Cosmopolitanism or subordination? Latin American scientists' participation in European programs: motivations and dynamics analyzed from the European scientific leaders' point of view

Adriana Feld[i]

[i] Researcher, Consejo Nacional de Investigaciones Científicas y Técnicas. Buenos Aires – Argentina

feldri75@yahoo.com.mx

orcid.org/0000-0002-9857-746X

Pablo Kreimer[ii]

[ii] Researcher, Consejo Nacional de Investigaciones Científicas y Técnicas; director, Centro de Ciencia, Tecnología y Sociedad/Universidad Maimónides. Buenos Aires – Argentina

pkreimer@yahoo.com

orcid.org/0000-0002-6737-8556

Received on 6 Dec. 2017.

Approved on 15 Mar. 2018.

Translated by Catherine Jagoe.

http://dx.doi.org/10.1590/S0104-59702019000300004

FELD, Adriana; KREIMER, Pablo. Cosmopolitanism or subordination? Latin American scientists' participation in European programs: motivations and dynamics analyzed from the European scientific leaders' point of view. *História, Ciências, Saúde – Manguinhos*, Rio de Janeiro, v.26, n.3, jul.-set. 2019. Available at: <http://www.scielo.br/hcsm>.

Abstract

Using a qualitative approach, we explore the motivations of scientific groups and their dynamics in international cooperation. We consider the participation of Latin American scientists in European consortia and analyze the European hosts' point of view. Within the framework of "North-South" scientific cooperation, we propose three levels of analysis: on the institutional level, understanding Europe's interest in cooperating with Latin America; in terms of cognitive strategies, tracing what motivates European group leaders to include Latin Americans in their research projects; and in terms of practices, figuring out how work within these consortia is allotted. Towards the end, we propose a typology of some of the modalities of scientific cooperation by Latin American groups.

Keywords: international scientific cooperation; centers and peripheries; Europe and Latin America.

Cooperation between scientists of various countries has continually increased, in particular over the last three decades, as seen through publications (Adams, 2012, 2013). Some authors, like Leydesdorff and Wagner (2009), argue that "International collaboration as measured by co-authorship relations on refereed papers grew linearly from 1990 to 2005 in terms of the number of papers," but it grew "exponentially in terms of the number of international addresses," which would confirm the hypothesis of an "inflation" of international collaborations (Persson, Glänzel, Danell, 2004). The proportion of internationally co-authored versus "domestic" articles is indeed rising continually in a large group of countries (in the United Kingdom and Switzerland, it is over half; see Adams, 2013). Thus, in 1988, just over 10% of papers were co-authored by researchers from more than one country, but twenty years later that percentage had risen to 30% (Boekholt et. al., 2009; Gaillard, Gaillard, Arvanitis, 2010). In this context, it is not surprising that Latin American scientists' participation in projects with groups and colleagues from more developed countries rose significantly during this period (Gaillard, Arvanitis, 2013; Kreimer, Levin, 2014). Thus, it is worthwhile asking ourselves about the nature of this collaboration, particularly in qualitative terms, and considering the perceptions of European group leaders.

In this article, we consider four significant issues within the general topic of international cooperation. Firstly, we are interested in analyzing what is generally referred to as "North-South" cooperation, between central countries and semi-peripheral or "non-hegemonic" ones (Losego, Arvanitis, 2008; Kreimer, 2006).[1] Secondly, within that set of relations, we are interested in observing scientific cooperation between Latin America and Europe, for reasons we will explain presently. Thirdly, although we are aware that not all international cooperation takes place under the umbrella of formal cooperation programs, we will concentrate here on institutional projects funded by the European Union (EU) that include Latin American partner groups. Fourthly, unlike most studies on international cooperation, we are not looking at publications (co-authorship or other indicators), but rather proposing a qualitative study of the perceptions and motivations of the actors involved.

In a recent article, we examined the point of view of Latin American group leaders, exploring the perceptions and attitudes of investigators in the region who have participated in European projects (Kreimer, Levín, 2014).[2] The current article is a complementary text presenting the "other side of the coin;" it concentrates exclusively on the perspectives of European group leaders (an aspect covered much less frequently in the literature), and we hope to combine both perspectives in a future text. Therefore, we have chosen a set of projects from the Seventh Framework Program, which featured research groups from the five most dynamic countries in Latin America (Argentina, Brazil, Mexico, Chile and Colombia). We chose those five countries because together they represent over 80% of Latin American participants in European consortia. As we shall see, even though Latin America is not a specific policy target for European cooperation with other countries, the growth of Latin American participation in the Framework Programs (for reasons we will explain later) explains the relevance of studying this type of bi-regional cooperation.

The general question underlying this article is to understand why European consortia include research groups from Latin America. This leads, in turn, to three questions: a) on a political and institutional level, what is the EU's interest in encouraging cooperation

with Latin America? b) in terms of cognitive strategies, what motivates European project leaders to include Latin American groups in setting up research consortia? and c) on a practical level, how do European leaders describe the role of Latin American groups in those consortia?

To answer these questions, in section 1 we discuss various approaches and provide a series of remarks about our research topic, bearing in mind two elements that allow us to approach the first question: a) organizational and geopolitical aspects that allow us to conceptualize the types of cooperation; b) the successive paradigms of North-South scientific cooperation that have guided policy in developed countries. In section 2, we describe the methodology used. Lastly, in section 3, we present the results and analysis of the information obtained, which is organized around two variables: the motivations of European group leaders in partnering with Latin American groups; the activities they carried out according to the internal division of labor, and the benefits obtained. We also offer a preliminary typology using the proposed variables, and end with some conclusions.

1. Overview of international scientific cooperation: some remarks about our research topic

General features of international scientific cooperation and North-South cooperation

The definitions, scope, actors, institutions, regulations and specific practices of international scientific cooperation contain many ambiguities and have been subject to much debate. Therefore, before going into a specific analysis of our topic, we need to provide at least two explanations about North-South cooperation and one on international scientific cooperation in general terms, which will allow us to limit the profiles of our objective.

North-South cooperation presents specific problems and interpretive tensions. Firstly, over the very definition of the actors involved: some studies of North-South cooperation refer to "developing countries" as a relatively homogenous group of countries. Thus, for example, Wagner argues that with the emergence of new networks as a way of organizing the production of knowledge in the twenty-first century, various operations relating to the uses of knowledge remain in the local sphere, so that developing countries need to establish and develop a series of institutional arrangements if they wish to take advantage of these possibilities. According to Wagner (2008, p.115), "since these countries do not have the embedded twentieth-century bureaucracies and institutions that were the hallmarks of the era of scientific nationalism, they have greater flexibility to pursue new developments in science. The absence of nationally driven constraints tied to a huge investment can actually be an advantage that developing countries can exploit by building a more nimble networked system."

