

Iritié, B. G. Jean Jacques

Working Paper

Economic issues of innovation clusters-based industrial policy : a critical overview

LADEG Working Paper, No. 002/2015

Suggested Citation: Iritié, B. G. Jean Jacques (2016) : Economic issues of innovation clusters-based industrial policy : a critical overview, LADEG Working Paper, No. 002/2015, ZBW - Deutsche Zentralbibliothek für Wirtschaftswissenschaften, Leibniz-Informationszentrum Wirtschaft, Kiel und Hamburg

This Version is available at:

<https://hdl.handle.net/10419/142746>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Economic issues of innovation clusters-based industrial policy : a critical overview

B. G. Jean Jacques Iritié¹

First draft : march 13, 2013

version 2: march 7, 2014

this version : june 30, 2016

(Revised and expanded version of LADEG Working Paper No. 002-2015)

1. Department of Management, Business and Applied Economics, National Polytechnic Institute Félix HOUPHOUET BOIGNY (INP-HB), B.P. 1093 Yamoussoukro, Côte d'Ivoire. (✉) jeanjacques.iritie@gmail.com. (☎) +225 5967-2812/+225 5890 7571. The paper is a revised and an expanded version of the chapter one intituled '*Politique industrielle basée sur les clusters R&D: cas des pôles de compétitivité*' of my PhD thesis submitted at the Faculty of Economics of University of Grenoble (France). I acknowledge Professors Eric Avenel and Daniel Llerena for very precious comments. However, the remaining deficiencies are my responsibility.

Abstract

Criticisms *vis-à-vis* cluster policy are numerous, often confusing and really unhelpful ; while some authors systematically question the merits, others on the contrary play a genuine role of counsel in his favour. This paper attempts to refocus the debate and analyses the economic issues, impacts and implications of the innovation clusters policy. To do this, we take a critical view of the literature on clusters, focusing on analysis of the effects of three industrial dynamics in perpetual movement within clusters, especially research and development, industrial location and technology cooperation. We assume that innovation cluster "potentiates", by a synergistic action, the beneficial effect of each of these three industrial dynamics in favour of localised firms. However, it appears from the analysis that the hopes and expectations invested in cluster policy must be reconsidered and relativised. So the reasons for the rising power of cluster policies must be sought elsewhere than in a necessarily consensual and tangible evidence of positive impacts of clusters.

Keywords : cluster ; innovation ; competitiveness pole ; research and development ; industrial location ; technology cooperation ; localised knowledge spillovers ; LKS ; epistemic communities.

JEL Classification : O25, O30, R10.

0.1 Introduction

The early 2000s was marked by a slowdown in the French economy and a loss of competitiveness; French industry is facing strong international competition : price competition in activities with labour-intensive but also strong competition in technology-intensive sectors ([Datar, 2004](#)). These results in companies relocating to countries with low-costs production and job losses in the industrial sector. Meanwhile, French industry is also facing the changes in the international industrial organisation; indeed, we are witnessing the emergence of new forms of industrial organisation based on knowledge economy and innovation. In this less optimistic environment, the Datar¹ suggests to decision-makers to initiate a new industrial policy based on territories; this appeal was reinforced by the conclusions of the report of the Deputy Crhistian Blanc²; then the new industrial policy called "competitiveness pole" (or French innovation cluster) has been launched in 2004; it is a research and development - oriented cluster model. Here the importance given to territory is based on the idea it facilitates the coupling between innovation, research and industry, therefore brings together various stakeholders and gives more competitiveness, jobs and growth.

With this new industrial policy, France has taken a position as part of the European strategy Lisbon 2000 which aimed to make the European economy the most competitive and dynamic knowledge economy in 2010³. Throughout Europe, many countries also choose innovation clus-

1. The Datar is founded in 1963; it is the former French administration responsible for preparing and coordinating the implementation of regional policies. Since january 1, 2006, it has become Diact (Inter-ministerial delegation for the development and competitiveness of the territories) ([Diact, 2009](#)).

2. Blanc, C. (2004) : Pour un écosystème de la croissance. Rapport au Premier Ministre. Assemblée Nationale.

3. Despite the failure of the Lisbon strategy in 2010, the issue of innovation remains central to European industrial policy with the strategy Europe 2020

ters as pivotal actors of their industrial strategies ; for example, the Basque clusters in Spain specialised in household appliances and automobiles, the German Kompetenznetze which are particularly active competence networks in high-tech sectors such as biotechnology and nanotechnology, the Medicon Valley which is a successful model of cooperation between Denmark and Sweden in biotechnology and pharmaceuticals, the Italian technology districts. In France, there are several competitiveness poles covering various fields including electronics, ICT, health, renewable energy, transportation. When the policy was launched, a competitiveness pole has been defined as :

The combination on a given territory, of companies, training centres and public and private research units engaged in a partnership in order to create synergies around common innovative projects ([Marcon, 2008](#), Quote translated from French).

The basic idea of competitiveness poles is to foster cooperation between local business networks, territory skills and innovation in order to create an innovative milieu in which collaborative R&D projects are central. However, since the failure of the doctrine of growth pole based on a diffusion process from one centre to the periphery ([Perroux, 1957](#)), planning policies of territories aim a twofold objective : regional growth and strengthening of territorial equity or cohesion⁴ ([Markusen, 1996](#)). The main idea is to avoid the concentration of activities in some rich regions and help the declining ones. But on the contrary the policy of competitiveness poles encourages the clustering of activities in order to improve firms productivity and competitiveness ; so, as argued [Duranton et al. \(2008\)](#), we move from a territorial equity purpose to an economic efficiency purpose supported by public interventions. Then cluster policy raises

4. In fact, in Article 174 of the Treaty on the Functioning of the European Union (TFEU), the European Union adopted the principle of territorial cohesion which complements economic and social cohesion. Territorial cohesion aims at reducing both disparities between the development levels of regions and backwardness of less favoured regions. In this context, Member States implement their own policy of reducing inequalities. Interested readers can see [Davezies \(2002\)](#) and [Jouen \(2008\)](#).

debates around the issue of arbitration between economic efficiency and territorial equity⁵, but also about other issues more or less debated in the economic literature : the problem of definition and theoretical position of cluster concept (see e.g [Martin and Sunley, 2003](#); [Desrochers and Sautet, 2004](#); [Howells, 2005](#); [Wolman and Hincapie, 2015](#)), the role of governments in its implementation and promotion (see e.g [Cooke, 2001](#); [Wolfe and Gertler, 2004](#); [Desrochers and Sautet, 2004](#); [Fromhold-Eisebith and Eisebith, 2005](#); [Ketels and Memedovic, 2008](#)), the coordination and interaction of clusterised actors (see e.g [Mendez, 2008](#); [Bocquet and Mothe, 2009](#); [Plunket and Torre, 2009](#); [Ben Letaifa and Rabeau, 2013](#)), the clusters impacts on firms innovativeness, competitiveness and economic growth (see e.g [Baptista and Swann, 1998](#); [Maine et al., 2010](#); [Falck et al., 2010](#); [Wolman and Hincapie, 2015](#)), etc.

Criticisms *vis-à-vis* cluster policy are numerous, often confusing and really unhelpful ; while some authors systematically question the merits, others on the contrary play a genuine role of counsel in his favour. This paper is far from a plea or fierce opposition to the cluster policy ; rather, it attempts to refocus the debate and analyses the economic issues, impacts and implications of the innovation clusters policy from the experience of French clusters. To do this, we take a critical view of the literature on clusters, focusing on analysis of effects of three industrial dynamics in perpetual movement within clusters, especially (1) research and development (R&D), (2) industrial location and (3) technology cooperation. Indeed, for us, analysis of issues,

5. Studies on regional development have highlighted a conflict between regional equity (i.e egalitarian distribution of income per capita between regions) and economic efficiency (i.e increase production or national income) ([Martin, 2008](#)). The idea is that there is a trade-off between equity and efficiency ; in other words the national income growth rate decreases when the level of regional equity exceeds some socially acceptable level. However, the work of [Alexiadis and Eleftheriou \(2011\)](#) with the 51 states of the United States shows that economic efficiency can be achieved simultaneously with a low level of inter-regional inequality ; so there could exist a complementarity between the two objectives.

motivations and speeches related to cluster policies shows that these collaborative structures can be considered and modelled as the junction of the three spheres of industrial activity (see following Figure 1).

