



SCIENCE & TECHNOLOGY, DEVELOPMENT AND LOCAL POWER: ELEMENTS FOR ANALYSIS OF THE BRAZILIAN CONTEXT

Sueli Goulart

Universidade Federal do Rio Grande do Sul (UFRGS)

sueligoulart@uol.com.br

Marcelo Milano Falcão Vieira

Escola Brasileira de Administração Pública e de Empresas da Fundação Getúlio Vargas (EBAPE/FGV)

Marcelo.Vieira@fgv.br

Abstract

This paper discusses the theoretical aspects of the relationship between scientific and technological production of universities and local development. The central argument is that this relationship is potentialized when produced knowledge permits the occupation of a position in the scientific field and is linked to specific forms of local insertion. In the context of globalization, which keeps the center-periphery structure of the world economic system practically intact, articulation is proposed between global and local dimensions of the environment. The recovery of theoretical-empirical categories formulated by Economic Commission for Latin-America and the Caribbean helps to place the discussion in a political sphere, and to characterize local development as an expression of social change on territorially demarcated scales.

Keywords: science, technology, local power, brazilian context, local development.

1. Introduction

Under the prevailing neoclassic economy and neoliberal ideology, development is a linear evolutionary process: the route to the more advanced stages is bound to the completion of stages, referring to the industrial capitalist model of reproduction. One of its main determining factors is scientific and technological production.

However, the policies adopted in that direction have not proven apt to settle the problem of hunger, poverty, illiteracy, violence, moral degradation, exhaustion of energy and natural resources. Moreover, increasing scientific and technological production in the peripheral countries, concentrated in the universities, has been unable

to further social transformations that contribute toward reversing their character of underdevelopment and dependence.

In order to understand the relations between scientific and technological production of the universities, particularly in Brazil, and economic and social development, the suggestion is to recover theoretical-empirical categories formulated by Economic Commission for Latin-America and the Caribbean (ECLAC) since the 1950s and 1960s, and articulate them to the notion of local development arising since the 1980s. It is argued that, jointly with the capacity to interpret the broader context, it is the involvement in the place, especially through actions mobilized on inter-organizational scales, that may assure

university organizations the effective capacity of intervention and from them to play their social role.

Based in Selznick (1972) we argue that organizations are responsible for technical, symbolic and standard elements. At the same time, they build them through relations and bonds that they establish in the environment, becoming institutions.

Pettigrew (1985) said that contexts and organizations shape and are mutually shaped to form a frame of complex interaction between organizations and contexts in a dynamic movement. The dynamic nature is visible in the light of the search for legitimization at the different levels and scopes of the environment, which may be translated into global-local dialectics.

This means that organizations need to be in the context of global environment elements, especially considering the phenomenon of globalization, but also need closer social recognition in their area of insertion, consisting of its geographic boundary, territorially demarcated. Hence the premise that the influence of social institutions on local development is mediated by their capacity to articulate between global and local dimensions of the context.

2. From Global to Local: organizational fields as reference

The dynamics of environment-organization relations that run processes of institutionalizing organizational forms can be better understood when one use the concept of organizational field, formulated by DiMaggio and Powell (1991). This concept refers to the influential relations that occur in a certain social space that is a recognized area of institutional life.

This broad notion is more specifically echeloned by Scott (1992) and Scott and Meyer (1992) in an attempt to demarcate some environmental frontier perceived by organizations. In this way, the idea of an inter-organizational field stresses the horizontal connections between sets of organizations, similar or otherwise, in a geographically outlined area. In general, it is informally structured, with relations of authority relatively negotiated and the interconnection occurs around locally oriented enterprises (Scott & Meyer, 1992).

Considering the way in which community life, public policies and welfare service systems are organized in contemporary society, Scott and Meyer (1992) propose to analyze societal sectors as a means to understand the structure and functioning of the organizations. The societal sector is characterized as a domain identified by the similarity of the service, product or function and, consequently, its boundaries are functional and not geographic. This means that in a certain sector the units are functionally interrelated, although they do not share the

same geographic space; the patterns of interaction are predominantly vertical and the direction extra-local. Although a geographic boundary is not demarcated, the proposal of a third level of interrelations and the way in which the relations occur in the societal sector suggest a demarcation relating to the geopolitical space of national states.

