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FULL ARTICLE

Regional science: economy and geography in France and French-speaking countries

Denise Pumain[1] | **André Torre**[2]

[1]UMR Géographie-cités, University Paris I Panthéon-Sorbonne, France

[2]INRA—Agroparistech, UMR SAD-APT, University Paris Saclay, France

Correspondence
André Torre, University Paris Saclay, INRA—Agroparistech, UMR SAD-APT, France.
Email: torre@agroparistech.fr

Abstract

The objective of this paper is to assess the French-speaking countries contributions to regional science since its creation in the 1950s. France, and other French-speaking countries, very quickly adhered to the approach of the founding fathers of regional science. French-language research developed for several years without maintaining major relations with the main streams that flow through regional science. However, the years 2000 and 2010 saw the emergence of streams of thought that strongly irrigate at the international level. The authors of this paper are part of this movement. Here we trace the origins and development of the French-speaking contribution to regional sciences, while highlighting the originality of the French-language approach. First, the question of academic and institutional contexts is discussed, with the role of the founders and the peculiar place of Journals and public institutions. Further sections analyse the main contributions coming from economics (local systems of production and innovation, innovative milieus and proximity analysis) and geography (regional development at a global scale, and urban systems and complexity). We conclude with cross-disciplinary contributions including intra-urban organization and mobility, territorial governance and territorial development, as well as other approaches to the social sciences, in the contemporary issues of city and territorial governance.

KEYWORDS

French-language, Regional Science

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1 | INTRODUCTION

The objective of this paper is to make an assessment of the French-speaking countries contributions to regional science since its creation in the 1950s. France, and other French-speaking countries, including Switzerland and Belgium, very quickly adhered to the approach of the founding fathers of regional science, in the first place of which Walter Isard. The Association Française de Science Régionale (ASRDLF), francophone branch of the International Association, was created in 1961 at the instigation of François Perroux. But despite the very close relationship of some researchers with the American starting team, such as Antoine Bailly for example (who would become President of the RSAI), French-language research will however develop for several years without maintaining major relations with the main streams that flow through Regional Science.

The concerns were not very different, the subjects dealt with and the main topics were related, and French-speaking authors became more and more familiar with what was happening at the international level, but the language issue remained important: for a long time many publications remained in French, and few were distributed at international level or translated into English, which makes it a very strong originality, as the references of this paper reveal. However, the years 2000 and 2010 saw the emergence of streams of thought that strongly irrigate at the international level and therefore the leaders published the results in English, in journals or books taking part to main academic debates. The authors of this paper are part of this movement.

Here we try to trace the origins and development of the French speaking contribution to regional sciences, by highlighting the main subjects dealt with, the responses provided from a theoretical point of view, the contributions to public policies and the recent developments, while highlighting the originality of the French-language approach. First, the question of academic and institutional contexts is discussed, followed by sections on the analysis of the main contributions coming from the two main constituent disciplines, economics and geography. We conclude with an analysis of the cross-disciplinary contributions of economics and geography, as well as other approaches to the social sciences, in the contemporary issues of city and territorial governance.

2 | THE ACADEMIC AND INSTITUTIONAL CONTEXTS IN FRANCE

2.1 | The Academic context

The two academic disciplines most concerned by the questions of regional science, economics and geography, have had very different academic geneses in the French system, which need not be recalled here. However, in all generations since at least the Second World War, these disciplines have come together, rarely through direct collaborations, but more often by a few prominent personalities playing the role of go-between among these separate communities. Crozier and Friedberg (1977) had clearly identified this essential functioning in the margins of institutions, and unjustly called "weak ties" in a formalized description of social networks organized in small worlds (Granovetter, 1977). We will recall them now through a brief overview of main scholars and journals in the field.

2.1.1 | The founders

François Perroux is really at the origin of the French regional science, be there through his contacts with other famous researchers worldwide or regarding its scientific contributions. His work deals with many dimensions related

to spatial issues, but his main contribution consists in the growth pole theory, based on the assertion that "growth does not appear everywhere at the same time; it appears within some places or growth poles, with various intensities; it is diffused through diverse channels with varied final effects for the economy as a whole" (Perroux, 1964). Perroux was soon convinced of the unbalanced nature of growth and development, as well as of the importance of spatial dimensions, which was reflected in his concept of economic space, much more complex than the geonomic space of locations (Perroux, 1950). As a student and disciple of Schumpeter, he was also convinced of the importance of structural changes, and he attempted to break with the static logic of the economic circuit, applying the same toolbox to a universe in which the notion of space is introduced.

To the innovative entrepreneur figure, he then substituted the propulsive firm, which innovative function is not limited to challenge production structures, but also to modify its localized economic environment. Two categories of polarization effects derive from the introduction of innovations and the implementation of new investments by these firms; first, the economies of agglomeration, which encourage the regrouping of complementary activities within the same area, and second, linkages effects between the firms. The latter are the result of the lack of balance initiated by the propulsive firm, which uses its extra profits resulting from its innovation policy to reduce its costs and to control some complementary activities, in such a way that it becomes able to govern the development and the growth of firms which are technically linked to it.

The polarization process is mainly of a hierarchical type; the innovative activity of the propulsive firm should induce the development of all the firms located within its immediate environment through pecuniary and Marshallian externalities. Perroux's approach permanently refers to two types of polarization, through the market and non-market one. As a matter of fact, growth always results from the impulse given by a propulsive firm or industry, which, more certainly than the association of two or several firms, will give birth to a network of local polarization. His growth pole theory provides, at a regional level, a theoretical explanation of the industrial and spatial origins of local interactions. Logically, it has been taken over by the public authorities to make it the basis of the growth poles strategy, which constituted one of the pillars of the French planning policy during the 1950s and 1960s.

The analytical posterity of his research will prove immense (Thomas, 1975). In France, a whole series of approaches will follow, but the most fruitful is certainly the one initiated by Jacques Boudeville (1972) and his epigones, in terms of static and dynamic formalization of polarization relations. Boudeville, followed by several authors (Lantner, 1972), would extend and enrich Perroux's approach to concrete cases and especially give it very strong formal foundations, with the analysis of Input-Output relations and graph theory approach. These pioneering studies are the direct precursors of the current analyses of social networks; they lay their foundations by analysing polarization relationships at the local level on the basis of notions like hierarchy, density, connectivity or contiguity within and between groups of interconnected firms or sectors. Boudeville has been associated with geographers such as Beaujeu-Garnier and Pinchemel and has helped to convey François Perroux's ideas among them, while facilitating discussions on regional planning.