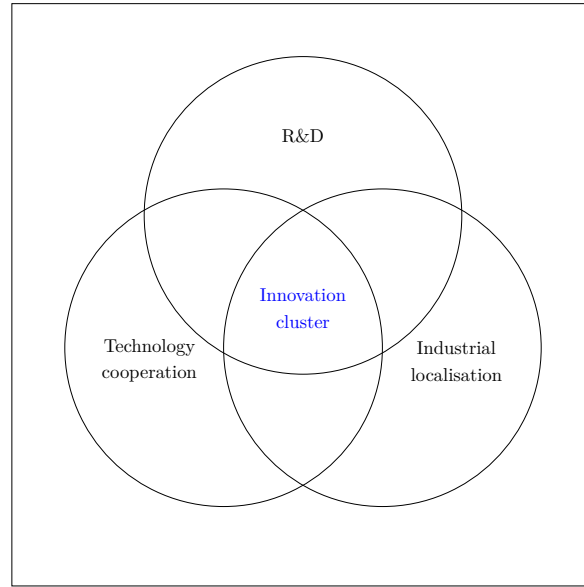


FIGURE 1 – Three industrial dynamics inside innovation cluster

In economic literature, research and development activities go hand in hand with creation of new knowledge, innovation, competitiveness and long term economic growth ; industrial location movements are justified by the opportunity of increasing returns and specially by the presence of localised knowledge spillovers (henceforth LKS) for innovative industries ; finally technology cooperation agreements aim generally the exploitation of complementarities and commonalities (i.e. co-development) and risk sharing between businesses. All economic gains resulting from the combination of contributions of the three industrial dynamics in perpetual motion within clusters are supposed greatly benefit to stakeholders, promote the development of the cluster and so participate in industrial and economic development ; otherwise, we assume that innovation

cluster potentiates, by a synergistic action, the beneficial effect of each of these three industrial dynamics in favour of localised firms ; each should see its effect in favour of firms strengthened by the presence of clusters. However, our critical review of the literature shows that the hopes and expectations invested in innovation cluster policy must be reconsidered and relativised. Indeed, the literature remains contrasted and fuzzy about the real impact of clusters on employment and economic growth, on the contribution of localised knowledge spillovers to firms activities and finally on the performance of technology cooperation agreements. So the reasons for the rising power of cluster policies must be sought elsewhere than in a necessarily consensual and tangible evidence of positive impacts of clusters. This paper has the merit to discuss in a critical manner the issue of cluster effects without falling into passion or non-constructive approach.

The rest of the paper is organised as follows. Section 0.2 focusses on R&D, i.e the critical analysis of cluster impacts on firms' innovativeness and employment rate and growth ; Section 0.3 discusses the arguments of the location of innovative activities and their effects due to clusters ; Section 0.4 is devoted to the analysis of technological cooperation within the clusters. Section 0.5 concludes the paper.

0.2 R&D, clusters and economic growth

The political discourse related to clusters policy shows the willingness of policy-makers to rely on innovation to create growth. Not surprisingly, it is now well-accepted that innovation is the cost to stay on the market for firms and the main engine of economic growth ([Kline](#)

and Rosenberg, 1986; Solow, 1956; Romer, 1986). As an example, recent empirical findings on relationship between innovation and economic growth have showed that reducing technology gap compared with advanced countries has been the main driver of the rapid growth and development of China (Wu, 2010), Eastern Europe (Petrariu et al., 2013) and South Korea (Hu, 2015). To achieve this, the process of technological catching-up in such countries has required significant investment efforts in R&D and in other activities enhancing their technology capacities. No one doubts about the importance of innovation; but today what attracts the curiosity of scientists is the global trend towards the concentration of innovation activities within the territorial spaces, as if to obey to the natural propensity of innovations to clusterise that Debresson (1989) talked about in his paper untitled "*Breeding innovation clusters : a source of dynamic development*". The region is thus treated as "an area of competitiveness" in a world that is paradoxically more globalised (Bristow, 2010).

The reduction of regional disparities has always been central to issues related to regional development. Originally reflections, neoclassical theorists have treated innovation as an exogenous factor of production, a public good other than "capital stock" and "labour", independent of location and whose contribution to growth and long-term economic convergence would be very important. In other words, they predicted that spatial disparity will be reduced over time. Yet there has not been convergence towards an economic optimum, so disparities continue to increase among regions. This is explained among others by the geographical heterogeneity of technical progress and the required time for technology diffusion (Pike et al., 2006). Indeed, endogenous growth theories led by Romer (1986) and schumpeterian economists believe that

innovation has local characteristics ; in other words, the persistence of disparities in regional development depends on the ability of regions to generate their own technologies, learn and adapt external ones⁶. It is in the resurgence of the region as a level of competitive economic organisation that clusters emerged as a new way to incite industrial innovation for local development and economic growth.

The origin of the cluster concept is often indissociable to the competitive advantage theory (developed in the 1990s by Michael Porter to explain the successful Silicon Valley in the United States). [Porter \(2000\)](#) defined clusters as follows :

”Clusters are geographic concentrations of interconnected companies, specialized suppliers, services providers, firm in related industries, and associated institutions (e.g., universities, standard agencies, trade associations) in a particular field that compete but also cooperate”.

According to Porter, the cluster is a conceptual framework for understanding the drivers of competitiveness of regions and nations. By proximity and interactions, cluster appears as a local source of competitive advantage for companies. [Porter \(2000\)](#) suggests that the determinants of competitive advantage are modelled by the four dimensions of his so-called ”competitive diamond” : resources, demand, industry partners and strategic and competitive environment ; more the interactions are intense and market is demanding and competition is vigorous, then more the quality of resources and industry partners is high, and the local competitiveness of cluster strengthens.

With the success of the cluster concept, the competitiveness of territories has become a hegemonic discourse in political circles. However, for many scientists, the concept is only used

6. In literature, one talks about ”learning regions”. This concept was introduced by [Florida \(1995\)](#) to assign to the region a role of ”technology infrastructure” that facilitates the creation and circulation of knowledge, ideas and interactive learning among localised actors. But for some authors, the concept remains weak, unclear and failed because unable to build strong empirical evidences about the relationship between ”learning” and ”regional development” (see [MacKinnon et al., 2002](#)).

for political purposes ; it is chaotic, vague, elusive, even expressly generic and contains the seed of its own demise ([Martin and Sunley, 2003](#); [Desrochers and Sautet, 2004](#); [Wolman and Hincapie, 2015](#)). It's true, we agree with these authors that clusters' purpose may need to be reconsidered, but we note that despite arguments used, their criticism rather fall within the conceptual domain. Today, the concept is perceived as a mostly operational and strategic tool for companies, regions and nations in search of competitiveness. OECD, emerging economies (India, China, Pakistan and Brazil) and Maghreb countries (Algeria, Morocco, Tunisia) use it as the key mode of economic coordination, development and growth ([Cooke, 2001](#); [Martin and Sunley, 2003](#); [Yang and Planque, 2010](#); [ONUDI, 2013](#)).