The problem with this perspective is that only countries with little scientific tradition or weak national science systems are included under the label of "developing countries." However, in terms of knowledge production, countries like Argentina, Chile, Brazil, Mexico, Egypt and South Africa, among others belonging to the broader "developing world," are highly dynamic and their scientific systems are over a century old, at least. Thus, Gaillard,

Gaillard and Arvanitis (2010) show that in Latin America international cooperation plays out very differently depending on the scientific strength of each country. Therefore, for this study we have chosen Latin American countries whose level of development (socio-economic and scientific) are relatively similar, which allows us to draw inferences on more solid ground.

Secondly, "North-South" scientific cooperation is usually presented by the decision-makers, both European and Latin American, as something "essentially beneficial," through a dual discourse: on the part of the Latin Americans, it is imbued with cosmopolitanism, the advantages of interacting with world leaders, and giving more visibility to local science. On the part of the EU, the discourses are more pragmatic, and refer to cooperation as a strategic resource for strengthening science and, above all, Europe's competitiveness.

However, the literature on the topic reveals certain interpretive tensions, particularly between "optimistic" views and critical ones. Some studies have echoed the optimist outlook, celebrating the intensification of cooperation as a way of encouraging cosmopolitanism in researchers from the "South" and integrating them into "international science" (Sebastian, 2007), or rather, underlining the democratizing effect of new forms of international cooperation and the "opportunities" they present for developing countries (Wagner, 2008; Anderson, 2011). On the other hand, more critical perspectives have stressed the asymmetries and relations of subordination or even dependence that structure modes of collaboration between contexts of greater and lesser relative development (Gaillard, 1994; Vessuri, 1996; Cetto, Vessuri, 2005; Velho, 2002; Kreimer, 1998; Kreimer, Meyer, 2008; Kreimer, Levin, 2014; Beigel, 2014). What matters is whether cooperation improves developing countries' technical and cognitive capabilities, whether their role is marginal and subordinate, whether there are asymmetries in the definition of research agendas, and whether those agendas do or do not fit developing countries' needs. This article addresses that question using a methodological strategy that focuses on work dynamics within research consortia as a way of exploring the complex – and often contradictory – nature of international cooperation relations between groups of differing levels of development relative to one another.

As regards international scientific cooperation in broader terms, Katz and Martin (1997) have shown the ambiguous definition of what was understood by cooperation at the time. For example, a plethora of studies use scientific publications – a bibliometric perspective – as material for studying relations of international cooperation, and particularly co-authorship, since this supposedly represents a good proxy for such practices (Gläser, Laudel, 2001; Newman, 2001; Leydesdorff, Wagner, 2009; Wagner, Kit Wong, 2012). Although this macro methodology allows us to observe a certain dynamic in terms of broad tendencies of cooperation between certain countries, in specific disciplinary fields and even in nuclei of concentration on particular topics, it only shows part of the product of collaborations (papers), and tells us nothing about the modes of organization or the motivations for cooperation, aspects that are crucial to understanding scientific relations between centers and peripheries. In fact, many activities and social practices do not necessarily lead to scientific articles, but are expressed in various other ways, such as exchanging researchers and scholars, developing joint training programs, developing products for industry, holding seminars etc. (Rodríguez Medina, 2014).

In general terms, we can say that there are three contextual elements that explain some of the transformations in the way cooperation has been organized in recent decades. The first of these involves the scale changes that have occurred since the end of the twentieth century, as we moved from what was known as "big science" (Price, 1973; Galison, Hevly, 1992), which evolved in the post-war and Cold War period (Hallonsten, 2016), toward a much larger scale, which involved – among other things – various "mega enterprises" (Beaver, 2001; Wagner, 2008; Kreimer, 2012), such as human genome sequencing or the Large Hadron Collider, which mobilized thousands of researchers. Unlike the traditional "big science" model, which was associated with a brain drain in developing countries (Devan, Tewari, 2001; OECD, 2002), these projects do not necessarily involve many researchers being in the same physical location, but rather, thanks to the growth of ICT, scientists can participate – through networks – from different geographic localities (Shrum, 2005; Adams, 2012).

The second point has to do with the reorganization of traditional disciplines and the emergence of new fields. Research spaces became more complex and there have been shifts and hybridization among disciplines and also between academic and industry research, in "research technology communities" (Joerges, Shinn, 2001), and new regimes of knowledge production (Pestre, 2003, p.104).

The third point has to do with policies for stimulating international cooperation, which have explicitly encouraged these connections; both in their discourses and by creating specific instruments, the EU (European Commission, 2008) and the United States (National Science Board, 2008) have for several decades provided specific instruments for promoting international cooperation. European countries promoted it both on an aggregate and a national level, while the United States has done so in diverse ways through numerous institutions and agencies (Whitley, 2010), both public and private.

These three elements are fundamental to understanding the specific modality of cooperation we refer to in this article. This involves cooperation arising from explicit EU policies, working toward pre-established objectives in programs in each subject area, defined in the calls for proposals. Such cooperation involves forming medium- to large-sized international consortia, lasting approximately 4 years, in which each group performs a specific task relating to the topic or problem involved, which transcends disciplinary barriers. Thus it is likely that many of the conclusions we draw from this study will not be generalizable to other modalities such as informal or occasional collaboration on a smaller scale or based on specific projects under bi-national agreements.

Given that EU policies play a fundamental role in the type of cooperation we plan to analyze, we, like many other authors on the subject, need to distinguish political motivations for cooperation from individual ones, and show how they dovetail with other factors that encourage or impede it (Beaver, 2001; Bozeman, Corley, 2004; Boekholt et al., 2009; Edler, Flanagan, 2011; Wagner, 2006, 2008; Gaillard, Arvanitis, 2013). Therefore, in the next section we analyze some of the general features of the policy of extra-European collaboration in the Framework Programs, which will give us a better understanding of the role of Latin American researchers in international research consortia.