The third space of relations proposed by Scott (1992) is characterized in the context of the worldwide system that, at the heart of the international division of work and globalization, affects the other contexts. In this sense, the author calls attention to the possible importance of the worldwide system in the next few decades, as a result of macroeconomic variables such as the development of capitalism and increase in multinational organizations.

The relevance that each of these levels has for the organizations impacts their directions; the predominance of elements from the relevant levels, whether in international, technical, cultural or historical aspects, set the context of reference of the organizations.

The levels of the context of reference have a relationship with organizational legitimization since, in order to survive and compete, the organization will strive to achieve legitimacy in the environment that is determining to it. The latter, in turn, is defined by the particular characteristics of the organizations, making them sensitive to the myths rationalized in that context (Meyer & Rowan, 1991). Myths from the call of shared collective constructions; rationalized by the standardizing character that they adopt. In an attempt to obtain legitimacy, organizations generally take lines of action previously defined and rationalized in society (Meyer & Rowan, 1991), and do so through isomorphic processes (Dimaggio & Powell, 1991).

This seems to be the case of the globalization process and insertion strategies of the peripheral countries and, more specifically, development strategies understood to be able to overcome the structural inequalities between center and periphery, adopted by governments and local organizations.

The concrete meanings of globalization, such as opening up markets, restructuring the State, privatization, competition, interconnectivity and its symbolic meaning, such as outside pressure on the way in which the organizations think and act seem to set a new institutional pattern. The ubiquity of the globalization process indicates that organizations cannot ignore these meanings. However, this same characteristic of globalization requires a reference to different levels of context, since it is reflected in several dimensions of social life.

In this scenario, organizations are pressured to share global values, but also to act more consistently and with commitment to the reality in which they are involved. From this viewpoint, they can be constituted in the articulating axis of global and local centers and play a

leading role in social development in relatively demarcated territorial spaces.

The ontologically universal nature of knowledge, whose production is the “distinct competence” (Selznick, 1972, p. 120) of the academic world, indicates that, in theory, universities inherently share global values. At the same time, their socio-institutional nature implies recognizing the social roots, that is, their overlapping at their boundary.

Accordingly, the relationship between universities, particularly of their scientific and technological production and local development would be automatic. Nevertheless, inasmuch as science – academic knowledge par excellence – was acquiring an institutional character in the context of the capitalist society, their production now constituted a recognized and specific field of the social universe that mobilizes conflicting interests. In this process, actors and institutions build and rebuild patterns of legitimacy, control mechanisms and access strategies that eventually change the universality of knowledge in a *continuum* to which it may be more or less close. In this sense, being close means constituting the field where the dispute occurs, having resources to be able to play the game in progress there.

The notion of a scientific field developed by Bourdieu (1983) contributes toward characterizing the relations that occur between actors, institutions and each other. The “forces and monopolies”, “fights and strategies”, “interests and profits” relations, encased in specific forms configure the scientific field in the environment of knowledge production (Bourdieu, 1983, p. 122).

An analysis of these relations helps reveal the mechanisms of power that were submerged in the notion of an organizational field as a social legitimization mechanism. The focus on the former conforms to certain standards. However, in the notion of a scientific field as a field of battle, the focus is to reveal how and who sets the standards.

That is why it is worth situating the key categories and references based on the notion of development and local power to discuss more appropriately the role and ranking of universities and their scientific and technological production in this scenario: if the one of conformation to established patterns and rules or, in opposition, the one of fighting to constitute the field where they are established.

3. Development and Local Power: social change and management scales

Although studies on development have occupied the agenda of social scientists, especially since the end of the Second World War, the oil crises of 1973 and 1979, subsequent recessions affecting the countries all over the world, and the foreign debt crisis, for example, contributed

to submerge concerns on this topic in a public agenda dominated by conjunctural situations.

The end of the stalemates between the two major world political systems – capitalism and socialism – with the apparent triumph of the former, also further reinforced the submergence of the theme. The neoliberal capitalist ideology pretended that it was almost the only possibility of a solution for the problems facing different countries in different economic, political or social situations.