However, we must recognize that the abundant empirical literature analysing relationship between innovation clusters and incentive to innovate at the firm level results in mixed results. While one group of studies shows that clusters stimulate firms' R&D activities (see e.g [Baptista and Swann, 1998](#); [Beaudry, 2001](#); [Beaudry and Schifffauerova, 2009](#); [Falck et al., 2010](#); [De Beule and Van Beveren, 2011](#)), the other group shows that a cluster itself has no perceptible effects and even can be a source of negative externalities. For the latter group, the simple geographic proximity is not enough to encourage innovation if we disregard firms' specificities, technology sector and the institutional environment (see for example works of [Beaudry and Breschi, 2003](#); [Hervas-oliver et al., 2009](#); [Nishimura and Okamuro, 2009](#); [Lee, 2009](#)). If we take a conciliatory view of these two groups of empirical results, it can be argued that they are not necessarily opposed but complementary : the first group highlights the cluster effect through geographical proximity and the second group shows the magnitude of this effect depends on characteristics

of localised firms and the institutional environment. However, even with this optimistic view, the question of the real contribution of clusters to innovativeness and competitiveness of firms remains a major concern, especially in scientific circles.

At the macroeconomic level, the empirical literature generally establishes a close and positive relationship between clusters and job creation and economic growth (see e.g [Glaeser et al., 1992](#); [Martin and Ottaviano, 1999](#); [Martin, 1999](#); [Riou, 2003](#); [Ketels and Protsiv, 2013](#); [Pires et al., 2013](#); [Delgado et al., 2010, 2014](#); [Mattoon and Wang, 2014](#); [Slaper and Ortuzar, 2015](#)). Studies argue that regional inequalities of growth of countries can be attributed to these forms of localised industrial organisation. However, a more careful scrutiny of these results shows that positive effect profiles vary from one cluster to another. For example, the work of [Pires et al. \(2013\)](#) analyses the performance of potential clusters of Brazil; they suggest that clusters that have a proximity and spatial similarity and industrial are strongly associated with job creation than specialised ones. Similarly, [Delgado et al. \(2010, 2014\)](#) show significant evidence of the positive impact of "strong" clusters on a number of aggregates such as entrepreneurship, job creation, wage growth, creation of new business and jobs in start-ups and the level of patenting if we control the convergence adverse effect (i.e. declining product growth rate due to diminishing returns). Furthermore, the clusters economic impacts assessment undertaken by [Slaper and Ortuzar \(2015\)](#) and [Mattoon and Wang \(2014\)](#) respectively in the south-central Indiana and in major metropolitan areas in US prefer traded clusters rather than local clusters; indeed in USA, it is generally accepted that without traded clusters, it is impossible for a region to achieve high levels of economic performance. However, the results of these two studies confirm

that all traded clusters do not have the same effects on growth and also multipliers' effects of employment are different ; therefore, employment profiles vary by region.

In short, the empirical literature shows that the cluster effect on innovativeness, job creation and growth depends on the type of clusters considered, industries and even researchers and the methodology used. Indeed, for example in empirical studies using econometric estimates, the independent variable (or index) used to measure the cluster effect differs according to the authors : concentration indices (see e.g [Glaeser et al., 1992](#)), measurement of location economy (see e.g [Barkley et al., 1999](#)), location quotient (see e.g [Pires et al., 2013](#); [Delgado et al., 2014](#)). According to [Wolman and Hincapie \(2015\)](#) such indices are rarely correlated with the concept of cluster. Thus, although authors are unanimous on the positive impact of clusters on the creation of new knowledge, job creation and growth, the empirical evidence remains unclear, and deeply suffers from the problem of diversity of operational definitions of the cluster concept ; what makes results very different and difficult to interpret. According to [Muller et al. \(2011\)](#) in their bibliographical note, this finding is not surprising as the general problem of measuring the impact and evaluation of the effects of certain policies related to innovation, science or technology is emerging.

0.3 Localisation of innovation

The concentration of industrial activities in space is not a new phenomenon. It had its origin in Alfred Marshall observations in the late 19th century. He observes in England a form of localised industrial organisation composed of a large number of small companies involved

in the production of a same good, each specialised in a production segment (Courlet, 2002); their coordination is ensured both by market (competition) and cooperation and reciprocity. Marshall's intuition facing this particular mode of industrial organisation as efficient as the dominant Fordist model is that there are "external economies" related to concentration and proximity. He termed "industrial district" this form of organisation; this term will be taken up and popularised by Italian economists such as Becattini (1991) a century later. Marshall (1920) identifies three sources of agglomeration externalities⁷: (1) local market of expertises, (2) local specific equipments, (3) network of interactions and information flows⁸. According to Duranton and Puga (2004), external economies are theoretically underpinned respectively by three mechanisms: matching, sharing and learning.

It was not until Krugman in 1991 to provide a theoretical and coherent body of Marshall intuitions. Today, the economic literature refers to this founder corpus of what is called "New Economic Geography (NEG)"⁹ to justify phenomena of agglomeration of economic activities in general, and innovative industries in particular. We know that the general arguments of the concentration of industrial activities are increasing returns, transport costs and the level of competition; indeed, agglomeration is more likely if there are increasing returns and low transport

7. Urban economists distinguish two types of agglomeration externalities: *urbanization externalities* that refer to the simple co-location of firms without their activities are connected and *localisation externalities* that are reserved to companies whose activity is similar or complementary (Belleflamme et al., 2000). According to this typology, Marshall externalities are localisation externalities.

8. Since Scitovsky (1954), we distinguish two types of externalities: *pecuniary externalities* that refer to benefits of economic interactions that are realised through the usual market mechanisms that are accessible to those who are located, and *technological externalities* that address the effects of interactions that occur outside markets and directly affect consumers' utilities or corporate production functions and are accessible to all. Breschi and Lissoni (2001) indicate that the boundary between these two types of externalities is blurred. According to these authors, econometric studies underestimate generally pecuniary externalities and overestimate technological externalities.

9. The paper of Fujita and Thisse (1997) is an excellent review of theoretical literature on New economic geography.

costs, all other things being equal. However, with specific regard to innovative industries, the arguments justifying their localisation remain knowledge spillovers and sharing of indivisibility. In the following subsections, we discuss these two arguments of concentration of innovation and analyse the impact of clusters on their contributions to firms' activities.

0.3.1 Knowledge spillovers

The seminal work of [Arrow \(1962\)](#) on economics of innovation showed that the allocation of resources by market for production of innovation is socially suboptimal. The fundamental reasons for this social distortion are the intrinsic uncertainty of innovation activity and the supposed nature of public good of knowledge (i.e, non-rival and non-excludable). The endogenous growth theories are largely based on these properties of knowledge to justify the non-convexity of production functions of economic activities and the self-sustaining economic growth.

There are generally two types of knowledge in the economic literature : codified knowledge (or standardised information) and tacit knowledge (not articulated or highly contextual) ; the key difference is that marginal cost of transmission of standardised information is made invariant by telecommunications revolution while marginal cost of transmission of tacit knowledge decreases with social interactions and exchanges between co-located agents ([Audretsch and Feldman, 2004](#)). In other words, the transfer of tacit knowledge is mainly based on face-to-face interactions and repeated contacts. Therefore, knowledge spillovers (mainly, tacit) are considered as a challenge, if not the main, of the location of innovative industries in a given territory. The literature argues that the tacit dimension of knowledge is very useful in inno-

vation process and justifies the localised nature of knowledge spillovers and the promotion of innovation clusters (Torre, 2008; Madiès and Prager, 2008). Thus, the tacit dimension dampen the transmission "over long distances" of knowledge. Recent works question the characteristic "tacitness" of knowledge and its effect on innovation activity in localised structures. We discuss here the question of the existence of localised knowledge spillovers, their spatial boundary and their transmission mechanisms. Our aim is to analyse their role but also the effect of clusters on their dynamics in the production of innovation. In general way, three groups of work and methods were used in the literature analysing knowledge externalities :