North-South cooperation and EU policy on international cooperation

Taking into account the international cooperation policies of international bodies and funding agencies in developed countries, Gaillard (1999) identifies three successive phases of North-South scientific collaboration: the first, dating from the colonial period up to the 1960s and 1970s, focused on finding quick solutions for developing countries' problems by mobilizing the scientific resources (both human and financial) of countries in the North; the second, from the 1970s through the 1990s, centered on constructing endogenous capabilities in Southern countries; and the third and most recent one is aimed at generating structures of cooperation in which the *leitmotiv* is mutual benefit.

The EU's scientific cooperation policies regarding developing countries have followed criteria analogous to those described by Gaillard. Indeed, those policies date back to the 1980s, when the European Parliament launched the Science and Technology for Development Program (STD), which went through three phases: STD1 (1983-1987), STD2 (1987-1990) and STD3 (1991-1994). These programs were designed to strengthen research capabilities and increase the impact of research on developing countries, especially in fields such as tropical and subtropical agriculture on the one hand, and medicine, health and nutrition on the other (Gaillard, 1994).

Starting with the Fourth Research Framework Program (1994-1998), the EU created a special sub-program to handle "Cooperation with Third Countries and International Organizations" (INCO), which included cooperation with developing countries (INCO-DC). INCO-DC broadened the scope of topics, including some not strictly linked to the needs of developing countries: 1) management of renewable natural resources (plants, oceans, water, energy); 2) agriculture and agroindustry (improving production, storage and commercialization); 3) health (controlling diseases, vaccinations, healthcare systems); 4) topics of mutual interest established by agreement in sectors such as information technologies and communication, new materials etc. (Gusmão, 2000).

Beginning with the Sixth and, above all, the Seventh Framework Programs, an interesting new feature emerged: cooperation with developing countries presented no significant differences, in terms of instruments, with cooperation with European or developed countries (European Commission, 2005). In order to understand this innovation, we need to briefly outline the general structure of the Seventh Framework Program (which was very similar to the Sixth), which was divided into four subprograms (European Commission, 2007):

a. *Cooperation*. This funds projects by transnational consortia between European and other partner countries in the following key thematic areas: health, food, agriculture and fisheries, information and communication technologies, nanosciences, nanotechnologies and materials, energy, the environment, transport, socio-economic sciences and the humanities, space, and security.

b. *Ideas*. This funds "frontier research" by individual teams, with no obligation for cross-border partnerships.

c. *People*. Funds projects involving intra and extra-European researcher mobility.

d. Capacities. This provides four instruments that partner countries can participate in: (a) research infrastructures; (b) research for the benefit of small-to-medium enterprises (SMEs); (c) regions of knowledge, research potential, science in society; and (d) specific activities of international cooperation (INCO).

Within this structure, cooperation with partner countries is no longer channeled exclusively through the INCO sub-program (which was transformed into a funding source for networking activities and crafting bi-regional agendas), and partner countries can also participate on an equal footing with member states in the "cooperation" sub-program. This latter fact is the most significant in budget terms, since it concentrates 69.5% of the resources of FP6 and 64.1% of FP7 (see https://cordis.europa.eu/fp6/budget.htm; European Commission, 2007).

Behind this organizational change lies an energetic policy of reinforcing the "European Research Area" (ERA), which necessarily involves developing international partnerships both within and beyond Europe. This policy led to a 40% increase in the annual budget of FP7, in comparison to FP6; this tendency continues in the recent Horizon 2020 (Muldur et al., 2006). This largely explains the growth of Latin American participation in FP6 (2002-2006); various Latin American groups took part in 204 projects, whereas in FP7 (2007-2013), they collaborated on 308 projects (Eularinet, 2009; Cordis, 2009).[3]

It is worth exploring the factors behind this policy. In their report synthesizing and classifying the drivers for international cooperation policies, Boekholt et al. (2009) differentiate between the "narrow paradigm" and the "broad paradigm:" the former refers to objectives within "science policies," such as improving scientific research quality, scope and critical mass or attracting highly-qualified human resources from third countries to the European Research Area; the latter refers to proposals within "policies through science," such as improving competitiveness, tackling global societal challenges and supporting less developed countries by developing science and technology capabilities. In both cases, the strategy was aimed at overcoming disadvantages in the European region compared to other global competitors, such as the United States or Japan.[4]

In terms of the "broad paradigm," an EU document states that:

> Europe can play a more active role in international agenda setting and formulation of policies and strategies and be more audible in international negotiations. Taking the fore on the international policymaking scene can be a way for the EU to reinforce the bases of its economic competitiveness in the future through influencing early the design of international regulations affecting its private sector (European Commission, 2008, p.29).

This concern with global agenda setting and competitiveness is the driver behind two features of the Framework Programs. The first is a tendency toward greater concentration of resources for better-defined and delimited objectives in calls for projects. The second is the increase in industry participation: while between FP4 and FP6, industry participation in research consortia declined, it rose from 17% of the total European Community contribution in FP6 to 25% in FP7, while the percentage of contracts with industrial companies versus other institutional participants increased from 19% to 30% between the two Programs

(European Commission, 2016). 48% of the increase in funding was concentrated in various thematic areas of the "cooperation" sub-program, and 21% was due to the introduction of new instruments in FP7 (European Commission, 2016).

Thus, although the Framework Programs include instruments for funding projects aimed at tackling global challenges (such as climate change) or improving research capacities and solving the problems of developing countries (such as endemic diseases), the *leit motiv* of North-South cooperation in the 1970s and 1980s was declining relative to a policy that, under the guise of "free access" to European instruments/funding and "mutual benefit," questions us once again on the (real or potential) asymmetries related to the definition of agendas and the (private) exploitation of knowledge.[5]

2. Methods

Our empiric work involves qualitative study of the issues that explain what motivates Latin American groups to get involved in European projects, and the type of roles they perform in those projects. Thus, it does not have statistical validity, and its results cannot be generalized to all scientific cooperation activities. Rather, we have chosen to observe paradigmatic cases that provide more detailed information on the topic of study. Therefore, the selection of cases for in-depth examination does not purport to be representative; our goal is rather to open up the issue to various possibilities and configurations deriving from the actors, their traditions, disciplines, lines of work, possible industry applications etc.

The study is based on analysis of the projects in the FP7 cooperation sub-program.

Therefore, we started out by analyzing the policies and instruments of scientific cooperation in the EU over the last two decades, the changes in orientation to allow collaboration with various countries, and in particular, actions involving Latin America.