Philippe Pinchemel was close also to planners and architects, whom he admired deeply. From the beginning of his career, while teaching at the University of Lille (between 1954 and 1965), he taught for several years at the International Institute of Urban Planning of Brussels, then at the Institute of Urbanism of the University of Paris. At the same time, he sat on numerous bodies where he rubbed shoulders with practitioners, for example as Director of Studies for the *Institut Régional d'Etudes et d'Action Démographique de Lille* (1961–1965), member of the *Comité d'Expansion Régionale de Picardie* (1962–1965) or later as an associate member of the *Conseil Général des Ponts et Chaussées* (1971–1985). Above all, he contributed with his writings to develop an urban geography strongly supported by the analysis of structures and forms, from a perspective of spatial planning. His two books: *Le niveau optimal des villes, essai de définition d'après l'analyse des structures urbaines du Nord et du Pas de Calais* (Pinchemel, Vakili & Gozzi, 1959) and especially *Le fait urbain en France* (with Carrère & Pincheme,1963) testify his concern for a scientifically grounded geographical approach of the cities in their relations between them and with the territory, and by putting in methodological innovations partly inspired by American works. He developed a concept of "spatial

system" combining the processes of "humanisation" (transformation of the environment by societies exploiting the resources) and "spatialization" (organisation of relational space according to social norms) and suggested a set of five functionalities in the spatial organization of societies that are invariant across the world (appropriation, land use and production, habitat, networks and administration/governance).

Geographers have progressively embarked on what would become a "science of cities and territories," from a perspective of theoretical construction more inclusive and less formalization-oriented than what was tempted in economics. However, the theoretical advances of the period have sometimes led directly to planning applications. Thus, even if Christaller's theory of central places (1933) was at first received as an excessive attempt at formalization, it figured prominently in the urban geography textbook of Georges Chabot[1] and Jacqueline Beaujeu-Garnier (Beaujeu-Garnier & Chabot,1963), and nonetheless inspired research that Pierre George (although very hostile to quantification) piloted in the years 1950–1960 in all regions of France. The goal was to take classical regional geography out of its descriptive and monographic position of carefully delineating homogenous regions, and conversely testing the concept of polarized regions, according to the hypothesis: "It is no longer the region that makes the city, but the city that makes its region" (George, 1970). These important doctoral dissertations on regional "urban networks" paved the way for a major participation of geographers in land-use planning policies aimed at equipping *métropoles d'équilibre* to compensate for the excessive centralization pointed out by geographer Jean-François Gravier (1947) in his famous book *Paris and the French desert*. After a first report about the state of the urban hierarchy established by Etienne Juillard in 1963, it is especially the geographer Michel Rochefort and the engineer, Jean Hautreux, who submitted the final report implemented in 1964. The economist Claude Lacour evaluated and updated the description of the urban hierarchy in 1970 with the OTAM research center (quoted in Pumain & Saint-Julien, 1976,1978).

Jaqueline Beaujeu-Garnier (1965), who soon acquired great international reputation in geography, became involved in all fields of research that reflected the postwar world transformations: demographic revolution, urbanization, tourism, etc. She was the first woman in Franceto hold a PhD in Geography (awarded in 1947), the first woman geographer to become a university Professor and the first president of the Geographical Society of Paris (1983–1995). She first took up the challenge of the field, then considered as reserved for men. She co-ordinated teams of geographers for the realization of regional atlases (for instance, Beaujeu-Garnier & Bastié, 1967) that were at the time the most useful tools for regional planning. She soon became an interlocutor listened by national planning services, and was extremely appreciated by Paul Delouvrier, responsible for the development of the Paris region. More broadly, she defended the development of applied geography, while introducing in academic geography a wide range of new themes: food, industry, recreation, health, the elderly, scientific research, gender, etc.

Among the great antecedents who played an important role in the theoretical constructions of the French-speaking regional science, we must cite the historian Fernand Braudel, for his creative role as theorist as well as institutional. On the one hand, he conceptualized the concept of "world economy" (Braudel, 1967), which shows the formation over the long run of territories, made of strongly interacting cities supported on different geographical milieus and organized according to a center-periphery model. He insisted on the role of cities and capitalism's methods in the trade flows building and sustaining these territories. On the other hand, Fernand Braudel helped reducing the institutional barriers between disciplines, for instance in participating to the creation of the 6th section of the Ecole des Hautes Etudes subtitled "Economics, Societies, Civilizations." The consideration of a systemic functioning at world scale probably inspired the construction of the concept of "international division of labour" coined by the economist Philippe Aydalot (1976), to explain how and why the less innovative or knowledge intensive activities were relocating in regions and countries offering cheaper labour force.

But among all these "great ancestors," we must make a special place for the personality of the economist Claude Ponsard, who deliberately advocated the introduction of space in economic theories, while beginning to implement new methods that make these proposals applicable. His two books with explicit titles (Ponsard, 1955, 1958) are

[1]George Chabot had undertaken, as soon as 1931, to launch a national survey for designing a map: "les zones d'influence des villes françaises" (influence zones of French cities) that was published by the CNRS in 1961.

complemented by pioneering advances, whether for the study of the "functional distribution of jobs" (Cahen & Ponsard, 1963) to test the theory of the economic base of cities, or for the application of graph theory, especially transfer graphs, to the study of spatial interactions, or finally of the theory of fuzzy subsets to help mapping the uncertainty of the delimitations of regional influences. Although being an economist, Claude Ponsard had many aquaintances with geographers such as Philippe Pinchemel or Etienne Juillard and he left his imprint on the work of the future generation of geographers (such as Christiane Rolland-May).

2.1.2 | The Journals

The *Revue d'Economie Régionale et Urbaine* (RERU) or *Regional and Urban Economics Journal* was created in 1978, at the request of the CNRS (National Center of Scientific Research), to promote and disseminate French-language scientific productions related to the fields of regional economics, urban economics, and more generally of all the fields concerning regional science and spatial analysis. It came from the consolidation of several smaller spatial analysis journals, with the objective of confirming the presence of French research at the European and international levels and showing the interest and originality of its conceptual and methodological contributions. Since its creation, it has undergone two major phases of development, first under the leadership of Claude Lacour, its creator, and then André Torre since 2010.

Very quickly, the RERU became the preferred vehicle for francophone research in regional science, whether it was French, Belgian, Swiss or Quebec researchers, and then, in the 2010s, more and more researchers from the Maghreb and Francophone Africa. Since 2009 it is also the official journal of the ASRDLF, the French speaking section of ERSA (European Regional Science Association) and RSAI (Regional Science Association International). The contributions are mainly published in the fields of economics, geography, spatial planning, management, and disciplines such as sociology and marketing. They also give prominence to multi-disciplinary approaches and monitor progress in computational and mathematical methods. Finally, the journal takes part in the reflection on economic and public policies, at the different levels of competence of the regions and states.