Nevertheless, restructuring in new production and accumulation models, the streamlining of the State apparatus by restricting public policies and privatizing various sectors, performed under the direction of that ideology, was not a solution for the problem of hunger, poverty, illiteracy, violence, moral degradation, exhaustion of sources of energy and natural resources.

The permanence and, in some cases, intensification of the disparities between the central and peripheral countries challenged the linearity, homogeneity and determinism of development mentioned in the industrial capitalist model of reproduction, and in its restructurings.

Since the 1980s, the globalization process, strengthened by the new information and communication technologies, acquires a determining character in relationships between countries, institutions, markets and individuals. Although understood as a cultural, economic and political phenomenon, globalization, boosted by neoliberal ideology, oriented the predominance of economic and financial over the other – cultural, political and political - spaces (Vieira & Vieira, 2003).

In this context, the notion of place now comprises a new categorization: local-places and global-places. The former demarcate the space of historical heritage that, even restructured in terms of global strategies, keep an identity. They are still the basis of territorial organization. Global-places are spaces defined as a result of globalization, fundamentally separating the center of the action from the seat of action. They are “the space for world strategies of the major multinationals, establishing territorial redefinitions and changes in administration procedures” (Vieira & Vieira, 2003, p. 20).

It is no coincidence that this categorization corresponds to the center-periphery structure discussed since the 1960s. At that time, this structure indicated basically the difference between industrialized and non-industrialized countries. Now the dichotomy is reproduced, practically with the same actors, differentiating countries that produce knowledge, technology and innovation from those that merely reproduce or operate the structures defined in the middle of the world economic system. At that time this structure guaranteed the hegemony of the central countries in an international division of labor that restricted the process of industrialization of the peripheral countries to “upgrading consumer patterns” (Furtado, 2000a, p. 27). Now it intends to define the conditions of its inclusion in

the globalization process, either as a supplier of manpower or spatial and fiscal low cost infrastructure, or as space for financial speculation.

From the center-periphery structure and theory of dependence, it was possible to characterize the development-underdevelopment process as expressions of social structures. An effective transformation of social structures corresponds to the former, while the latter is restricted to upgrading the life style. Therefore, underdevelopment could be specifically characterized “as the shaping of societies in which asymmetric external relations, that create dependence, are internally coordinated with the system of social domination” (Furtado, 2000a, p. 39).

This is why these same categories continue to make sense in understanding the world economic structure and its underlying system of power, props that Furtado (2000b) calls global capitalism.

It seems, therefore, essential to retrieve them as a backcloth in order to understand the strategies and models that have been discussed over the past thirty years and have been lumped together under the framework of sustainable and integrated local development. When retrieving them, it is found that the contextualization should be added not only to the mobilization of endogenous forces but also to the global scenario, since the parameter under which the world system is directed is globalization, from which it seems no longer possible to keep away.

As a space for operationalizing development, the place consists of power relations between individual and collective actors, striving to coordinate a capacity to act on multiple bases. The focus on the place and the coordination between different kinds of institutions mean recognizing a more or less clearly defined stage where different actors play power games to thereby constitute the notion of local power.

Fischer (2002, p. 13) affirms that this notion “refers to relations of forces, by which alliances and disputes are processed between the social actors, as well as to configuring specific identities and practices of administration”, which appear in inter-organizations. Partners, joint ventures, networks, productive arrangements, alliances, or clusters are the forms in which inter-organizations can be presented. State, trade and/or social organizations are configured in those forms, seeking to promote development in territorially demarcated spaces (Fischer & Melo, 2003). These hybrid configurations, consisting of different collective social players, in the understanding of the aforementioned authors, play a key role in the management of local development, since they are connected by common purposes and they potentialize their forces.

However, the connection and integration through common purposes do not eliminate the variations between the organizations, implying moving away from the

monolithic notion of inter-organizations. Integration, in the place, “refers to complots and power games that define relations” (Fischer, 1996, p. 13). These relations are marked by negotiation and the difficulty of the organizations to maintain their own objectives and projects and to insert them in a collective project comprising them.

According to Enriquez (1996), the difference between organizations will tend to create a synergy if they knew to what extent it is possible to join forces and maintain boundaries. Acknowledgement of these differences helps demystify the fallacies of depoliticization, post-democratic consensus and local citizenship (Fischer, 2002; Acselrad, 2002) since, if the joint effort is the key to inter-organizational relations, then policy and, consequently, power are key elements in the management of the new development model.