Then, using the CORDIS database (that is, the total number of projects registered in that database), we extracted projects that were listed as having at least one group participant from Argentina, Brazil, Mexico, Chile or Colombia. Secondly, we organized this sample by topic area and selected those areas in which Latin America has a stronger research tradition (SALUD and KBBE),[6] and another which, unlike the previous ones, involves a type of research in the field (as opposed to laboratory research) generally devoted to the study of global systems (ENV). Lastly, we chose five to six projects from each of the three areas that met the following requirements: they had to be funded under the heading "collaborative projects"[7] and deal with different issues within an area, so as to have projects representing various orientations.

The features of the projects selected were studied via two mechanisms. Firstly, we searched each project's web page (17 overall) to find the coordinators, partners from different countries and institutions, the general description of the project (including the objectives of each work package), the activities performed and the results obtained. Secondly, we conducted a semi-structured interview with each of the project coordinators, in order to explore the following issues:

a. Origin of the project (coordinator or other group) and participation of Latin American groups (LG) in formulating it.
b. Motivation for recruiting specific LG: advantages in terms of evaluation, the availability of highly-trained human resources, access to resources in the Latin American region (specimens, populations), knowledge of specific techniques or topics, contribution of matching funds etc.
c. Distribution of the work packages.
d. Type of activities carried out by the LG: routine vs. innovative techniques, updating new techniques and equipment, data collection information or theory development, development of new processes or products, transfer to the productive sector.
e. Results obtained: joint publications, patents registered, new regulations or rules.
f. Role and characteristics of businesses that were part of the consortium.
g. Negotiations about intellectual property of potential results.
h. Benefits for the LG: human resource training, starting new lines of investigation, access to funding, contact with international scientific leaders and integration into global networks, solving social needs, creating new businesses.

3. Results and analysis

To focus our analysis, we organized the results into two main categories: the motivations of European leaders in recruiting Latin American groups, and activities performed by them, within the internal division of labor, as well as the benefits obtained.

Motivations for recruiting Latin American groups

The first thing we observed in European leaders' responses about their motivations for including Latin American groups in the consortia is that, as a general rule, the Latin American scientists invited were highly valued as scientists. All the European leaders we interviewed listed this as their primary justification. This should not surprise us since, as some earlier texts have shown (Kreimer, 2006), there is a high correlation between elite Latin American groups' level of internationalization and their relative prestige locally. In other words, Latin American scientific leaders construct their prestige partly on their local performance, but above all by exploiting their international relations locally. This ability derives from two sources: on the one hand, because some of the Latin American leaders have done part of their training in elite laboratories in more advanced countries (Kreimer, 2012), they usually retain important links to those groups, which gives them easy access to international research networks. In fact, the majority of the European leaders interviewed stated that they already knew the Latin American leaders before recruiting them into European networks. In addition, institutions that promote and evaluate scientific careers in Latin America (generally led by prestigious investigators) grant greater relative weight to connections, cooperation and funding from international agencies, which creates a sort of feedback loop, since the higher the scientists' international profile, the greater relative prestige they are accorded.

Also, in the past, when the publication of scientific articles in peer-reviewed international journals was not yet institutionalized as a standard metric for scientific quality, some local prestige was gained by recognition from international peers.[8] Nowadays, participating in international projects – and/or having international funding – is an important source of prestige in all countries, but is more obvious in countries with mid-level scientific development.

However, there are substantial differences in terms of the motivations for recruiting Latin American groups. We have identified four types of motivation/relationship:

a) Including Latin Americans as a condition for obtaining subsidies

This is the case for SALUD-5; KBBE-6 and ENV-6. In these cases, we need to explore the motivation for choosing those groups over others, but not why a Latin American group was included. The answer here seems to come from two different sources: the first is of a technical or cognitive nature, such as the additional capacities provided by the invited Latin American groups, or access to cognitive resources, such as availability of specific strains, access to patients etc. The second is of a sociological nature, and involves the links established between partners in the past, bonds of familiarity and trust, and even shared scientific paradigms, which are frequently evoked by those interviewed.

b) Consortia that work on Latin American issues

This is the case for most of the health-related projects, including tropical diseases (like Chagas disease: SALUD-1, 4 and 5). In this case the additional question we need to formulate is why Europe decided to fund research on topics that do not affect its own context (or do so only marginally). Here, too, we find two different levels of response: the first is that research on local issues (diseases) can contribute to understanding more fundamental phenomena. In that sense, for example, research on ways of attacking the causal agents of those diseases might shed light on fundamental biological or physiological mechanisms that could be extrapolated to other cognitive aspects beyond the cases studied. Furthermore, trials with new molecules, carried out in association with businesses from the pharmaceutical sector, might generate knowledge applicable to universal diseases, independently of exclusively local issues.

The second level of response points to the result of globalization processes and migration trends: some classically "tropical" diseases have been spreading to other regions and generating new problems, about which there is very little accumulated knowledge. This is the case, for example, with Chagas disease in Spain, France, Texas and California. In these cases, besides their potential prestige, Latin American researchers bring a specific expertise related to an object of study, and exclusive access to indispensable resources for research, such as patients or various strains of parasites or other organisms.

c) Consortia that investigate global problems, with specific manifestations in various contexts

Here we need various observation points located in different contexts. This is most frequently the case in environmental projects and, in our study, in the consortia ENV-1, 2 and 4. In these cases, the phenomena investigated respond to more general phenomena,

such as climate change, and manifest in some very localized geographic sites, such as the concentration of mercury in rivers or the consequence of glaciers melting. In these cases, there are two complementary modalities for recruiting Latin American groups: the first is the need to collect data from specific observation points that generate a "global view" of the problem. In these cases, Latin American groups need to have access to such resources – rivers, glaciers, various species of fauna or flora etc. – and possess the technical capability to generate standardized data according to protocols established by the consortium overall, since here the use of methodology is key for the homogeneity of the data collected.

In the second modality, Latin American groups must be able to mobilize cognitive – and also technical – resources, such as knowledge of their specific contexts and, in particular, be able to use equipment allowing them to carry out work that is homogeneous with that done at other observation sites.