Since its creation, the RERU has published numerous articles on practical cases, field studies and statistical and econometric approaches related to spatial analysis and geographic economy. Through its special issues, it has also made it possible to study in depth and to put on the agenda in the French-speaking debate recurring issues such as the study of the place and role of cities, the processes of peri-urbanization, the rural-urban link, the land use and real estate evolutions, the development of rural areas, the role of small and medium-size enterprises (SMEs) in local development, the local-global link, the European policies and their impact, or the rise of environmental issues and circular economy. Moreover, it is the main place of debate regarding the research carried out on the major themes of regional science, in particular French speaking ones. Thus, highly read and quoted special issues have been devoted to topics such as the analysis of innovative environments, local productive systems, approaches to proximity relations, or recent developments in spatial econometrics to take just a few examples.

L'Espace Géographique is a geographical journal created by Roger Brunet in 1972. It includes in its subtitle, alongside geography, territorial planning and the environment. The first issues devoted in-depth articles to theoretical and methodological reflection, or to the theme of the spatial organization, for example under the pen of Bernard Marchand, Sylvie Rimbert or Paul Claval. Many of the youngest members of the editorial board participated to the activities of ASRDLF and received the publications of RSA. Under the leadership of Antoine Bailly, the journal also undertook to publish a "regional science column" written by a team of four persons (Antoine Bailly, Hubert Béguin, Denise Pumain and Thérèse Saint-Julien) during the years 1980 to 1994, in which several major English-language journals of regional science and urban studies were subject of systematic reporting. This approach reflects the interest of geographers in contemporary developments of regional science and urban economics. The journal also regularly organized debates on theoretical issues and devoted one of these debates to the question: "New economic geography and geography: which dialogue?" in 2007. A more recent entirely electronic and open-access (diamond) journal, *Cybergeo*,

European Journal of Geography, was created in 1996 by Denise Pumain. The initial intention was to provide a support for publishing the papers presented at the European Colloquia in Theoretical and Quantitative Geography. Multilingual and offering a diversity of headlines for a generalist view of geography among neighboring disciplines, the production of the peer reviewed journal has grown exponentially and has become probably the most widely used geographical journal for French speaking regional scientists. It is the first French speaking journal in this area to offer headlines for publishing the model codes (GeOpenMod) and original datasets (Data Papers) according to an editorial policy for sharing a reproducible science. It has acquired an increasingly enlarged international audience (Raimbault et al., 2019).

2.2 | The Institutional context

Exchanges between regional science and planning research on the one hand and policy-makers on the other are important in many countries. But the case of France is original in this regard. Since the 1950s, economic and regional development policies have been marked by extremely strong interactions between the two worlds. From spatial planning policies to recent strategies of poles of competitiveness, back and forth between research, policies and foresight exercises are crucial and the recommendations of regional science experts are often experienced at the local level.

2.2.1 | The peculiar role of DATAR

At the heart of the French national spatial planning policy is the crucial role played by a particular institution, DATAR. The *Délégation à l'Aménagement du Territoire et à l'Action Régionale* (Regional Planning and Regional Action Delegation), was created in 1963 by General de Gaulle, then President of the Republic, The original aim was to prepare and co-ordinate the necessary elements for Government decisions on spatial planning and regional policy. Its role has evolved over time and at the whim of governments and reforms, but it has always allowed the expression of the voice of researchers, mostly French but sometimes foreign (like Roberto Camagni for example), by consulting them, including them in governance committees, or by involving them in various regional foresight exercises.

In a centralized country like France, DATAR was a very original tool, and for several decades it has played a key role in the implementation of public policies, or the setting of pilot operations at the territorial level (Lacour & Delamarre, 2003). It has been at the heart of the governmental organization of spatial planning, proposing agendas of actions discussed in the Council of Ministers but also carrying out very concrete actions at the level of the regions and territories, such as planning missions in certain regions (Languedoc-Roussillon, Corsica, Aquitaine) or interventions in territories in difficulty due to deindustrialization or rural exodus, for example. It can also be considered to have played a pioneering role in the preservation of the environment, the protection of biodiversity and the maintenance of local resources by promoting the creation of regional nature parks with a strong environmental vocation as early as the 1960s.

Today DATAR has been merged into a more important set (the *Commissariat Général à l'Egalité des Territoires*). But it remains the symbol of the desire for decentralization and interest in local dimensions on the part of a very centralized State that is unwilling to delegate its power to local authorities. In this respect, and beyond its concrete actions, DATAR has played a very important role in the invention of public policies and modes of intervention. It was manifested on several occasions by the presentation of scenarios for the future development of the French territories, some of which were presented as "unacceptable," and it embodied myths and dreams (progress, solidarity, local) which have made it possible to cement in French public opinion the idea of the importance and unavoidable character of its territories.

The DATAR has also been quite largely an instigator of institutionalized thinking on spatial planning in European Union (and this although the term territory does not appear in the treaties). After the Lisbon Treaty, the "Schéma de Développement de l'Espace Communautaire" (ESDP) was prepared by a European consortium involving many geographers of several countries (in France, the national focus group was piloted by the Géographie-cités laboratory). It was approved by the Informal Council of Ministers responsible for Spatial Planning in Potsdam in 1999. The ESDP aims at a balanced and sustainable spatial development of the territory for the regional policy of the European Union. A permanent observatory (ORATE or ESPON: European Spatial Planning Observation Network) has been created as a result of this decision and provides regular reports, whereas a dedicated research laboratory, RIATE, was created in France with support from DATAR under the direction of the geographer Claude Grasland.

2.2.2 | Strong and diverse Public policies

France has been a highly centralized country for centuries, with the state intervening in all areas of public life, even for example with regard to culture (Lucchini, 2002). This multi-secular centralization is the main explanation of the primacy of its capital, unique among the major industrialized countries, Paris has been concentrating for at least two centuries with a population approximately seven times larger than that of the second city. Since the reconstruction of the post-war period, the public authorities have embarked on a policy of political-administrative decentralization, which entered the law in 1982. But the new powers conferred on local and regional authorities have hardly changed the spatial distribution of populations and wealth and especially that of decision centres. The development policies of the DATAR, after those of industrial and then tertiary decentralization of the years 1960–1970, and that of the *métropoles d'équilibre* already cited, tried to revitalize the medium-sized cities, then the *pays* (corresponding to small agricultural regions), before yielding in the 1990s to the tendencies of metropolization relaunched by openness to globalization networks. However, these policies were hardly successful, they helped in diffusing modernization throughout the country but not much contributed to reduce the major territorial gaps, as for instance when the DATAR tried to organize networks of cities (*réseaux de villes*) for mitigating urban rivalries and encouraging co-operation in sharing equipment among second tier cities.

The taste of public authorities for polarization policies, which started with the growth pole policies inspired by Perroux and his disciples continues to be confirmed, even in the 2000s. In particular, local production systems strategy (*systèmes productifs locaux*), launched by DATAR in 1998, covered all French territories. This policy, strongly inspired by the research in terms of industrial districts and SPL, resulted in a system of logistical and financial support to selected networks of firms. Particularly oriented towards support for SMEs and medium-sized enterprises, its aim was to increase their productive performance, improve their human resources management and foster the development of innovation.

