variety of the linkage that bind the two continents, well beyond the simplified views of science, either as the brainchild of global networking or as a result of dependence. The book also develops an innovative methodological approach, combining bibliometric analysis, social surveying, in-depth interviews, and a careful analysis of research programmes and policies. While arguing that the asymmetry of relations that once existed in cooperation has turned into a more equal partnership between the two continents, it deciphers some of the reasons behind this more balanced cooperation. It also challenges the view of science as a global self-organising system through collective action at the level of researchers themselves. On the contrary, the importance of policy, institutions, and previously developed research is highlighted and recognised.

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