Subsequently, the results are processed by the program coordinators (in some projects an initial level of local processing is done prior to that) and the products are created; these may take the form of intervention protocols, policy recommendations (to international bodies, the EU or national governments), and also scientific articles or, eventually, transfer to private companies, although in the case of environmental projects, business participation tends to be less than in other subject areas.

d) Latin America is an important – and sometimes indispensable – context for observation/ experimentation

This is the case in the development of genetically modified organisms (GMOs), done by the KBBE-1 consortium. While laboratory trials on these are authorized in Europe, it is practically impossible to carry out field trials on a significant scale. In Latin America, on the other hand, there are very few restrictions on GMO trials, as long as some basic technical rules are followed. Therefore, consortia that carry out activities that are banned or very difficult in Europe must, of necessity, find an area outside their own region in order to hold such trials. Something similar happens in the KBBE-4 and SALUD-1 consortia, involving clinical trials on patients which, while not banned in the EU, are much more rigidly regulated than in Argentina and Brazil, where both consortia have held their trials with less oversight, which allows them to obtain results more rapidly.

Types of activity performed by the Latin American groups and benefits obtained

In the sample research consortia we chose for our study, the prevailing types of activity performed by the Latin American groups in all fields of study involved the collection and systematization of data and technical work, both routine and innovative. This shows us a specific type of partnership role in the planning of research that is consistent with the causes for recruiting such groups: as we saw, in most of the projects, the predominant reasons had to do with observation sites for phenomena, either specific to Latin America (although of global interest), or local manifestations of much broader phenomena.

To these we can add two very important pieces of information: on the one hand, in most cases, the Latin American groups were invited to become part of the consortia once the broad

outlines of the work plan were established and, therefore, their participation in designing the methodology and distributing tasks was slight. There are only two exceptions: the cases of SALUD-1 and KBBE-6, in which Latin American groups took an active part in the design.

On the other hand, Latin American groups were in charge of coordinating a work package, in other words managing part of the resources assigned to the project, in only two of the consortia analyzed. These were SALUD-4 and KBBE-6 (which are also two of the projects in which the groups took part in the general design of the research) and, in both cases, they were very prestigious groups from Brazil, with a strong research tradition and major visibility, which makes them international reference points (Fiocruz and Embrapa).

As to industry participation, all the consortia analyzed (except for three: ENV-1, ENV-4 and ENV-5) included firms from European countries and two projects included Latin American firms (one from Chile and another from Argentina). We should point out that, according to EU rules, business partners in the consortia should be small to medium-sized. According to statements by the consortia directors, none of the businesses in these consortia provided funds specifically for research, but rather "in kind" contributions, for example, by providing chemical compounds, data-processing capabilities, marketing and promotion, or specific equipment. For all those projects, we tried to look into the agreements on industrial property and exploitation of the results of the research, but it proved impossible; that information is confidential.

Having said that, we should highlight some particular features of the various subject areas and disciplinary fields:

Of the health projects, two are on Chagas disease, which is endemic to Latin America, and the most active groups in the world are researchers from Brazil, Argentina, and to a lesser extent, Colombia. In these consortia, their participation in the design of research and the different stages is really significant, and one of them (SALUD-4) is among the very few cases in which a Latin American group is managing a work package. In fact, it is also one of the few that show that the main benefit for the group is financial, since "the resources they handle are quite considerable."

Also, all the health projects involve industry participation, in general by pharmaceutical laboratories. However, only one of those is Latin American. Thus, when we attempted to find out who would handle industrial application of the results obtained by the consortium, we discovered that a European industry laboratory would be in charge of producing new drugs, while the Latin American one would only handle distribution.

Meanwhile, in the health field, almost all the Latin American groups had links to patients and only in the case of SALUD-2 did a Latin American group (Chilean, in this case) provide biological compounds and big data analysis capability.

We should not assume that in the health field the tasks of data "collection" and "systematization" are merely technical activities with no scientific content: since these involve developing experiments, scientific capabilities are fundamental. However, these activities are subordinate to centralized information processing capacity, which is also located in one of the European centers.

In KBBE, the situation is rather similar: in general, it involves processes of research into agriculture and agribusiness, where availability of local cognitive resources is crucial, as are

the strong research traditions of the Latin American groups. Thus, two of the projects are designed to hold field trials in the Latin Americans' countries, since in one case such trials are banned in Europe (KBBE-1), and in the other the regulations are laxer in our region (KBBE-4). Other groups also carried out clinical trials (KBBE-5) or field trials (KBB-6), activities that clearly predominate.

Curiously, in KBBE, the groups performing more scientifically complex activities are both from Chile: one is a veterinary center devoted to vaccine production (KBBE-3), and the other is expert at an internationally-respected technique for biological waste valorization (KBBE-2).

In the field of environmental research, which has less of a tradition in Latin America than the two previous fields (health and agriculture), all the groups identified carry out data collection and production, in all cases according to pre-established protocols. The data generated by the Latin American groups is intended for various different goals: systematizing the concentration of mercury in the waters of various regions (ENV-1); using global models on specific observation points (ENV-2 and ENV-4); generating conceptual models (ENV-3); or proposing policies and intervention tools (ENV-6). However, the participation of scientists from our region in these global objectives is very low or nonexistent, since their role often ends after processing and systematizing the data generated.

As to the benefits of research for the Latin American groups, our findings are conclusive: the greatest benefit is seen in terms of the increase in international publications. To this we can add the ability to interact with internationally-known research groups. Contrary to our assumptions, obtaining funding was not the primary benefit for the majority of the Latin American groups, according to statements by the European coordinators. There may be various reasons for this: firstly, since they are elite groups, they already have their basic funding needs covered; secondly, there are intangible benefits, such as access to cutting-edge technologies, sharing international databases, or other tacit knowledge; thirdly, while the consortia's general resources are relatively major, the share received by the Latin Americans (with few exceptions, namely, administrators) is not seen as significant, in comparison with other benefits.

Aspects of a typology

To conclude, based on all the elements laid out, we wish to propose a preliminary typology of the various partnership modalities for Latin American groups in international consortia, based on our empirical work. To do so, we defined four types of participation, and we demonstrate them with a concrete example from some of the consortia analyzed.

- Type 1: Participation due to local resources in Latin America crucial to the research.
- Type 2: Participation by "subcontracting" specific contributions to a global investigation or in order to generate regulations.
- Type 3: Participation based on the international reputation of the Latin American group, or specific knowledge necessary for the investigation.
- Type 4: Participation thanks to the ability to carry out (clinical or agricultural) trials with less regulatory oversight in Latin America than in Europe.

Let us take a brief look at each of those modalities:

Type 1: BERENICE (Benznidazol and Triazol Research Group for Nanomedicine and Innovation on Chagas Disease).