In 2009, DATAR launched the *grappes d'entreprises* or clusters strategy. The aim of this policy, devoted to interrelated small and medium-sized firms that co-operate with public and private actors in their territorial environment, is to support exemplary initiatives, which can play a training role on their local production system. Particular attention is given to sectors with low R&D activity or insufficient critical mass. The idea of competitiveness prevails, with the selected clusters being able to contribute to global French growth.

But the 2000s are marked above all by the implementation of the policy of poles of competitiveness (*poles de compétitivité*). The state is back in business, but with a much more place based industrial policy. This national strategy is supposed to guide the production and, above all, the innovation activities of many French firms through the implementation of an incentive policy (Longhi & Rainelli, 2016). Contrary to the growth pole policy, in this case the State is no longer the prime contractor or the site manager, but rather the initiator or facilitator of the initiatives. In addition, the sectoral logic of big projects gives way to a logic of spatial agglomeration of activities, with a central role of the territories and of the concentration of funding in devoted geographical areas. Finally, the competitiveness cluster policy is part of the EU's Lisbon strategy and therefore promotes knowledge-related activities.

This approach is based on a double analytical influence. On the one hand, it is the influence of cluster analysis, with its spatial dimension and the role played by the incentives of public authorities. This is expected to have an impact on the geographical spread of innovations and the transmission of knowledge. On the other hand, it is the research on endogenous growth theories that put innovation and R&D activities at the heart of the processes of growth of nations or local areas. But, while the bulk of the projects selected are devoted to industrial activities, the idea is to share high and medium technology between local actors. The weight put on spatial distribution is obvious, to the point that several SPL already labeled became poles of competitiveness, making blurred the separation between large and small structures, or between high and medium tech activities.

3 | MAJOR CONTRIBUTIONS IN REGIONAL SCIENCE/ECONOMY

Regional science approaches were very quickly echoed by economists, for two reasons. The first is linked to the legacy and posterity of François Perroux, who for a long time held a very peculiar place within French academia, including the existence of opposing streams of thought claimed for his legacy. The second stems from the long tradition of spatial planning. The public authorities started to use the competencies of various researchers for their development programs, including many economists. Very quickly the result was a series of works often very much related to the most productive, and industrial dimensions, although many of these researchers contributed to regional science "unknowingly" it could be said. From the 2000s, that research was being broadened and internationalized, and the awareness of taking part to larger groups of thought at the global level has developed. We choose to elaborate on three main contributions, mainly related to industrial or innovation economics.

3.1 | Local systems of production and innovation

Research into localized production systems has its origins in two categories of work. On the one hand, these are the works of French sociologists who pointed out the existence of "local industrial systems," in which they analysed in the first place and in a very detailed way local labour relations, without claiming to provide a systematic form to these localized systems (Ganne, 1983; Raveyre & Saglio, 1984). But the major influence was related to the work of Italian economists on Industrial Districts (Becattini, 1991; Brusco, 1982), who re-actualized Alfred Marshall's work. They studied the unexpected economic success and the ability to withstand the economic crisis of some regions of Italy, which would later be called the "Third Italy"; the latter owed its success and resilience to the spatial concentration of small firms, which were not all characterized by high technology.

Following and beyond the particular case of Third Italy, the French authors pointed out the existence of localized production systems (called SPL, or *systèmes productifs localisés*), which refer to a set of interdependent activities, technically and economically organized and territorially agglomerated (Benko & Lipietz, 1992). As for the industrial districts, the connection with a particular territory is always put forward, but the quasi-exclusive reference to small enterprises is abandoned, for the benefit of taking into account all large firms or subsidiaries situated in the territory. As a result, the family dimension and the importance of a local community generally take a back seat, while productive relations are not always informal, but, on the contrary, often rely on market or contractual links

A SPL is built on a wide variety of local actors: households, consumers as well as production actors or administrative staff; firms of all sizes and legal statuses; but also public authorities and local institutions such as Chambers of Commerce or local management bodies. Its structure is based on the intertwining and overlapping interactions between these close actors.

According to Courlet (2002) localized production systems share different common characteristics:

- they correspond to a homogeneous territory and house a specialized production system, if not on a single product, at least in a characteristic field of activity (mechanical, turning, clothing, footwear, aerospace);
- the products and techniques used are based on specific intangible factors of production (know-how, technical culture, entrepreneurship), historically constituted and territorially accumulated. However, many SPLs base their development on a specialization of production in advanced technologies (biotechnology, aerospace, microelectronics);
- the fields represented, the techniques used and the products produced are often compatible with the small size of the production units;
- interdependencies between local firms lead to the setting of co-operation and exchange networks in production and innovation;
- specific and flexible labour markets ensure the training of qualifications and the mobility of skills and know-how between enterprises;
- the development of joint collaborations and experiences leads to learning dynamics enabling actors to modify their behaviour in response to changes in the external environment and to find new solutions; and
- the interweaving between economic relations and social and symbolic relations is strong. Localized economic relations are understandable only in the context of the socio-economic context in which they take place.

Finally, according to Courlet and Pecqueur (2014), a SPL is based on a triangle linking a significant agglomeration of firms, a robust specialization of the latter and a set of specific characteristics such as distinctive competences, complementarity links and co-operation. This definition can be linked to Markusen's (1996) "sticky places" definition, which are characterized by their ability to attract and retain economic activities and their ability to adapt to changes in their environment and to overcome any periods of setback or uncertainty. Their attraction properties and their productive retention capabilities depend on particular internal organizational characteristics, are an essential component of their success and are largely the basis of their persistence and resilience.

It should be noted that these works and in particular the "label" SPL, have met such a success in France that they gave their name to a public policy, initiated by the State. The local production systems strategy was launched by DATAR in 1998, which initiated this approach across all French territories. Strongly inspired by approaches in terms of industrial districts and SPL, this policy was particularly oriented towards supporting SMEs and medium-sized enterprises. It resulted in a system of logistical and financial support to selected networks of firms, with the objective of increasing their productive performance, improve their human resources management and foster the development of innovation. It was later transformed into a *grappes d'entreprises* policy, always directed toward medium-sized structures.

3.2 | Milieus and innovative milieus

The notion of milieu comes from the work of a group of researchers called the GREMI (*Groupe Européen de Recherche sur les Milieux Innovateurs*), created in the 1980s around Philippe Aydalot (Aydalot, 1984; Maillat, Quévit, & Senn, 1993). Although it is mainly related to issues of territorial economy and development from below, it does not correspond to a precise category of localized production systems but rather refers to the cognitive block on which the functioning of these systems depends, in other words, the localized relational capital and innovation networks that characterize them. The GREMI group showed this by the completion of major surveys which made it possible to document the conditions for knowledge deployment at the local level.