The first group is based on the econometric estimation of knowledge (or innovation) production function proposed by Griliches (1979) and applied to local units of observation in order to estimate the extent of knowledge spillovers. For example, let's consider a following innovation production function I_i :

$$I_i = \alpha(E_i)^{\beta_1}(R_i)^{\beta_2}(R_i^*)^{\beta_3}\epsilon_i$$

with E_i a variable of firms or industries or a country, R_i inputs of internal R&D and R_i^* the stock of external research and which participate in increasing I_i ; so, the result of innovation activity depends on innovation inputs; the elasticity of innovation β_3 to an increase of the stock of external research R_i^* measures the effects of knowledge spillovers. Jaffe (1989) uses this aggregated production function at US state level to explore the existence of knowledge spillovers from academic research to industry, and their extent in space. The estimation results show that the elasticities are all significantly positive. This means, according to the author, academic knowledge overflow and reach other economic agents and private research laboratories

and these spillovers are localised. [Breschi and Lissoni \(2001\)](#) blame at least two weaknesses in this study; first, the chosen geographical unit (i.e. state) is too large to facilitate face to face contacts; second, the technological distance is too great to assume alignment between all actors; moreover, they point out the fact that there is no evidence that there has been no formal contractual arrangements of transfer of results from universities to other economic agents. Several other studies use the same methodology and broadly support the existence and the important role of technology spillovers in industrial location; for example, one cites [Acs et al. \(1992\)](#) who replicated the work of Jaffe (1989) by substituting patents by innovation counts, [Audretsch and Vivarelli \(1994\)](#) who point out that knowledge spillovers from neighbouring universities are more important to small firms than for large firms, and [Audretsch and Feldman \(1996\)](#) show the polarisation effect is more pronounced during early stages of the industrial life-cycle because the effects of congestion may arise during the phases of maturity and decline. Although these results are converging, the literature on knowledge spillovers remains confused and does not necessarily prove the existence of LKS.

A second method, patent citations, has been widely used to measure the local dimension and quantify knowledge spillovers. Here, authors consider that knowledge spillovers leave traces in form of patent citations; they assume that patent citations contained in a new patent is a preliminary stock of knowledge to identify, at least partially, the diffusion path of innovation and geographic character. In [Jaffe et al. \(1993\)](#), the authors compare the probabilities of patent citations from two samples : patent citations and control patents. The results show that citations are much more localised than control patents. In other words, the probability that the

cited patents and patents citing are co-located is stronger than the probability that the cited patents and control patents are co-located. The authors deduce that knowledge spillovers are geographically constrained and this is due to the tacit dimension of knowledge. More recent works using patent citations as proxies of knowledge spillovers broadly confirm the positive influence of geographical proximity on patent citations in different regions worldwide; it's the case of [Verspagen and Schoenmakers \(2000\)](#), [Maurseth and Verspagen \(2002\)](#) and [Bottazzi and Peri \(2003\)](#) in Europe, [Lukach and Plasmans \(2002\)](#) in Belgium, [Duguet and MacGarvie \(2005\)](#) in France, [Singh et al. \(2010\)](#) in USA and [Aldieri \(2011\)](#) in USA, Japan and Europe. Criticism of this method are questioning on one hand the reasons that would push researchers to prefer cite patents or local publications, and also the relevance of the link between patent citations and LKS, especially as the patent is only a partial indicator of innovation and is also a reflection of codified knowledge. According to [Breschi and Lissoni \(2001\)](#), the results of the analysis of patent citations are a weak evidence of the existence of LKS.

In the third method, we includes all studies that highlight the importance of human intellectual capital in the treatment of knowledge spillovers. These are (1) studies that analyse the necessary conditions allowing absorption of new knowledge and (2) studies that analyse the channels or transmission media of spillovers. In the first case, we can mention [Cohen and Levinthal \(1989\)](#) and [Cockburn and Henderson \(1998\)](#) who worked on the building of absorption capacity. They show that access to knowledge requires the availability of expertise and internal knowledge. It is noted however that the influence of the absorption capacity on the geographical dimension of externalities is still little studied. In the second case, for example, one

cites [Zucker et al. \(1994\)](#) and [Almeida and Kogut \(1999\)](#); [Almeida and Kogut \(1999\)](#) test the assumptions of [Jaffe et al. \(1993\)](#) in the domain of semiconductors and question the nature of the channels of transmission of knowledge. Their results argue that knowledge are not spread by themselves; it is the skilled workers that constitute knowledge transfer vectors through their inter-firm mobility. In other words, interpersonal and occupational mobility is an important factor for the location of spillovers because knowledge is incorporated into the body. However, a limit to this group of works is that it does not test the effect of the transfer of knowledge on the productivity of firms that hire these workers.

The above short literature review on knowledge spillovers shows localisation has probably significant effects on innovation activities. However, empirical studies have formally still struggling to prove the origin and existence of LKS. [Breschi and Lissoni \(2001\)](#) questioned the distinction between codified and tacit. According to them, "tacitness" should not be considered as an intrinsic property of knowledge but as a property of transmitted and exchanged messages within an epistemic community¹⁰ and as the result of a incentive system; tacitness and codification are mutually compatible and all knowledge can be codified, disclosed or shared as messages over long distances by means of media. This reflection is consistent with that of [Cowan et al. \(2000\)](#) for whom knowledge can be codified for one person, tacit for another and impenetrable mystery for a third one according to its absorption capacity. In other words, for these authors, geographical proximity becomes irrelevant to justify the location and sharing of knowledge spillovers, even tacit; rather it is the epistemic proximity that becomes necessary

10. We can broadly define a epistemic community as "a transnational network of knowledge-based experts interconnected by the respect of a procedural authority". See for instance [Cowan et al. \(2000\)](#) and [Cohendet et al. \(2014\)](#) for further details.

for the transfer of "tacit messages". This position is broadly supported by [Boschma \(2005a,b\)](#) for whom cognitive (or epistemic) proximity is a prerequisite for interactive learning and innovation while geographical proximity is a simple non-essential facilitator of interactions and cooperation between actors.

Yet the literature on LKS does not focus on the concept of epistemic community in explaining the dynamics of creation and sharing of new knowledge within clusters. [Håkanson \(2005\)](#), the first to approach the subject, also calls into question the principle that co-located companies have a privileged access to tacit knowledge giving them a competitive advantage. He argues instead that the concept of "tacitness" is meaningless, without scientific consensus, and should not be the focus of discussions on the importance of LKS nor on the dynamics of knowledge within clusters. As the previous authors, [Håkanson \(2005\)](#) emphasizes the importance of relevant epistemic communities in access and exploitation of knowledge and expertise, regardless of their degree of articulation and codification. But on the contrary, according to [Håkanson \(2005\)](#), the location of epistemic communities play a decisive role in the dissemination of knowledge. [Cohendet et al. \(2014\)](#) addresses in the same direction ; they write, in their recent study : "Our view is that, to a large extent, the cognitive building of an epistemic movement will continue to be done within a localised milieu. The main reason is that the essential part of the cognitive building of an epistemic movement (in the search for allies, in the exposure to critics, in the interaction with other domains of knowledge, etc.) is obtained through interactions, frictions or even clashes between the epistemic community and other communities. These encounters between different communities mostly happen in local context...Our conviction is

that the generative dance between epistemic movements and localised milieus that we have tried to highlight in this contribution will continue to be the main basis for the formation of some radical innovations in society” (Cohendet et al., 2014, pp. 949-950).

In other words, the epistemic communities/localised milieus pair occupies a prominent place in the localised innovation process. It is true that today, beyond any theoretical consideration, the speeches of politicians and professionals around the direct economic gains due to LKS continue to encourage businesses, research centres and private and public laboratories to come together, creating a strong enough snowball effect to encourage more reluctant to join the group (or cluster). However, obviously, an analysis based on the study of cognitive dynamics of epistemic communities within these innovation clusters could allow us to better evaluate the effect of LKS and thus greatly appreciate the likely potentiating effect (still largely misunderstood) of innovation clusters on LKS.

0.3.2 Sharing of indivisibilities

The research activity requires heavy investments for experiments (e.g cleanroom in nanotechnology), transport infrastructure, energy and external inputs (such as support institutions for innovation, academic knowledge, specialised services). The presence of these infrastructures - high fixed costs' resources - in some sites encourages the localisation of innovative industries. Feldman (1994) uses the term "technological infrastructure" to qualify this integrated set of spatially concentrated networks of complementary institutions and resources that provide necessary inputs to innovation process. Some authors such as Riou (2003) and Ottaviano

(2008) show that improving these facilities generates externalities and affects the geographical distribution of economic activities.