A consortium run by a Catalan group: it is testing the toxicity profile of benznidazol, the only existing drug for treating Chagas disease.

The Brazilian group (Fiocruz and Ouro Preto) focuses on designing and implementing clinical trials. According to the coordinator, "they are a fundamental piece: the trial is based exclusively on the data produced by Brazilian groups (with Chagas patients)." It also involves *in vivo* models. The Argentinian group (ANLIS) is in charge of testing new alternative molecules to benznidazol and their contribution is also "indispensable, thanks to their experience with T. cruzi."[9]

Despite their apparent importance, the Latin American groups took no part whatsoever in defining the project (objectives, methods or distribution of tasks).

Type 2: VIROCLIME (Impacts of Climate Change on the Transport, Fate and Risk Management of Viral Pathogens in Water).

This consortium is coordinated by a British group: it analyzes water pollution in rivers by different types of virus, as a result of climate change.

The project studies various European rivers and seeks to compare them with a tropical region (studies in the Amazon basin). The Brazilian group (UFRJ) was called in because it is "highly respected internationally," but above all because "it was necessary (and appropriate) to have a tropical location and they have access to the Amazon." Their task was "to take samples according to the protocols, do the measurements – which is a delicate job – and generate the corresponding reports."

The coordinating group had already received two requests from the European Commission (and two from European projects) to write up a policy report on river epidemiology and measuring viral concentrations.

Type 3: EPIMIRNA (Micro RNA in the Pathogenesis, Treatment and Prevention of Epilepsy)

This consortium is coordinated by an Irish group: they are using micro RNA (small cellular molecules) to seek a treatment for epilepsy cases in which traditional medications are not effective.

The Brazilian group (Campinas) was called in because it is "very well known internationally, with major publications in the epilepsy field. Above all, they are very strong on genetic aspects and what we wanted in this project was to look at the genetics of a particular type of gene in epilepsy. This Brazilian group has really got incredible skills in the field of epilepsy genetics."

Furthermore, for the consortium it was very useful to be able to do trials on "other populations – genetically speaking – outside of Europe … and that's why we thought of doing trials in the USA and Brazil" (the group is linked to a clinic in São Paulo and has access to patients). However, the genetic work outside Europe was coordinated by an American researcher (Columbia University).

Type 4: AMIGA (Assessing and Monitoring the Impacts of Genetically modified plants on Agro-ecosystems).

This consortium is coordinated by an Italian group: its objective is to evaluate the potential environmental and economic impact of GMO cultivation. One species evaluated in this project is the genetically modified potato, a topic on which the Argentine group (INTA) worked for several decades. The task of the Argentine group, in particular, is to work on validating the control methodology in areas of large-scale cultivation of GMOs. An initial validation of the methods is planned in the United Kingdom, but it needs to be tested for large-scale production, which is allowed in Latin America but not in Europe.

Final considerations

Through empirical analysis, we were able to determine that, while scientific relationships are becoming more complex, and the participation of Latin American research groups in international consortia continues to increase, the basic structure of those relationships is still organized around modalities of "subordinate integration": the activities mostly carried out by Latin American researchers in the division of labor within the research consortia involve data production, organization and systematization. The expansion of technologies to share both research materials and results does not seem to have modified the structure of earlier relationships. Meanwhile – with few exceptions – European groups tend to concentrate on designing the research, both theoretically and, above all, methodologically, and they have the capability to centralize the data generated and to produce conceptual interpretations.

To the extent that almost all the Latin American research groups (minus the exceptions mentioned) were invited to join the consortia after the research had already been designed, their ability to orient the results of the work towards the needs of, or potential use in, Latin America was extremely slight.

On the other hand, as we pointed out in the previous section, almost all the consortia had European business partners, generally medium-sized ones. Although for reasons of confidentiality we were not able to access the agreements on industrial property and use of results, it is quite plausible to deduce that those agreements would imply that, were commercially viable results to be obtained, the business partners in those consortia would be the first to benefit, followed by other European companies. Thus, any industrial application of knowledge – should it take place – would occur primarily on the European continent.

Let us go back to the two paradigms that form part of the EU's explicit discourses: the "narrow" paradigm and the "broad" one. Based on our research, we can observe that employing the narrow paradigm – namely, the goal of "improving the quality, scope and critical mass of research" – implied increasing participation by Latin American researchers, who bring specialized research capacities in specific subject fields, which add to specifically European human resources. Unlike in the past, this occurs without causing permanent or long-term migration of scientists, since Latin American groups work in their own countries and thus also depend on the infrastructures that exist there.

On the other hand, an effect of "cultural proximity" and broadening of communities happens between partners from both regions, which boosts the amount of available knowledge for potential use by Europe.

It is worth considering the "broad paradigm," that is, the level of policies and the goal of improving competitiveness, tackling global social challenges and helping to build science and technology capacities in less developed countries. We should say briefly that, given the significant level of development of the scientific groups in the countries considered, strengthening the capacities of those countries doubtless occurs as a result of the cooperation analyzed, but it is not a determining factor (as it would be in the case in less developed countries). However, it is clear that the nature and dynamics of the projects considered help strengthen a global vision on the part of the EU, both by providing "observation points" on various global phenomena in Latin America (such as climate change), the ability to do trials in areas with less regulations, and also the ability to generate knowledge on local questions that yields a broader vision or helps generate regulations in Europe.

At this point, we could advance the hypothesis of a "functional interdependence" between European policies encouraging the participation of non-European scientists and Latin American elites: while the EU succeeds in expanding the number of researchers devoted to specific questions of interest to Europe, Latin American elites find a way of formalizing their international connections, increasing their publications and, in general terms, the international visibility of their work.

Furthermore, it is worth mentioning the role of institutions governing policy, promotion and the growth of Latin American scientific careers. As a general rule, these institutions (universities or national councils, such as CONICET in Argentina, CONACYT in Mexico, CNPq in Brazil or COLCIENCIAS in Colombia) tend to encourage international cooperation in the belief (although with some nuances we cannot go into here) that the greater their researchers' level of international cooperation, the greater the benefit for the development of local science. Thus, cosmopolitanism has apparently been seen as of intrinsic value to local scientific communities; it has not prompted any critical reflection (with the exception of a brief period during the Lula administration in Brazil, and some contradictory initiatives in the last decade in Ecuador), on the part of science and technology policy-makers, about the relatively subordinate role that Latin American researchers occupy in collaboration networks set up by more developed countries. This is mostly expressed, as we showed, in the definition of agendas, the choice of research techniques, a certain asymmetry in the distribution of tasks and the potential use of knowledge produced, given Latin American societies' historic weakness in terms of industrial application of knowledge. Therefore, mere participation by groups from the region in international networks is treated in evaluation of scientific careers as a favorable element per se; there is rarely any exploration of the characteristics and benefits that such participation implies.