The milieu is in a way the brain of the local production system, in the sense that it constitutes an aggregation of the action capacities and the cognitive faculties of the different actors. It will be called different names (anchoring or evaluators milieus, etc.), even if it is the notion of innovative milieu that became viral. Not all milieus are or are becoming innovative. Some are frankly inhibitors. It is assumed that the milieu is innovative when it is able to open

itself to the outside world and to collect the specific information and resources that the local production system attached to it needs to innovate, or when it generates processes capable of making the resources of the local production system usable for new techno-productive combination, giving priority to collective actions that help mobilize resources on long-term development projects.

Milieus do not encompass all the components of a region. These are groups of local actors, with a certain autonomy of decision (SMEs, local authorities, subsidiaries of large groups, training and research institutions, economic and political actors, etc.), which establish privileged competition/co-operation relations between them in order to develop technological and organizational products or solutions. Innovation networks are set between actors who do not have sufficient individual resources to innovate. These co-ordinated sets of heterogeneous professional actors (public laboratories, technical research centres, companies, etc.), collectively participate in the design, the development, the production and the dissemination of production processes, goods and services. This co-operative strategy, which is often organized in a sustainable way, allows both an improvement in creativity and a reduction in the risks and costs inherent to the innovation process (Camagni & Maillat, 2006; Maillat, 1995). In systems operated by innovative milieus, the latter is understood as a collective process, involving a set of formal and informal relationships within localized innovation networks. However, it is not only the result of endogenous dynamics, but also of interactions with the global world.

These innovation networks are based on trial and error and successive reorientations of the project. It is therefore crucial to be able to engage in the long run with trusted partners. The GREMI assumes that they are based on geographical proximity relationships. The innovative milieu then appears the appropriate context for their training and development because the participating agents share similar representations, quickly identify partners within them, exchange information, trust each other. It acts as a tool of intermediation, allowing actors to imagine and formulate their joint projects. More recently, the idea has emerged that consumers/users/citizens can also contribute to these networks and in turn bring economic value to local products.

As the years passed, the focus of the milieus approach to innovation issues has tended to weaken in favour of a diversification of the themes analysed and the idea that the mobility of people and factors of production–in particular, financial capital and knowledge—is an unsurpassable fact of contemporary economies. This mobility has an impact on the conditions of territorial development, which is no longer characterized by the development of knowledge on a local basis, but rather by the mobilization and anchoring of knowledge existing elsewhere (Kebir, Crevoisier, Costa, & Peyrache-Gadeau, 2017). It is on this basis that milieus can continue to perform and take advantage of this competitive advantage, mostly if they are able to use local skills in a globalized network of specialized and/or complementary skills, the territorial dynamics of knowledge becoming more and more combinatorial, and less cumulative (Crevoisier & Jeannerat, 2009). It is also fair to notice that this approach is challenged by the new definition of territory adopted by the French authors, which makes it a moving concept and first of all a lively system defined by the actions of local actors, as Lacour illustrates with his notion of "tectonics of territories Lacour, 1996."

3.3 | Proximity analysis

The French school of proximity built up in the filiation of works on local production systems (districts, SPL, milieus) and their interest in proximity relations. But it is also in response to these approaches, and in particular to the trend of the 1990s, which attributed very strong virtues to local interactions, in particular of a tacit or face-to-face nature. Very sceptical about this idea, the authors who published a first special issue of the RERU in 1993 on the subject (Bellet, Colletis, & Lung, 1993) also pay a very large debt to evolutionist and institutional economics analyses. Their strong interest in industrial relations and innovation (Rallet & Torre, 1995) lead them to carry out numerous empirical studies and develop an analytical corpus around different categories of proximity and their variations.

The basic of proximity approaches is to show that the relations and the interactions between economic actors, and most particularly between industrial and innovative firms rest on two main categories of proximity: geographical proximity and organized proximity.

Geographical proximity reflects the distance between two entities (individuals, organizations, cities), weighted by the temporal and monetary cost of its crossing. It has two essential properties. It is first of all of a binary type: there are infinite graduations but the analysis of geographical proximity has in the end the object to know if one is "far from" or "close to" another person or a given location. It is then doubly relative. First, the kilometric distance, which forms the basis of the division between geographical proximity and remoteness, is related to the means of transport, their cost and the topology of the places. Second, proximity is not just objective data. It is also a matter for individuals or groups to judge the nature of the geographical distance between them. And this perception varies according to age, social group, sex, and profession.

If authors like Boschma (2005), who were further inspired by this approach, go as far as counting four types of non-spatial proximities, the French scholars usually group them under the term of organized proximity, based on two logics (Torre & Rallet, 2005). The logic of belonging indicates the fact that two or several actors belong to the same graph of relations, or still to the same network of actors. The logic of similarity corresponds to the mental adherence to common categories, in low cognitive distance; it can involve people who recognize themselves in shared projects, or who share common values in terms of culture, religion. These relations of organized proximity allow to exchange knowledge and to work at a distance, by abolishing widely constraints of geographical proximity, and thus distance, in particular thanks to the development of the ICTs like internet, or social networks.

The multiplication of field studies and applied works realized on this basis then showed two main things:

- first of all geographical proximity cannot stand alone for the success of innovation activities at the local level and quite particularly in industrial clusters. Organized proximity is also necessary, and thus spatial concentration is not enough, quality interactions are also needed. For instance a cluster "that works" is based on the combination of the two types of proximities; and
- then, that remote work, co-ordination or collaboration between firms located at a distance, in particular innovative or knowledge economy firms, cannot be successful in the absence of spatial or geographical interactions. Even the members of the communities of practice spread all around the world need to know each other or to rely on a central organizer that comes to meet them on a regular basis. The development of technological projects led at a distance need preliminary onsite meetings, and also annual meetings where all the participants interact in the same place. The most important industrial conflicts can resolved only by means of face to face interactions, etc.

The authors have deduced that geographical proximity can be permanent or temporary. In the first case, it is the location nearby. In the second, it is the result of occasional meetings between actors, for example during a fair, a Congress, or as part of a business trip (Torre, 2008); they sometimes talk about temporary clusters. Space counts in a renewed way, which is that of temporary encounter. Temporary geographical proximity thus corresponds to the possibility of satisfying the need for face-to-face contacts through the displacement of actors between different locations. These mobilities, facilitated by the development of communication techniques, favoured the existence of moments of geographical Pproximity, whose duration may vary but which are always limited in time.

These analytical refinements have enabled proximity approaches to move beyond the strict initial industrial and innovation framework and address issues as diverse as sustainable development processes with land use conflict analysis, city formation, control over power and management relationships, and territorial development issues (Torre & Wallet, 2014). Today, however, these latter developments are limited to the French-speaking world, since the paternity and reputation of proximity approaches are most often linked, at the international level, to their interest in cluster relations or to the location and competitiveness of innovative firms.