Technology platforms are a perfect example of indivisibility in Europe; they bring together common infrastructure and equipment of R&D and innovation for providing services or resources (rent of equipment, etc.). They are open to actors of innovation clusters, especially to small and medium enterprises characterised by low own-resources. They enable a community of users to carry out R&D projects, industrial tests, manufacturing pre-series; this indivisible and costly set is an essential element justifying the development of innovation clusters. In France, the financing of innovation platforms responds to a call for structuring projects; it is regulated by the European Commission in respect of non-economic activities¹¹.

Sharing indivisibilities may however be subject to negative effects such as congestion and competition effects; congestion occurs for example by saturation of transport routes, over-use of equipment, energy supply faults while competition can lead to a risk of "hold-up" in the recruitment of researchers; the effects will be stronger so that the grouping of inventive activities is in a same industry¹² (Crampes and Encaoua, 2005).

11. Cf. Decision 2006/C323/01 on Community Guidelines on State aid for research, development and innovation.

12. There is an interesting discussion in the economic literature on the benefits of specialisation or diversification of research activities within innovation clusters (see for example Feldman and Audretsch, 1999; Cortright, 2006; Beaudry and Schiffauerova, 2009). For adepts of specialisation, Marshall, Arrow and Romer, the grouping of innovative industries related to a same sector helps a cumulatively refinement of knowledge. Diversification advocates argue instead that diversity is a source of success, interaction, creation of new knowledge and new industries.

0.4 Technology cooperation

Studies related to the analysis of competition effects on innovation were initiated by [Lee and Wilde \(1979\)](#), [Loury \(1979\)](#) and [Dasgupta and Stiglitz \(1980\)](#). Models developed ¹³ show that competition between innovative firms led to the both over-investment in R&D compared to what would be collectively optimal to achieve and innovation rent dissipation ¹⁴. This is due to the fact that each firm, trying to appropriate first innovation, knows that increasing its R&D effort negatively affects the chance of discovery of its rivals. Therefore, if firms decide to coordinate their R&D investment levels, they will eliminate these strategic externalities, avoiding *de facto* duplication of research effort. One might conclude that cooperation, by eliminating inherent externalities to innovation competition, achieves the socially optimum level of research effort. But we note that these models do not explicitly incorporate knowledge spillovers particularly important in innovative industries. In fact, when a portion of a firm R&D results can be captured by other competing firms, we expected that firms that make noncooperative R&D be less engaged to innovate. Thus the consideration of knowledge spillovers in innovative activities has made cooperation in R&D the subject of numerous studies and above all a strategic tool for innovation policy. Cooperation between actors not only fits in a logic of organisation of transactions between contractors, but also in a strategic logic of complementarity or technological interdependence around innovation activity.

One of the most important contributions to theoretical literature on cooperation in R&D

13. [Dasgupta and Stiglitz \(1980\)](#) develop a deterministic model of auction (i.e, competition) while [Loury \(1979\)](#) and [Lee and Wilde \(1980\)](#) use a stochastic model of patent race (i.e, tournament).

14. The work of [Crampes and Encaoua \(2005\)](#) has a very educational and simplified synthesis of these models. Other works such as [Reinganum \(1989\)](#) makes an overview of the literature by integrating dynamic aspects.

is the work of D'Aspremont and Jacquemin (1988). D'Aspremont and Jacquemin (henceforth, DJ) analyse the effects of cooperation agreements in R&D on private incentives to invest, on quantities produced on final market and on the social welfare in the presence of knowledge spillovers. They consider an industry with two firms doing process innovation. They produce a homogeneous good on final market and face a total demand $p = a - bQ$, where $Q = q_1 + q_2$ is the sum of quantities. Each firm is characterised by a marginal cost of production :

$$c_i(x_i, x_j) = A - x_i - \beta x_j; \quad i = 1, 2; \quad i \neq j$$

where x_i is the level of a firm R&D investment and β the level of knowledge spillovers; the parameter β indicates that each firm benefits indirectly from its rival R&D effort. The authors pose some restrictions : $0 < A < a$, $0 < \beta < 1$, $x_i + \beta x_j \leq A$ and $Q \leq a/b$. The fixed R&D cost for firm i is given by $\frac{1}{2}\gamma x_i^2$ showing the existence of decreasing returns of R&D effort. The strategies of a firm consist in choose its R&D effort level and its quantity produced on final market.

The model is a two-stage game where cooperation in R&D precedes the production stage. The authors compare the equilibrium strategies of three scenarios : firms compete in R&D, they cooperate only in R&D, and they cooperate in both R&D and product. They show that with high levels of knowledge spillovers ($\beta > 0.5$), firms benefit more within a cooperative structure at R&D stage than to compete. Indeed, the internalisation of knowledge spillovers increases their levels of R&D effort, reduces costs, increases levels of production and lowers prices. Cooperation increases the benefit of producers, but also the welfare of consumers, and

therefore social welfare, provided that there is no collusion behaviour at production level.

Since the results¹⁵ of [D'Aspremont and Jacquemin \(1988, 1990\)](#) and many extensions in the economic literature¹⁶, cooperation in R&D emerges in the technology sector as one of the most used modes of coordination. It is considered by theorists economists and industrial practitioners as an effective way of stimulating innovation, business competitiveness and economic growth¹⁷. The cooperation enables firms to internalise knowledge spillovers, but also to benefit from new markets, develop complementarities, define common standards, share research fixed costs and minimize the risks of R&D activities. With this, although the policy of European competition¹⁸ condemns cooperation between firms in the market, it encourages horizontal agreements at the R&D stage (or pre-competitive stage) in industrial sectors with high technological benefits while engaging in the fight against illegal agreements aiming restrict competition ([Cabon-Dhersin, 2007](#)). Cooperation in R&D between competing firms has exemption and the conditions of the exemption are defined by Regulation 1217/2010¹⁹ on the application of Article 101 of the TFEU ; not only the European Commission derogatorily authorises cooperation agreements in

15. [Henriques \(1990\)](#) shows that DJ model may raise stability problems for some parameter values ; [Amir \(2000\)](#) compares DJ model with model of Kamien, Zang and Muller (1992) and argues that the properties of Kamien, Zang and Muller's model seem more relevant than those of DJ model.

16. See e.g [Marjit \(1991\)](#), [Kamien et al. \(1992\)](#), [Combs \(1992\)](#), [Motta \(1992\)](#), [Vonortas \(1994\)](#), [De Bondt \(1997\)](#), [Amir and Wooders \(1998\)](#), [Amir \(2000\)](#), [Kamien and Zang \(2000\)](#) et [Miyagiwa and Ohno \(2002\)](#).

17. This interpretation must be relativised as cooperative choices are not always stable. [Kogut \(1988\)](#) shows that 20 % of alliances disappear after 5-6 years after their formation while [Cabon-Dhersin \(2007\)](#) argues that more than half of cooperation agreements are doomed to failure. This is explained by the fact that spillovers and incomplete contracts can still generate opportunistic behaviour and test the stability of R&D agreements. According to [Kogut \(1989\)](#), links built on historical experiences and exchange of technological information between two firms promote stability of cooperation in R&D and reciprocity.

18. The European antitrust policy (Cf. Article 81 to 89 of the Treaty of Rome) ensures that companies respect the rules of competition and allow the opening monopolistic sectors to competition (Art. 86). To do this, it uses instruments such as prohibition and sanctions anticompetitive behaviour (Art. 81), prohibition and punishment of abuse of dominant position (Art. 82), control of mergers (Regulation 139/2004), control of compliance of aid of States according to EU rules (Art. 87, 88 and 89).