Oliveira (2001, p. 13) criticizes the attempt to present local development “as a ‘patchwork’ (from the novel by Machado de Assis, *Memórias Póstumas de Brás Cubas*) that can cure ailments of a perverted society, placing bucolic and harmonious communities in place”. If it were like that, the discussion would move away from the “complexity of modern society and go in search of the identical, the same (...). The challenge of local development is that of being aware of this complexity and not rejecting it”.

This author defends that two fundamental dimensions must be added to the notion of local development as a set of welfare and quality of life requirements: the specific background emphasized in the concept of underdevelopment, and citizenship. With regard to the former, he says that “local development will not be the link in a chain of total development; the latter is, or is conceived as, an alternative or will reproduce the structural form” (Oliveira, 2001, p. 11-12).

The proposal is then reinforced to recover the categories worked by the intellectuals from ECLAC, particularly the center-periphery dichotomy and the specific aspects of underdevelopment, placing them in the context of a globalized world scenario, on the risk that peripheral countries may become mere operational units. Or that the global dimension only affects them in the sense of dissipating their identities, making them homogeneous, in thousands of global-places, amorphous entities, always on the fringe of decisions that, emanating from the center, determine the conditions of everyone’s survival.

In times of globalization and over-valorization of knowledge as capital that mobilizes innovation and transformations, science and technology have become fundamental elements in the strategies and directions of development. In Brazil, 90% of scientific and technological research is carried out in the sphere of the public higher education institutions (Trindade, 2000). A brief description of how this situation was institutionalized, characterizing how it happened and to what it is linked contributes to an

outline of the way in which the universities can effectively become institutions capable of influencing the definition of the standards and directions of development, from the viewpoint of countries situated on the periphery of the world economic system.

4 Universities as *loci* of scientific and technological production

The link between science and university, when considering the longstanding history of both in humanity, only happened in the last two centuries. Science, studied by the Greeks since olden times, looked for rational forms of learning about nature; the university, created in the Middle Ages, was first directed toward training the scholars and administrators of the Church, guardians and reproducers of dogmas and certainties.

The approximation is one of the most significant results of Illuminism, which was an intellectual movement that first appeared in the 18th century. Until then, scientific research was performed through the individual work of researchers who created, as a place for meeting and discussion, the Societies or Academies of Sciences, as occurred in England and France since the 17th century (Schwartzman, 2001). The so-called traditional universities functioned as centers of the classics, conveying established knowledge.

Only in the 19th century did science, considered an activity that created knowledge, using its own methods, influenced and influencing its historic era, develop in the sphere of the European universities (Schwartzman, 1979), especially as a result of radical changes in the institutions of Germany, France and England.

The benchmark of the modern university was the University of Berlin, created in 1810. Its foundations were laid on the search for truth, professional learning and general culture, to become a center of investigation and research and no longer merely a center for reproducing exemplary knowledge (Teixeira, 1968).

As elsewhere in the world, Brazilian scientific production did not begin in association with the universities. When this link first occurred in European countries – early 19th century – science in Brazil was inaugurated as a practice of individual schools, such as the Ouro Preto Mines School in 1876; of a few individual researchers and institutes, namely Adolfo Lutz, in São Paulo, since 1893, or Manguinhos Institute in Rio de Janeiro, in 1901 (Schwartzman, 2001).

The creation of the University of São Paulo (USP) is considered a landmark when research was included as

one of the main attributes of Brazilian universities and from it the key element of scientific progress. In his diligent work on the formation of the scientific community in Brazil, Schwartzman (2001, p. 164) writes that the creation of that university is “the most important event in the history of science and education in Brazil”.

This model gradually spread to the other Brazilian States, generally as a result of mobilizing local forces under the aegis of national policies directed at establishing the higher education system in Brazil, and at forming its basis for producing scientific and technological knowledge.

Science, after the Second World War, and raised to the conditions of a cornerstone on which economic and social development should be built, was now a strategic element and required “administration”, in other words, budgets, projects and decisions should be part of a “national plan for development and use of research results” (Dedijer, 1968 as cited in Schwartzman, 1979).