4 | MAJOR CONTRIBUTIONS IN GEOGRAPHY

Geographers have not lost interest in the topics explored by the economists mentioned above for which they continued to complete many surveys. Besides, it is quite difficult to identify geographers' contributions to regional science, since its objectives are not clearly separated from those of geography, while focusing primarily the theoretical construction on economic principles. We choose here to mention the most formalized works in geography, partly inspired by the "theoretical and quantitative revolution" of the 1970s (Isnard et al. 1981; Cuyala, 2014; Pumain & Robic, 2002). Without making it an absolute rule, the most original contributions of francophone geographers to regional science over the past three decades have been on objects observed at larger scales than those just described above, namely, innovative milieus or local productive systems. Geographers were interested for instance in structuration of the whole world (Brunet, 1991), theorizing concepts such as "world-system" or systems of cities and large international networks. Whereas Pierre George had maintained his economic geography to the location of production and consumption within an *a priori* typology based on political economy (market economies, socialist and third world countries), Jean Gottmann (1961) and Claval (1962, 1968) soon invited to conceptualize new forms of regionalization at large scales based on spatial and economic interactions. However, it is in the domain of urban systems that major methodological advances were conceived by francophone geographers for modeling spatial interactions, interpreting spatial forms and simulating dynamic models.

4.1 | Regional development and global scale

On the question of regional development, the originality of French-speaking geographers is mostly in rejecting the theories of the equilibrium and convergence of mainstream economic theories and in the affirmation of an open centre-periphery dynamics which often tend to increase inequalities. In this sense they join the propositions of Camagni (1999) who bases the territorial and urban dynamics on the notion of unequal exchange. Their contribution consists for example in reformulating the nomenclature of the divisions of labour according to a Marxian theory (Beckouche & Damette, 1993), or to highlight the plurality of the causes of under development and of models of development (Lacoste, 1968, 1980). An illustration of new economic principles and their territorial consequences is given in the book written by a geographer and an economist: The regulation's principles of institutional economics articulated by Robert Boyer (who conceives production structures as forms of co-ordination and conflict resolution) have been confronted with the reorganization of the post-industrial economy (post-Fordism, post-modernism) and the multiplication of global networks to interpret the mosaic of inequalities of development in the synthesis work published by Benko and Lipietz in 1992. In general, geographers have paid more attention than economists to the social processes associated with territorial inequalities in income and development. The "social geography" launched by Frémont (Frémont, Chevalier, Hérin, & Renard, 1984) has sparked a great deal of work on the strategies of territorial actors, land-use conflicts, as well as the effects of territoriality in "lived spaces" (Frémont, 1976). The processes of globalization studied at all scales have recently been analysed "from below" in a book on the practices of the poorest peoples facing the networks of globalization (Choplin & Pliez, 2018).

In line with the best ambition of geography for "covering the world" (Robic, Mendibil, Gosme, Orain, & Tissier, 2006) the geographers in the 1990s have proposed several new descriptions of the spatial organization and regionalization at world scale based on classical geographical knowledge revisited through the results of theoretical and quantitative geography. Roger Brunet and Olivier Dollfuss signed with a significant contribution by François Durand-Dastès the first book of the "Géographie Universelle" in twenty volumes published by Hachette and the GIP RECLUS in 1991. The title of this first volume: "New Worlds," clearly identifies a process oriented vision of geography that emphasizes a wide variety of ways for partitioning the world and explaining the diversity of its features. A series of atlases were produced that have changed the classical geographical approach by proposing a rational hierarchy of explanatory factors that interact in generating regional inequalities and differences. These analyses brought up

essential information and provided help for decision makers (for instance, Didelon, Grasland, & Richard, 2008), before the generalization of the geographical information systems and the recent revolution of big data deeply modified the available tools for urban and regional planning.

Geographers talk about the world by mobilizing a wide variety of criteria to explain the diversity of regions and territories. Specialized journals maintain an unflagging vigilance in focusing their attention on specific territorial processes, as for instance the effects of domination in relationships, such as the journal of geopolitics *Hérodote* founded by Yves Lacoste in 1976, or the cultural aspects of territorial identities like the journal *Geography and Culture* founded by Paul Claval in 1992. Until now regional science did not consider much each of these dimensions, but other research directions followed by geographers could be as well of immediate interest for them, as for instance studies about territorial discontinuities (Grasland, 2008; von Hirschhausen, 2017) or the various ways of considering the process leading to the territorial integration of Europe (Marreï & Richard, 2018; Richard & Van Hamme, 2013).

4.2 | Urban systems and complexity

It is in the field of urban geography that the contributions to French and international regional science are most clearly identifiable. After a few pioneer works in formalizing urban networks (for instance, Beguin, 1979), geographers have developed a multi-scalar concept of urban systems, going much further, in the formulation and formalization, than the famous "cities as systems within systems of cities" proposed by Brian Berry in 1964. Based on comparative research on the economic structures and the demographic evolution of the French cities, progressively extended to Europe and other regions of the world, they elaborated an evolutionary theory of urban systems (Pumain, 1997). It first relied on multivariate statistical analyses highlighting both the relatively long stability of the functional structure of the urban system and the parallelism of the temporal trajectories of cities in the socio-economic space. The major differentiation of economic profiles can be related to historical waves of urban specialization whereas the common trajectories reflect the rapid speed of their adjustments to current innovations and their ability to adapt (Baudet-Michel, 2001; Cattan, 1992; Paulus, 2004; Pumain & Saint-Julien, 1976; Rozenblat, 1992). The new concept of *co-evolution of economic profiles of cities* under the process of hierarchical diffusion of innovation waves coined by Hägerstrand (1952) is at the core of this evolutionary theory of urban systems.

This evolutionary theory also contributed to considerably enrich the lengthy discussions about Zipf's law and the distribution of growth process within systems of cities by connecting them to economic transformations that are a major driving force of urban growth (Favaro & Pumain, 2011). Geographers also were keen at emphasizing the importance of an appropriate consideration of the construction of urban data (Moriconi-Ebrard, 1994; Bretagnolle, Mathian, Pumain & Rozenblat, 2000), especially when they are used for testing models, which often cause the apparent contradictions in research results among many authors (see for instance, Cottineau, 2017). In the same line French geographers have suggested an interpretation of urban scaling laws (as introduced by West and Bettencourt) that goes beyond the highly formalized but not so well adapted explanatory frame proposed by physicists (Finance, 2016; Pumain, Paulus, Vacchiani, & Lobo, 2006). Entirely new visions of systems of cities using more or less formalized but comparable descriptions of their hierarchical and functional structures and evolution have been made for all parts of the world (Cattan, 2007; Dureau, Dupont, Lelièvre, Lévy, & Lulle, 2000; Pumain et al., 2015; Rozenblat, Pumain, & Velasquez, 2018).