19. The Research and Development Block Exemption returned in force January 1, 2011 and expires on 31 December 2022

R&D, but also encourages them. Thus, several European financial support programmes for co-operation have emerged; the most important are the Framework Programmes : the Framework Programme for Research and Technological Development (FP) and the Framework Programme for Competitiveness and Innovation (CIP)²⁰. The seventh Framework Programme (FP7) was completed in 2013; he identified cooperation as one of its specific objectives and structuring of the European research effort. This "cooperation" programme was funded at almost 60% of the FP budget and aimed to strengthen cooperation relationship between different European actors in order to give concrete applications to technology and knowledge. The framework programmes have been criticised for the cumbersome bureaucracy which is detrimental to driving innovation and competitiveness of European industry. Since January 2014, the EU launched "Horizon 2020"²¹, the new funding of research programme and innovation in the European Union for the period 2014-2020.

Cooperation is one of the challenges of innovation clusters policy all the more as it should allow the internalisation of localised spillovers favoured by geographical proximity. However, it is clear from the literature that geographical proximity aroused by cluster does not in itself guarantee the existence of dense relationships. It is not necessarily a necessary coordination support to cooperation and may even appear in some cases as an obstacle to business networks, collaboration and communication especially in a highly competitive environment (e.g, [Mendez](#),

20. In addition to the Framework Programmes, other European programmes (under great financial importance initiatives) such as ERDF, EUREKA and EUROSTARS also support cooperation in R&D through funding of collaborative research projects of innovative firms with high potential growth. The EUREKA intergovernmental initiative supports both large companies and SMEs, while the EUROSTARS programme only supports SMEs; Structural Funds ERDF encourage the establishment and development of transnational cooperation on innovation; see <http://www.eurekanetwork.org/>, <http://www.eurostars-eureka.eu/>, http://ec.europa.eu/regional_policy/en/funding/erdf/ (accessed 15 May 2016).

21. See <https://ec.europa.eu/programmes/horizon2020/> (accessed 15 May 2016).

2008; Ben Letaifa and Rabeau, 2013). Moreover, if we consider that the formation of certain clusters was not spontaneous but rather induced by public initiative (i.e top-down approach), it is likely that cooperative relations were also formed for the sole purpose of responding to the opportunity offered by the State in favour of territories. In this case we speak of occasional cooperations to capture public funds (Iritié, 2015). However, even in the case of local ecosystems spontaneously coming out of private business initiatives, nothing guarantees the quality of cooperation relationship within actors networks in motion.

The co-production of new knowledge in a cluster therefore requires a structure for coordination and facilitation of emerging cooperation relationship. Coordination reports to a mandatory hierarchic process and based on procedures while the cooperation comes under the voluntary mutual adjustment (Calamel et al., 2012). In France, the role of coordination of cooperation relationship within clusters is devoted to governance structures ; they must firstly help to define common strategies for alignment (or convergence) of cognitive and technological capabilities, and also bring out collaborative projects ; something that is not necessarily obvious especially as the motivation of actors to cooperate is not natural but is acquired over time. In addition, it raises the question of how the internal organisation of clusters success to converge towards common projects different actors subject to different legal and tax rules and whose interests are heterogeneous. In the case of French innovation clusters, we know governance structures organise fairs, innovation workshops, calls for internal projects and collaborative days. However, we need the cooperation relationship initiated during these meetings are strengthened, contractualised and supported by public policies.

0.5 Concluding remarks

Clusters are still considered as pivotal structures of industrial policies anywhere in the world ; they are supposed to overcome market failures for innovation and facilitate technological and industrial development by acting on key levers of innovation policies, such as the availability of quality skills, bringing together actors and mobilising funds for R&D. Despite high expectations, the cluster policy raises many controversial debates and criticisms.

The present critical overview on clusters is an opportunity to refocus the debate on economic issues of this new type of industrial organisation. Our approach was to conduct reflection based on the impacts of clusters on the contributions of three industrial dynamics moving within clusters : i.e research and development, localisation and technological cooperation. We implicitly assume that each of these dynamics will normally see its effects in favour of firms redefined and strengthened by the presence of clusters.

However, it emerged from our analysis that the hopes and expectations placed on cluster policy must be reconsidered and relativised ; the desired potentiating effect is not necessarily apparent in the literature ; we can therefore think that the reasons for the rising power of cluster policies must be sought elsewhere than a consensual and tangible evidence of positive impacts of clusters. However, some synthetic elements should be put forward for further reflections :

(1) given the diversity of methods used in the literature to measure the impact of clusters on innovativeness, job creation and economic growth, it is necessary to harmonize and establish a uniform methodology guide, rich and adjustable according to the characteristics of clusters.

(2) the literature on the existence of localised knowledge spillovers is abundant and some-

times redundant ; the importance of the border between tacitness and codified in the interactive process of learning and local innovation tends to disappear in favour of the interest given to the cognitive dynamics of epistemic communities ; moreover, the analysis of the effects of localised knowledge spillovers on clustered business activities remains unclear, but it will now continue by taking into account the cognitive process of building epistemic movements within clusters.

(3) the positive impact of clusters on the probability of connecting previously unconnected actors do a shadow of a doubt ; However, the literature is silent on clusters effect on the performance of cooperation relationships initiated during these making of contact. The analysis of the output of technological cooperation within the clusters are therefore needed to eventually isolate the strengthening effect of cluster policy.

Finally, for the third world (such as Africa and Latin America), we note that the economic justification of cluster policy by successful experience returns of industrial countries will probably have enough elements to initiate also this new industrial policy of innovation.

Bibliographie

- Acs, Z. J., Audretsch, D. B., and Feldman, M. P. (1992). Real effects of academic research : Comment. *American Economic Review*, 82(1) :363–67.
- Aldieri, L. (2011). Technological and geographic proximity effects on knowledge spillovers : evidence from the US patent citations. *Economics of Innovation and New Technology*, 20(6) :597–607.
- Alexiadis, S. and Eleftheriou, K. (2011). A note on the relation between inter-regional inequality and economic efficiency : evidence from the US states. *Regional Science Policy & Practice*, 3(1) :37–44.
- Almeida, P. and Kogut, B. (1999). Localization of knowledge and the mobility of engineers in regional networks. *Management Science*, 45(7) :905–917.
- Amir, R. (2000). Modelling imperfectly appropriable R&D via spillovers. *International Journal of Industrial Organization*, 18(7) :1013–1032.
- Amir, R. and Wooders, J. (1998). Cooperation vs. competition in R&D : The role of stability of equilibrium. *Journal of Economics*, 67(1) :63–73.
- Arrow, K. (1962). Economic welfare and the allocation of resources for invention. In *The Rate and Direction of Inventive Activity : Economic and Social Factors*, NBER Chapters, pages 609–626. National Bureau of Economic Research, Inc.
- Audretsch, D. B. and Feldman, M. P. (1996). Innovative clusters and the industry life cycle. *Review of Industrial Organization*, 11 :253–273.
- Audretsch, D. B. and Feldman, M. P. (2004). Knowledge spillovers and the geography of innovation. In Henderson, J. V. and Thisse, J. F., editors, *Handbook of Regional and Urban Economics*, volume 4 of *Handbook of Regional and Urban Economics*, chapter 61, pages 2713–2739. Elsevier.
- Audretsch, D. B. and Vivarelli, M. (1994). Small firms and R&D spillovers : Evidence from Italy. *Revue d'Économie Industrielle*, 67(1) :225–237.
- Baptista, R. and Swann, P. (1998). Do firms in clusters innovate more? *Research Policy*, 27(5) :525–540.
- Barkley, D. L., Henry, M. S., and Kim, Y. (1999). Industry agglomeration and employment change in non-metropolitan areas. *Review of Urban & Regional Development Studies*, 11(3) :167–186.
- Beaudry, C. (2001). Entry, growth and patenting in industrial clusters : A study of the aerospace industry in the UK. *International Journal of the Economics of Business*, 8(3) :405–436.
- Beaudry, C. and Breschi, S. (2003). Are firms in clusters really more innovative? *Economics of Innovation and New Technology*, 12(4) :325–342.
- Beaudry, C. and Schiffrauerova (2009). Who's right, marshall or jacobson? the localization versus urbanization debate. *Research Policy*, 38 :318–337.
- Becattini, G. (1991). Italian industrial districts : Problems and perspectives. *International Studies of Management and Organization*, 21(1) :83–90.
- Belleflamme, P., Picard, P., and Thisse, J.-F. (2000). An economic theory of regional clusters. *Journal of Urban Economics*, 48(1) :158–184.
- Ben Letaifa, S. and Rabeau, Y. (2013). Too close to collaborate ? how geographic proximity could impede entrepreneurship and innovation. *Journal of Business Research*, 66(10) :2071–2078.
- Blanc, C. (2004). Pour un écosystème de la croissance. Rapport au premier ministre, Assemblée Nationale.