In Brazil, this condition was translated in the founding of some institutions designed to create institutional structures as support for Brazilian scientific and technological production. Therefore, the National Research Council, now called the National Council of Scientific and Technological Development (CNPq), and National Campaign for Higher Education Enhancement, now Coordination of University Graduate Enhancement (CAPES), were both created in 1951 (Silva & Melo, 2001).

In the first few years, these two agencies concentrated their efforts on granting overseas scholarships to train researchers and then on fixing them in Brazilian universities. They helped, therefore, implement post-graduation in the country and create incentive mechanisms for exclusive dedication to teaching and research of post-graduates (Carneiro Jr. & Lourenço, 2003).

The creation of the University of Brasilia in the early 1960s was another important landmark in establishing the Brazilian university. Under the leadership of Darcy Ribeiro, various researchers, mostly members of the Brazilian Society for Scientific Progress, contributed toward planning and consolidating an innovative university project. However, the military coup d'état in 1964 led to the dismissal of a very large number of professors and to a serious crisis in that institution.

The formal identity of the Brazilian university is more clearly defined in the second half of the 1960s, first in the federal universities and São Paulo state universities, spreading by law to the other institutions, regardless of their legal nature or administrative dependence. The set of laws in the 1968 University Reform defined the basic principles under which university institutions should function. They included the establishment of a fulltime system and exclusive dedication, career progression linked to titles and research requirements, not dissociated from teaching (Cunha, 2001).

Accordingly, the institutional conditions were formalized to consolidate universities as a privileged space for Brazilian scientific and technological production, although surrounded by every economic and political restraint of that time. Universities became, then, direct targets of government policies explicitly focusing on scientific and technological development and a center supporting this system.

Other agencies or programs created between the 1960s and 1970s, such as the Funding Agency for Studies and Projects (FINEP) and National Fund for Scientific and Technological Development (FNDCT), acted as a reinforcement for post-graduation as a strategy to consolidate the Brazilian scientific and technological system. In 1985 the Ministry of Science and Technology was created (MCT) to which these organizations, in addition to CNPq, were subordinate.

The joint action of the various agencies, namely CAPES and CNPq, demonstrates the close connection between science, technology and universities, not only on the formal but also practical level. Information collected by Carneiro Jr. and Lourenço (2003) shows the progress in granting scholarships at home and abroad by both agencies between 1991 and 2001.

In CAPES, Masters and Ph.D. scholarships granted in the country rose from 13,791 in 1991 to 20,915 in 2001. The number of overseas scholarships granted dropped from 380 in 1991 to 221 in 2001. On the other hand, the number of scholarships for a sandwich Ph.D. and post-Ph.D. rose from 28 and 41 in 1991 to 427 and 277, respectively, in 2001.

In CNPq, the scholarships in the country rose from 11,271 in 1991 to 11,640 in 2001. Within this slight variation is included the significant drop in the Masters scholarships that in 1995 were 10,960, and in 2001 dropped to 5,798. In the same period there was a rise in the number of Ph.D. scholarships that in 1991 was 2,674 and in 2001 5,842. Overseas scholarships dropped in all modalities from 2,013 for a Masters and Ph.D. in 1991 to 439 in 2001, and no overseas Masters scholarship has been granted since 1999.

The constitution of the institutional supporting foundation for Brazilian scientific and technological production is visible in the consolidation process of Brazilian post-graduation and in acknowledging the strategic role that the national system of science and technology now has, from the national development plans of the military governments until the current proposals of the Lula government, such as the Science and Technology Program for Social Development and increase in sectoral funds.

However, there is still a long way to go toward the competent inclusion of the country in the globalized world. In the traditional model of development, science and technology were considered exogenous factors, whose

evolution would determine on a linear basis the evolution of society (Zouain, 2001). Yet, under the paradigm of globalization and the specific aspects of Brazilian society, there could be no development “if the national system of science does not relate to the national system of innovation, adding value to export products, and solving serious income distribution problems and access to medical care in Brazil” (Chaimovich, 2000, p. 33).