Geographers were very soon interested by the developing science of complex systems (Dauphiné, 2003; Banos, 2013). They have experimented new tools for modelling and predicting land use changes at different scales of analysis as cellular automata, especially in Belgium and the Netherlands (Engelen, White, Uljee, & Drazan, 1995), even by developing a dedicated software named Spacelle (Guermond, 2005) or using multi-agent systems for simulating diffusion processes (Daudé, 2004). Many solutions for improving the modeling methods in spatial analysis and spatio-temporal processes have been proposed (Mathian & Sanders, 2014; Sanders, 2001). Among the most continuous efforts in theoretical building with the help of modelling is through introducing in urban studies dedicated dynamic

simulation models. They were conceived for reconstructing the properties of systems of cities at macro-scale and the evolutionary demographic and economic trajectories of cities from their various spatial and economic interactions. Models using systems of non-linear equations were first tested, applying principles of self-organization and synergetics (Pumain, Saint-Julien, & Sanders, 1989; Sanders, 1992). But this mathematical formalism was not flexible enough to represent the variety of types of spatial interaction thus it was completed by agent-based computer modeling (Pumain & Sanders, 2013). In 1996 a first publication about the Simpop model enabled translation and ing of theoretical principles with a computer program that simulated the emergence of an urban hierarchy in a functionally differentiating system of settlements over a 2000 year period (Bura, Guérin-Pace, Mathian, Pumain, & Sanders, 1996; Sanders, Pumain, Mathian, Guérin-Pace, & Bura, 1997). Another model of the Simpop series was applied to the evolution of European cities (Sanders, Favaro, Glisse, Mathian, & Pumain, 2007). Trajectories of cities could be reconstructed via such simulation models on the very long term for systems of cities as different as Europe and United States (Bretagnolle & Pumain, 2010) and all countries of the former Soviet Union (Cottineau, 2014). The last developments of these investigations were accompanied by the construction of a simulation platform named OpenMole (Reuillon, Leclaire, & Rey Coyrehourcq, 2013) that enables social scientists to use evolutionary algorithms and distributed intensive computing for a much more efficient and secure validation of the simulation results (Pumain & Reuillon, 2017; Schmitt, Rey-Coyrehourcq, Reuillon, & Pumain, 2015). Theoretical hypothesis of a simulation model can thus be tested to determine if they are not only *sufficient* to produce the desired stylized facts to be reproduced but as well *necessary*.

Other important improvements to regional science have come from networks analysis at large scale. The major contribution of French geographers and computer scientists in this domain is both methodological and theoretical. They have built new methods for exploring and visualizing the internal structure of very large spatial networks by identifying a hierarchy of levels of connectedness within them (Rozenblat & Melançon, 2013). This was of great help for demonstrating the important effect of proximity in the design of global flows of air passengers or in networks of multinational firms whose subsidiaries are still mostly organized in "small worlds" according to their locations by continent (Rozenblat, 2015). Moreover, Céline Rozenblat succeeded in "opening the black box" of agglomeration economies by analysing the networks of ownership linkages between firms inside the large urban metropolises (Rozenblat, 2010). She was able to propose an extended alternative for avoiding the theoretical and methodological biases that weaken the quality of results in the GAWC line of research (Rozenblat & Pumain, 2007).

5 | CROSSED EXPLORATIONS AND INVOLVEMENT OF OTHER SOCIAL SCIENCES

In many domains of regional science the frontiers between disciplines were crossed so many times that it is less easy to disentangle which is mainly responsible for contributions on certain research topics. This seems to be the case for French speaking research on the spatial organization and processes inside cities and for investigations related to the role and strategies of actors in territorial governance. In these two cases, not only does the research rely on cross-influences from economics and geography, but it also involves other contributions, coming from sociology, history, management science or political science. Many scientists invoke the necessity of multi-disciplinary collaborations in the building of the "science of territories" (Beckouche, Grasland, Guérin-Pace, & Moisseron, 2012).

5.1 | Research on intra-urban organization and mobility

A rich field of research on social organization within cities and representations of urban space was continuously developed. Thorough investigations in urban ecology using multivariate analysis were conducted in the late 1960s,

for instance by Jean-Bernard Racine (1971) in Montréal (and Henri Reymond (Racine & Reymond, 1973) in Sherbrooke. Both contributed to generalize the new nomothetic approach authorized by quantitative methods and developed theoretical generic principles for geography (Isnard, Racine & Reymond, 1981). The latter especially used gravity models for representing inter-urban spatial interactions (Reymond, 1974). Other geographers also took inspiration from the USA or from Quebec for developing analysis of the perception of urban space, as Antoine Bailly (1974), whereas Sylvie Rimbert (1973) provided original reflection on urban landscape. Pioneer of the use of remote sensing methods and automated cartography, she also anticipated the use of models for constructing the theoretical knowledge in urban geography (Rimbert, 1990), Another cartographer, Colette Cauvin developed new insights in distinguishing between perception and cognition in urban representations and using Waldo Tobler's method for interpreting the human and social concept of urban space (Cauvin, 1984, 1999).

Economists and geographers collaborated for building models of urban morphologies under equilibrium constraints, as in a group formed by Pierre Henri Derycke, Jean-Marie Huriot and Dominique Peeters, or Jacques Thisse and his team on spatial competition and agglomeration economies. However, recent investigations have led to propose introducing some complex processes in those models at equilibrium, as for instance by Geoffrey Caruso and Remy Lemoy in Luxembourg University renormalizing the distribution of intra-urban densities (Lemoy & Caruso, 2018). A few scholars also developed land rent theory, with contributions coming from different perspectives and cross explorations: it encompasses planning theory and practice (Paul Lacaze), public finance (V. Renard), economic-marxist perspective (Lipiez), land economics (Derycke, Sallez and Granelle), and political science (Guigou, 1982).

Many efforts have been devoted to applying fractal models for the description of spatial urban forms. The pioneer work by Pierre Frankhauser (1994) has been considerably developed and enriched by Cécile Tannier (2017) who participated in the elaboration of the dedicated software Fractalyse, and the Belgian geographer Isabelle Thomas who undertook international and multiscale comparisons of fractal measurements (Tannier, Thomas, Vuidel, & Frankhauser, 2011; Thomas & Frankhauser, 2013; Thomas, Frankhauser, & Biernacki, 2008). Fractal models are a reasonable alternative to previous models based on densities for describing the strong slopes of intra-urban gradients in land prices, intensity of land use or the unequal presence of service activities, technical networks, firms and residents (Guérois & Pumain, 2008). They enable to compare urban processes with similar types of self-organized principles in complex systems.

Last but not least, studies in urban mobility, and their interactions with the spatial organization of urban landscape as in LUTI models have probably been the widest field where specialists of different disciplines (economists, geographers, sociologists, engineers) have interacted and collaborated for theoretical as well as applied research. The Laboratoire d'Economie des transports (LET) in Lyon is a major centre with works from Alain Bonnafous on estimated urban transportation costs (Bonnafous & Masson, 2003), Charles Raux on urban pricings (Raux & Souche, 2004), Yves Crozet on mobility invariants (Crozet & Joly, 2004) that are among the most representative contributions. But geographers as Jean Philippe Antoni and Cécile Tannier in the THEMA laboratory in Besançon on LUTI models as well as Cyrille Genre-Grandpierre in Avignon denunciating the perverse effects of speed acceleration on urban sprawl also have marked advances in the general knowledge of urban mobility. This without mentioning the numerous contributions on urban rural-relations and peri-urbanization processes that are a “grand classique” among geographers (Roncayolo, 1990) that was recently rediscovered by economists, especially at the INRA laboratories.