- Bocquet, R. and Mothe, C. (2009). Gouvernance et performance des pôles de PME. *Revue Française de Gestion*, 2008/10(190) :101–122.
- Boschma, R. (2005a). Does geographical proximity favour innovation? *Economie et Institutions*, (6 and 7) :111–127.
- Boschma, R. (2005b). Proximity and innovation : A critical assessment. *Regional Studies*, 39(1) :61–74.
- Bottazzi, L. and Peri, G. (2003). Innovation and spillovers in regions : Evidence from European patent data. *European Economic Review*, 47(4) :687–710.
- Breschi, S. and Lissoni, F. (2001). Knowledge spillovers and local innovation systems : A critical survey. *Industrial and Corporate Change*, 10(4) :975–1005.
- Bristow, G. (2010). *Critical reflections on regional competitiveness : Theory, policy and practice*. Routledge, Taylor & Francis e-Library.
- Cabon-Dhersin, M.-L. (2007). Le laboratoire commun de recherche : quelles implications pour une politique de la concurrence? *Recherches économiques de Louvain*, 1 :77–93.
- Calamel, L., Defelix, C., Picq, T., and Retour, D. (2012). Inter-organisational projects in french innovation clusters : the construction of collaboration. *International Journal of Project Management*, 30(1) :48–59.
- Cockburn, I. and Henderson, R. (1998). Absorptive capacity, co-authoring behavior, and the organization of research in drug discovery. *The Journal of Industrial Economics*, XLVI(2) :157–181.
- Cohen, W. M. and Levinthal, D. A. (1989). Innovation and learning : the two faces of R&D. *Economic Journal*, 99 :569–596.
- Cohendet, P., Grandadam, D., Simon, L., and Capdevila, I. (2014). Epistemic communities, localization and the dynamics of knowledge creation. *Journal of Economic Geography*, 14(5) :929–954.
- Combs, K. L. (1992). Cost sharing vs. multiple research projects in cooperative R&D. *Economics Letters*, 39(3) :353–357.
- Cooke, P. (2001). *Cluster as Key determinants of Economic growth : The example of Biotechnology*, chapter Cluster Policies - Cluster Development, pages 23–34. Nordredio Report 2001 :2.
- Cortright, J. (2006). *Making sense of clusters : regional competitiveness and economic development*. Discussion paper. The Brookings Institution Metropolitan Policy Program.
- Courlet, C. (2002). Les systèmes productifs localisés : Un bilan de la littérature. *Etudes et Recherches sur les Systèmes Agraires et le Développement*, 33 :27–40.
- Cowan, R., David, P. A., and Foray, D. (2000). The explicit economics of knowledge codification and tacitness. *Industrial and Corporate Change*, 9(2) :211–253.
- Crampes, C. and Encaoua, D. (2005). Microéconomie de l’innovation. In Economica, editor, *Encyclopedie de l’innovation*, pages 405–430.
- Dasgupta, P. and Stiglitz, J. (1980). Industrial structure and the nature of innovative activity. *Economic Journal*, 90(358) :266–93.
- D’Aspremont, C. and Jacquemin, A. (1988). Cooperative and noncooperative R&D in duopoly with spillovers. *American Economic Review*, 78(5) :1133–37.
- D’Aspremont, C. and Jacquemin, A. (1990). Cooperative and noncooperative R&D in duopoly with spillovers : Erratum. *American Economic Review*, 80(3) :641–42.
- Datar (2004). La france, puissance industrielle. une nouvelle politique industrielle par les territoires. réseaux d’entreprises, vallées technologiques, pôles de compétitivité. Technical report, Etude prospective de la DATAR.
- Davezies, L. (2002). Notes de lecture du deuxième rapport sur la cohésion : unité de l’Europe, solidarité des peuples, diversité des territoires. In *Territoires d’Europe*, number 5, pages 69–74. Territoires 2020.
- De Beule, F. and Van Beveren, I. (2011). Does firm agglomeration drive product innovation and renewal? An application for Belgium. *Tijdschrift voor Economische en Sociale Geografie*.
- De Bondt, R. (1997). Spillovers and innovative activities. *International Journal of Industrial Organization*, 15(1) :1–28.
- Debresson, C. (1989). Breeding innovation clusters : a source of dynamic development. *World Development*, 17(1) :1–16.
- Delgado, M., Porter, M. E., and Stern, S. (2010). Clusters and entrepreneurship. *Journal of Economic Geography*, 10(4) :495–518.
- Delgado, M., Porter, M. E., and Stern, S. (2014). Clusters, convergence, and economic performance. *Research Policy*, 43(10) :1785 – 1799.
- Desrochers, P. and Sautet, F. (2004). Clusters-based economic strategy, facilitation policy and the market process. *The Review of Austrian Economics*, 17(2/3) :233–245.

- Diact (2009). *Les pôles de compétitivité*. La documentation française.
- Duguet, E. and MacGarvie, M. (2005). How well do patent citations measure flows of technology ? evidence from French Innovation Survey. *Economics of Innovation and New Technology*, 54(5) :375–393.
- Duranton, G., Martin, P., Mayer, T., and Mayneris, F. (2008). *Les pôles de compétitivité : que peut-on en attendre ?* Number 10 in Opuscles du CEPREMAP.
- Duranton, G. and Puga, D. (2004). Micro-foundations of urban agglomeration economies. In Henderson, J. V. and Thisse, J. F., editors, *Handbook of Regional and Urban Economics*, volume 4 of *Handbook of Regional and Urban Economics*, chapter 48, pages 2063–2117. Elsevier.
- Falck, O., Heblich, S., and Kipar, S. (2010). Industrial innovation : Direct evidence from a cluster-oriented policy. *Regional Science and Urban Economics*, 40 :574–582.
- Feldman, M. P. (1994). Knowledge complementarity and innovation. *Small Business Economics*, 6 :363–372.
- Feldman, M. P. and Audretsch, D. B. (1999). Innovation in cities : Science-based diversity, specialization and localized competition. *European Economic Review*, 43(2) :409–429.
- Florida, R. (1995). Toward the learning region. *Futures*, 27(5) :527–536.
- Fromhold-Eisebith, M. and Eisebith, G. (2005). How to institutionalize innovative clusters ? comparing explicit top-down and implicit bottom-up approaches. *Research Policy*, 34(8) :1250–1268.
- Fujita, M. and Thisse, J.-F. (1997). Économie géographique : Problèmes anciens et nouvelles perspectives. *Annales d'Économie et de Statistique*, (45) :37–87.
- Glaeser, E. L., Kallal, H. D., Scheinkman, J. A., and Shleifer, A. (1992). Growth in cities. *Journal of Political Economy*, 100(6) :1126–52.
- Griliches, Z. (1979). Issues in assessing the contribution of research and development to productivity growth. *The Bell Journal of Economics*, 10(1) :92–116.
- Henriques, I. (1990). Cooperative and noncooperative R&D in duopoly with spillovers : Comment. *American Economic Review*, 80(3) :638–40.
- Hervas-oliver, J.-I., de Miguel-molina, B., and Albors, J. (2009). How much important is the cluster effect ? making sens of the firm’s internal and meso (relational) resources to explain innovation. *DRUID Paper to presented at the Summer Conference*, page 26p.
- Howells, J. (2005). Innovation and regional economic development : A matter of perspective. *Research Policy*, 34 :1220–1234.
- Hu, A. G. (2015). Innovation and economic growth in East Asia : An overview. *Asian Economic Policy review*, 10 :19–37.
- Håkanson, L. (2005). Epistemic communities and cluster dynamics : On the role of knowledge in industrial districts. *Industry and Innovation*, 12(4) :433–463.
- Iritié, B. G. J. J. (2015). Conditions of diffusion of competitiveness clusters’ technologies : A brief theoretical note. *International Journal of Economics and Finance*, 7(10) :66–73.
- Jaffe, A. B. (1989). Real effects of academic research. *American Economic Review*, 79(5) :957–70.
- Jaffe, A. B., Trajtenberg, M., and Henderson, R. (1993). Geographic localization of knowledge spillovers as evidenced by patent citations. *The Quarterly Journal of Economics*, 108(3) :577–98.
- Jouen, M. (2008). *La cohésion territoriale, de la théorie à la pratique*. Policy paper 35, Notre Europe.
- Kamien, M., Muller, E., and Zang, I. (1992). Research joint ventures and R&D cartels. *American Economic Review*, 82(5) :1293–1306.
- Kamien, M. and Zang, I. (2000). Meet me halfway : research joint ventures and absorptive capacity. *International Journal of Industrial Organization*, 18 :995–1012.
- Ketels, C. and Protsiv, S. (2013). Clusters and the new growth path for europe. *Working Paper no 14, WWWforEurope, Vienne*.
- Ketels, C. H. and Memedovic, O. (2008). From clusters to cluster-based economic development. *International Journal of Technological Learning, Innovation and Development*, 1(3) :375–392.
- Kline, S. J. and Rosenberg, N. (1986). An overview of innovation. In Landau and Rosenberg, editors, *The positive Sum Strategy : Harnessing Technology for Economic Growth*, pages 275–305. National Academic Press.
- Kogut, B. (1988). A study of the cycle of joint ventures. *Management international Review*, 28 :39–52.
- Kogut, B. (1989). The stability of joint ventures : Reciprocity and competitive rivalry. *Journal of Industrial Economics*, 38(2) :183–98.