Lastly, we hope that our proposed preliminary typology will serve as a starting point for more in-depth analysis of the participation of Latin American groups in international consortia and, more generically, into some modalities that structure the relationships between hegemonic centers of knowledge production and semi-peripheral contexts. We also trust that this typology will be enriched by new empirical investigations that take

into account not only cooperation with Europe, but also connections funded by various agencies in the United States, and also less formalized cooperation modalities, in order to observe whether they follow a similar pattern to the ones we have observed here, or whether it is possible to identify different modalities.

NOTES

[1] The term "North-South" cooperation is misleading, since it mechanically applies a geographical definition to the capacities of each regional context. Strictly speaking, Mexico is in the North, and Australia in the South. We mention the expression because it is still strongly anchored in the discourses, but we feel the definition "peripheral" or "non-hegemonic" is much more appropriate to our topic.

[2] In this article, we show the results of a survey sent to 900 Latin American researchers – all of whom participated in European projects within the Sixth and Seventh Framework Programs – which asked them 21 different questions.

[3] This figure only includes the participation of Latin American groups in research projects and not in projects involving researcher mobility.

[4] Indeed, in terms of human resources, the number of researchers compared to the number of economically active members of the population was less in Europe than in Japan and the United States: in 2003 the proportion was 5.4 out of 1,000 in the EU, compared with almost double that in the United States and Japan (9 and 10.1 per 1,000, respectively). Of course, there are important differences within the European area (Muldur et al., 2006).

[5] To give an idea of the structural asymmetries, we should point out that in countries like Argentina and Brazil, private for-profit institutions as well as small and medium-sized businesses represented about 14% of the total participants in FP7.

[6] The acronym SALUD means "health;" KBBE stands for "Knowedge-based bio-Economy," which broadly includes biotechnology projects applied to agriculture, among other things.

[7] We concentrate on schemes that support strictly research projects, ruling out funding for creating and/or consolidating international networks, where Latin American participation is less significant.

[8] For historical cases of this process of external construction of scientific capital, see Romero (2004), Cukierman (2007), Buch (2006) and Kreimer (2016), among others.

[9] In this and other statements made by coordinators of groups, the names cannot be mentioned due to previous agreements.

REFERENCES

ADAMS, Jonathan.
Collaborations: The fourth age of research. *Nature*, v.497, p.557-560. 2013.

ADAMS, Jonathan.
Collaborations: The rise of research networks. *Nature*, v.490, p.335-336. 2012.

ANDERSON, Melissa S.
International research collaborations: anticipating challenges instead of being surprised. In: *The Europa world of learning*. London: Routlegde. p.14-18. 2011.

BEAVER, Donald.
Reflections on scientific collaboration (and its study): past, present, and future. *Scientometrics*, v.52, n.3, p.365-377. 2001.

BEIGEL, Fernanda.
Current tensions and trends in the world scientific system: alternative circuits and new forms of peripheriality. *Current Sociology*, v.62, n.5, p.617-625. 2014.

BOEKHOLT, Patries et al.
Drivers of international collaboration in research. Amsterdam: Technopolis Group. 2009.

BOZEMAN, Barry; CORLEY, Elizabeth.
Scientists' collaboration strategies: implications for scientific and technical human capital. *Research Policy*, v.33, n.4, p.599-616. 2004.

BUCH, Alfonso.
Forma y función de un sujeto moderno. Bernardo Houssay y la fisiología argentina. Buenos Aires: Editorial de la UNQ. 2006.

CETTO, Ana María; VESSURI, Hebe.
The international scientific cooperation of Latin America and the Caribbean. Unesco World Science Report. Paris: Unesco. 2005.

CORDIS.
Community research and development information service for science, research and development. Disponible en: <http://cordis.europa.eu/fp7/understand_en.html>. Acesso: 2009.

CUKIERMAN, Henrique.
Yes, nós temos Pasteur: Manguinhos, Oswaldo Cruz e a história da ciência no Brasil. Rio de Janeiro: Relume Dumará; Faperj. 2007.

DEVAN, Janamitra; TEWARI, Parth S.
Brains Abroad. *The McKinsey Quarterly*, n.4, p.1-10. 2001.

EDLER, Jakob; FLANAGAN, Kieron.
Indicator needs for the internationalization of science policies. *Research Evaluation*, v.20, n.1, p.7-17. 2011.

EULARINET.
Latin American participation to the 6th Framework Programme of the European Commission. Bruselas: European Commission. 2009.

EUROPEAN COMMISSION.
Directorate-General for Research and Innovation. *An analysis of the role and impact of industry participation in the Framework Programmes*. Luxembourg: Office for Official Publications of the European Communities. 2016.

EUROPEAN COMMISSION.
Directorate-General for Research. *Opening to the world: international cooperation in science and technology*: report of the ERA expert group. Luxembourg: Office for Official Publications of the European Communities. 2008.

EUROPEAN COMMISSION.
FP7 in brief: how to get involved in the EU 7th Framework Programme for Research. Luxembourg: Office for Official Publications of the European Communities. 2007.

EUROPEAN COMMISSION.
Directorate-General for Research. *Impact assessment report on the specific programme international RTD Cooperation Fifth Framework Programme (1998-2002)*. Luxembourg: Office for Official Publications of the European Communities. 2005.

GAILLARD, Jacques.
La coopération scientifique et technique avec les pays du sud. Peut-on partager la science? Paris: Karthala. 1999.

GAILLARD, Jacques.
North-South research partnership: is collaboration possible between unequal partners? *Knowledge, Technology & Policy*, v.7, n.2, p.31-63. 1994.

GAILLARD, Jacques; ARVANITIS, Rigas.
Science and technology collaboration between Europe and Latin America: towards a more equal partnership? In: Gaillard, Jacques; Arvanitis, Rigas. (Ed.). *Research collaborations between Europe and Latin America. Mapping and understanding partnership*. Paris: Archives Contemporaines. p.1-20. 2013.