5.2 | Territorial governance and territorial development

The Millennial analyses devote a peculiar attention to the question of governance, as well as its role in a renewed conception of the processes of territorial development. They are inspired in the first place by the reflections of authors such as Foucault on this notion and its declensions. While the idea of government refers to a top-down and binding hierarchy, the idea of governance refers to more flexible forms of power, with a co-ordination of actors,

social groups and institutions in order to achieve common objectives (Le Galès, 2014). This notion, which conditions an increasing involvement of the actors, points to a context of increasing differentiation (and empowerment) of the society and the multiplication of stakeholders (Pasquier, 2012). Actors move from a pyramidal or hierarchical organization, based on public institutions, to more network-based relations involving different stakeholders (Pierre, 2000) and using multiple territorial levels, such as multi-level governance (Hooghe & Marks, 2001).

These changes have an impact on local dynamics and lead to the consideration of territorial governance processes (Chia, Torre, & Rey-Valette, 2008; Leloup, Moyart, & Pecqueur, 2005; Leroux, 2006). The authors define it as a process of co-ordination between stakeholders or actors of different types (productive, associative, individual, public or local authorities), with asymmetrical resources, brought together around territorial issues and contributing with the help of appropriate tools and structures to the sometimes concerted and sometimes conflicting development of joint projects for territorial development (Torre & Traversac, 2011). Territorial governance meets a number of objectives: to contribute to the preparation or implementation of development projects; to facilitate co-ordination between stakeholders; to prevent certain actors from leaving the territory (desertification or abandonment); to avoid blocking clashes and decide development paths.

There is a certain consensus on the need for the participation of the actors in the debates or in the decision about development projects. Concertation creates conditions for co-operation, for example around the collective design of a project or the planning of uses of a resource or a landscape (Beuret & Cadoret, 2010), and it contributes to the construction of projects. But beware of the idyllic vision of purely collaborative and deliberative governance. Indeed, its functioning can be difficult, and also rely on asymmetric relations and oppositions. Obstacles remain and the success of the territorial negotiation process depends on two preconditions: the acceptance of the rules of the game by the actors, who can leave the party rather than adhere to a joint project (Tiebout, 1956) or choose not to speak out and act outside the governance devices, as well as the designation of the representatives who discuss and implement the territorial projects and the development process.

Research shows that taking the conflict dimension into account is essential in land use planning, regional development or territorial governance processes. While land use conflicts are often referred to as obstacles to "good" governance, contemporary French authors rather consider them as participating in this process. They play their part in the acceptance or rejection of decisions taken by different categories of actors, in particular public authorities or large companies, and they are the expression of resistance and opposition to certain decisions that leave some of the local population dissatisfied (Darly & Torre, 2013). In addition to co-operation, conflicts thus represent the other way to enter into discussion on the issues and paths of territorial development because their protagonists can hope to influence decisions by taking part in the process from which they were excluded or by changing the technical modalities, even, more radically, by rejecting them.

Some innovations or novelties—infrastructures, land use choices, governance structures—give rise to more or less important oppositions. In the course of the conflict, innovations arise, whether social and organizational (setting up new groups of actors), institutional (new norms or regulations) or technical (new productive solutions). Some of the proposals are rejected, but others are amended and improved by this collective learning process. Territorial governance thus can be viewed as an interaction between forces that push for co-operation and others for conflict. Each novelty can thus meet three solutions: rejection, modification of the technical or organizational dimensions of the project, or acceptance in the form initially proposed, in an approach strongly inspired by the Hirshmanian tryptic; exit, voice and loyalty.

The result is a reconsideration and broadening of the analysis of territorial development processes (Torre, 2015). If they are based on technological and organizational innovation drivers, as has been pointed out for a long time by approaches to local productive systems for example, they are also based on innovations of a completely different nature, social and institutional ones. The latter are strongly linked to governance processes and point out the importance of the role played by the different stakeholders and the local society in these territorial dynamics. In parallel, while territorial development is generally associated with co-operative processes and complementarities of all kinds, these approaches also highlight the importance of conflicting processes, which play the role of trial and errors of

novelties coming from the outside. By doing so they provide with a theoretical explanation of some of the roots of the geography of discontent.

6 | CONCLUSION

We would first like to thank Roberta Capello and Roberto Camagni for having asked us and given the opportunity to write this review about French-speaking regional science, trying to highlight its originality. The exercise was undoubtedly frustrating and difficult, as the scientific production is immense, and its borders blurred. As a result, this work is probably flawed, and we ask all those whom we would not have cited to forgive the inevitable mistakes or omissions we may have made. However, the exercise was also very stimulating, and we hope its result is fruitful, in that it shows intense creativity and many interactions in the field.

We could risk an apparent old-fashioned geographical determinism (in fact it is rather a cultural idiosyncrasy following a political-historical sequence, or path-dependence effect) if we argue that the main originality is probably to reveal a multi-scalar attachment to the territory. This would be a first distinctive mark for French regional science, in its scientific and institutional dimensions. France is the only European country that has kept the administrative division of its territory unchanged since more than two centuries (i.e. 36,000 municipalities, inherited from the Middle Ages), while having developed one of the two major European capitals which is also a "global" city. Without going as far in planning and territorial regulations as more densely populated countries (such as the Netherlands), France has maintained at least since the 12th century in its institutions a strong tradition of territorial planning and helped to build it at a European scale. This collective feeling of the lived space may have influenced the interest of many economists and geographers to participate in the numerous local and national consultations and encourage them to participate in the construction of the fundamentals of a science of the territories.

This close interweaving of fundamental research and its applications is among the proponents of the various disciplines involved, mainly economics and geography, whose contributions we have traced in more details but to which history, sociology, management science, social psychology, environmentalists, engineering, philosophy and many other disciplines, as well as urban and regional planning practitioners, have also provided essential elements. The relative narrowness of the research groups and their relative confinement in the French-speaking linguistic sphere, compared to the United States, probably explain this porosity between disciplines, and the intense participation of specialists from other countries sharing the same language, as Belgium, Switzerland, Quebec or African countries, whose contributions should be valued far more widely than we have been able to do in this limited-dimensional paper.

Another possible originality of this research can be seen in an integration, perhaps stronger than elsewhere, of the historical and political dimensions of the territories in economic and geographical theoretical constructions, which often brings a critical discussion even in the most formalized contributions. This may hopefully mean opportunities for greater openness to participatory governance issues in the coming ecological transition and integration of technological innovations into the future organization of cities and territories.

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