Based on data from *Science Citation Index*, Cruz (2002) ascertains that the growth in the volume of publications by Brazilian scientists (from around 2000 a year in the 1980s to around 10,000 in 2001) does not correspond to the production of technological innovation. Data quoted by MCT in 1998 showed that, while the Brazilian contribution toward world scientific production is 1.2%, its share in the world technological production is 0.06%¹ (Viotti, 2001). The verified ratio in Brazil of 20 to 1 cannot be compared to another eight countries under study: United States (0.62); United Kingdom (3.22); German (0.96); France (1.76); Italy (2.22); Israel (3.13); Korea (1.26); and Japan (0.39).

Marcovitch (2000, p. 108) includes health, environment, safety, work and education among the Brazilian social priorities discussed in the academic sector and says that the role of universities is to provide elements to equate these problems by analyzing, criticizing and interpreting. In short, their intervention must occur through “their mission to form a mentality and renew concepts” and not as a “proposals factory” and “finished and definitive formats” of public policies.

When completing the work in which she discusses fragments and reconfigurations of the place as subsidies to understand contemporary administration and strategic cities, Fischer (1996, p. 21) mentions the need to investigate the commitment of academics “to a twofold movement: from valorizing the roots to the contingencies and challenges of globalization, from a culturally sensitive coexistence in the place to the competence to intervene in different times and spaces”.

It is a truism when it is said that science is power and, consequently, that the organizations producing it have a high capacity to intervene in the development process. The universities in peripheral countries, such as Brazil, are the almost only basis for their scientific and technology production. However, economic and social pointers, especially when considered regionally, show a gap between institutionalized discourse and social reality.

¹ Percentage of the total number of articles published by Brazilian authors in periodicals indexed by *Science Citation Index* and a percentage of the total number of patents granted by the US Patent Office to residents in Brazil, respectively.

5 Conclusions

When looking for substance in the institutional theory to address these questions and argue that organizations play a determining role in the development process, we return to the concept of an institution formulated by Selznick (1972), especially the specific character and distinct competence that organizations acquire because they are a product of social needs and pressures. Imbued in this concept is the historical construction process of institutions and their being interwoven in the environment, whose dimensions extend to sociological neo-institutionalism. This is also the source of theoretical-empirical categories that contribute toward understanding the role of organizational studies and of organizations in the discussions about local development in the globalization context.

Analyzing the inter-organizational field (Scott & Meyer, 1992) is an important resource toward understanding inter-organizations (Fischer, 2002), which mobilize actions focusing on local development. On a larger scale, the analysis of the context of the global system (Scott, 1992) permits the understanding of concrete and symbolic meanings that globalization has over organizational and inter-organizational action.

Thus, in the articulation between the local (inter-organizational field) and global (worldwide system) levels, it is possible to find a backing for the premise that the broader the reference context of organizations and greater their insertion in the place, the greater their capacity to influence local development.

On the university campus, research plays a key role in legitimization of organizations and their members, enabling them to have social recognition, further autonomy and access to resources (Schwartzman, 1986). And from presuming, therefore, that the prevalence of elements from the institutional context of international reference offers the universities further environmental support. This prevalence will only be consistent if it corresponds to an effective attitude in the scientific field, that is, if it reflects the competence to participate in the game that defines authority and scientific legitimacy. Nevertheless, this macro-environmental reference does not exempt them from their narrower social role whatever it may be, or from responding and reflecting on the demands of individuals, groups and organizations in its immediate surroundings, based on its socio-institutional character.

Establishing the university institution in society is significantly marked by its history, attributing a leading role to these organizations in society, which influences and is also influenced. Anísio Teixeira, one of the most eminent educational and university thinkers in Brazil, conceived it as one of the characteristic and indispensable institutions in modern society, “without which a nation does not even

exist. Those without them are also without an autonomous existence, living solely in the reflection of others” (Teixeira, 1998, p. 43).

The conclusion therefore may be the capacity to include and construct an identity of these organizations, as well as their potential to influence the process of cultural, economic, political and social development of the countries. This is because, in theory, while contributing to construct the nationality, they boost their connection with the world, since their prime purpose is to produce knowledge and this is, inherently, universal. For this reason, it is possible to argue that, jointly with their capacity to interpret the broader context, it is their insertion in the place, especially through actions mobilized on inter-organizational scales, that it may assure university organizations effective capacity to intervene and play their social role.

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