GAILLARD, Jacques; GAILLARD. Anne-Marie; ARVANITIS, Rigas.
Mapping and understanding EURO-LAC international cooperation in science and technology. EULAKS Document. Seventh Framework Programme. 2010.

GALISON, Peter; HEVLY, Bruce.
Big science: the growth of large-scale research. Stanford: Stanford University Press. 1992.

GLÄSER, Jochen; LAUDEL, Grit.
Integrating scientometric indicators into sociological studies: methodical and methodological problems. *Scientometrics*, v.52, n.3, p.411-434. 2001.

GUSMÃO, Regina.
La implicación de los países latinoamericanos en los programas europeos de cooperación CyT con terceros países. *REDES*, v.7, n.16, p.131-163. 2000.

HALLONSTEN, Olof.
Use and productivity of contemporary, multidisciplinary big science. *Research Evaluation*, v.25, n.4, 2016, p.486-495. Disponible en: <https://doi.org/10.1093/reseval/rvw019>. Acesso en: 13 ago. 2019. 2016.

JOERGES, Bernhard; SHINN, Terry (Ed.).
Instrumentation between science, state and industry. Dordrecht: Kluwer Academic Publishers. 2001.

KATZ, Sylvan; MARTIN, Ben.
What is research collaboration? *Research Policy*, n.26, p.1-18. 1997.

KREIMER, Pablo.
Contra viento y marea en la ciencia de la modernidad periférica: niveles de análisis, conceptos y métodos. In: Kreimer, Pablo (Ed.). *Contra viento y marea*: emergencia y desarrollo de campos científicos en la periferia. Buenos Aires: Editorial de CLACSO, p.9-60. 2016.

KREIMER, Pablo.
Délocalisation des savoirs en Amérique Latine: le rôle des réseaux scientifiques. *Pouvoirs Locaux*, n.94, n.3, p.25-28. 2012.

KREIMER, Pablo.
¿Dependientes o integrados? La ciencia latinoamericana y la división internacional del trabajo. *Nomadas*, n.24, p.199-212. 2006.

KREIMER, Pablo.
Understanding scientific research on the periphery: towards a new sociological approach? *EASST Review*, v.17, n.4, p.13-21. 1998.

KREIMER, Pablo; LEVIN, Luciano.
Scientific cooperation between the European Union and Latin American countries: Framework Programmes 6 and 7. In: Gaillard, Jacques; Arvanitis, Rigas (Ed.). *Research collaborations between Europe and Latin America*: mapping and understanding partnership. p.79-104. Paris: Archives Contemporaines. 2014.

KREIMER, Pablo; MEYER, Jean-Baptiste.
Equality in the networks? Some are more equal than others. International scientific cooperation: an approach from Latin America. In: Vessuri, Hebe; Teichler, Ulrich (Ed.). *Universities as centers of research and knowledge creation*: an endangered species? Rotterdam: Sense. p.121-135. 2008.

LEYDESDORFF, Loet; WAGNER, Caroline.
International collaboration in science and the formation of a core group. *Journal of Informetrics*, v.2, n.4, p.317-25. 2009.

LOSEGO, Philippe; ARVANITIS, Rigas.
La science dans les pays non hégémoniques. *Revue d'Anthropologie des Connaissances*, v.2, n.3, p.334-342. 2008.

MULDUR, Ugur et al.
A new deal for an effective European research policy: the design and impacts of the 7th Framework Programme. [S.l.]: Springer. 2006.

NATIONAL SCIENCE BOARD.
International Science and Engineering Partnerships: a priority for U.S. foreign policy and our nation's innovation enterprise. Washington, DC: The National Academies. 2008.

NEWMAN, Mark.
The structure of scientific collaboration networks. *Proceedings of the National Academy of Science of the USA,* n.98, p.404-409. 2001.

OECD.
Organisation for Economic Co-operation and Development. International mobility of the highly skilled. Disponible en: <http://dx.doi.org/10.1787/9789264196087-en>. Acesso em: 13 ago. 2019. 2002.

PERSSON, Olle; GLÄNZEL, Wolfgang; DANELL, Rickard.
Inflationary bibliometrics values: the role of scientific collaboration and the need for relative indicators in evaluative studies. *Scientometrics*, v.60, n.3, p.421-432. 2004.

PESTRE, Dominique.
Regimes of knowledge production in society: towards a more political and social reading. *Minerva*, v.41, n.3, p.245-261. 2003.

PRICE, Derek de Solla.
Little science, big science. New York: Columbia University Press. 1973.

RODRIGUEZ MEDINA, Leandro.
Construyendo periferia: un microanálisis de objetos subordinantes como tecnologías epistémicas. *Sociológica*, v.29, n.83, p.9-46. 2014.

ROMERO, Flor.
Manuel Elkin Patarroyo: un scientifique mondial. Inventeur du vaccine de synthèse de la malaria. Paris: L'Harmattan. 2004.

SEBASTIÁN, Jesús.
Conocimiento, cooperación y desarrollo. *Revista CTS*, v.3, n.8, p.195-208. 2007.

SHRUM, Wesley.
Reagency of the internet, or, how I became a guest for science. *Social Studies of Science*, v.35, n.5, p.723-754. 2005.

VELHO, Léa.
North-South collaboration and systems of innovation. *The International Journal of Technology Management and Sustainable Development*, v.1, n.3, p.171-181. 2002.

VESSURI, Hebe.
Scientific cooperation among unequal partners: the strait jacket of the human resource base. In: Gaillard, Jacques (Ed.). *Coopérations scientifiques internationales*. Paris: Éditions de l'ORSTOM. 1996.

WAGNER, Caroline.
The new invisible college: science for development. Washington: Brookings Institution Press. 2008.

WAGNER, Caroline.
International collaboration in science and technology: promises and pitfalls. In: Box, Louk; Engelhard, Rutger (Ed.). *Science and technology policy for development, dialogues at the interface*. London: Anthem Press. p.165-176. 2006.

WAGNER, Caroline; KIT WONG, Shing.
Unseen science? Representation of BRICs in global science. *Scientometrics*, n.90, v.3, p.1001-1013. 2012.

WHITLEY, Richard.
Reconfiguring the public sciences: the impact of governance changes on authority and innovation in public science systems. In: Whitley, Richard; Glaeser, Jochen; Engwall, Lars (Ed.). *Reconfiguring knowledge production*: changing authority relationships in the sciences and their consequences for intellectual innovation. Oxford: Oxford University Press. p.3-50. 2010.