- Lee, C.-Y. (2009). Do firms in clusters invest in R&D more intensively? theory and evidence from multi-country data. *Research Policy*, 38(7) :1159–1171.
- Lee, T. and Wilde, L. L. (1979). Market structure and innovation : A reformulation. *The Quarterly Journal of Economics*, 94(2) :429–436.
- Loury, G. C. (1979). Market structure and innovation. *The Quarterly Journal of Economics*, 93(3) :395–410.
- Lukach, R. and Plasmans, J. (2002). Measuring knowledge spillovers using patent citations : Evidence from the Belgian firm's data. *Working paper 754, CESifo Group Munich*.
- MacKinnon, D., Cumbers, A., and Chapman, K. (2002). Learning, innovation and regional development : a critical appraisal of recent debates. *Progress in Human Geography*, 26(3) :293–311.
- Madiès, T. and Prager, J.-C. (2008). Innovation et compétitivité des régions. Technical report, Avis au Conseil d'analyse économique.
- Maine, E. M., Shapiro, D. M., and Vining, A. R. (2010). The role of clustering in the growth of new technology-based firms. *Small Business Economics*, 34 :127–146.
- Marcon, A. (2008). Les pôles de compétitivité : faire converger performance et dynamique territoriale. Technical report, Avis du Conseil économique social.
- Marjit, S. (1991). Incentives for cooperative and non-cooperative R and D in duopoly. *Economics Letters*, 37(2) :187–191.
- Markusen, A. (1996). Interaction between regional and industrial policies : evidence from four countries. *International Regional Science Review*, 19(1-2) :49–77.
- Marshall, A. (1920). *Principles of economics*. MacMillan.
- Martin, P. (1999). Public policies, regional inequalities and growth. *Journal of Public Economics*, 73(1) :85–105.
- Martin, P. and Ottaviano, G. (1999). Growing locations : Industry location in a model of endogenous growth. *European Economic Review*, 43(2) :281–302.
- Martin, R. (2008). National growth versus spatial equality? a cautionary note on the new 'trade-off' thinking in regional policy discourse. *Regional Science Policy & Practice*, 1(1) :3–13.
- Martin, R. and Sunley, P. (2003). Deconstructing clusters : chaotic concept or policy panacea? *Journal of Economic Geography*, 3(1) :5–35.
- Mattoon, R. and Wang, N. (2014). Industry clusters and economic development in the seventh districts largest cities. *Economic Perspectives*, 38(2) :52–67.
- Maurseth, P. B. and Verspagen, B. (2002). Knowledge spillovers in Europe : A patent citations analysis. *Scandinavian Journal of Economics*, 104(4) :531–545.
- Mendez, A. (2008). Quelles articulations entre les pôles de compétitivité et les tissus productifs régionaux? Une mise en perspectives de quatre pôles en Provence-Alpes-Côte d'Azur. Technical report, LEST.
- Miyagiwa, K. and Ohno, Y. (2002). Uncertainty, spillovers, and cooperative R&D. *International Journal of Industrial Organization*, 20(6) :855–876.
- Motta, M. (1992). Cooperative R&D and vertical product differentiation. *International Journal of Industrial Organization*, 10(4) :643–661.
- Muller, E., Héraud, J.-A., Menz, N., Benaim, M., and Zenker, A. (2011). La mesure de l'impact des clusters - quelques éléments de réflexion et de bibliographie. *Working Papers Firms and Region, No. R1/2011*, pages 1–19.
- Nishimura, J. and Okamuro, H. (2009). R&D productivity and the organization of cluster policy : An empirical evaluation of the industrial cluster project in japan. CCES Discussion Paper Series 4, Center for Research on Contemporary Economic Systems, Graduate School of Economics, Hitotsubashi University.
- ONUDI (2013). Diffusion de la démarche clusters dans trois pays du Maghreb (Algérie-Maroc-Tunisie). Technical report, ONUDI, Vienne, Autriche.
- Ottaviano, G. (2008). Infrastructure and economic geography : An overview of theory and evidence. EIB Papers 6/2008, European Investment Bank, Economic and Financial Studies.
- Perroux, F. (1957). Note sur la notion de pôle de croissance. *Economie Appliquée*, 7 :307–20.
- Petrariu, I. R., Bumbac, R., and Ciobanu, R. (2013). Innovation : A path to competitiveness and economic growth. the case of CEE countries. *Theoretical and Applied Economics*, 5(582) :15–26.
- Pike, A., Rodríguez-Pose, A., and Tomaney, J. (2006). *Local and regional development*. Routledge, Taylor & Francis e-Library.

- Pires, J. C., Cravo, T., Lodato, S., and Piza, C. (2013). Industrial clusters and economic performance in brazil. *Inter-America Development Bank Working Paper Series No. IDB-WP-475*.
- Plunket, A. and Torre, A. (2009). Les poles de compétitivité ou le retour ambigu des déclinaisons locales de la politique industrielle française. *Economia e politica industriale*, 36(3) :159–177.
- Porter, M. (2000). Location, competition, and economic development : local clusters in global economy. *Economic Development Quarterly*, 14(1) :15–34.
- Reinganum, J. F. (1989). The timing of innovation : research, development and diffusion. In Schmalensee, R. and Willig, R., editors, *Handbook of Industrial Organization*, volume 1, chapter 14, pages 849–908. Elsevier.
- Riou, S. (2003). Géographie, croissance et politique de cohésion en europe. *Revue Française d'Économie*, 17(3) :171–202.
- Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, 94(5) :1002–37.
- Scitovsky, T. (1954). Two concepts of external economies. *Journal of Political Economy*, 62.
- Singh, J., Marx, M., and Fleming, L. (2010). Patent citations and the geography of knowledge spillovers : Disentangling the role of state borders, metropolitan boundaries and distance. *Working paper 2010/03/ST, INSEAD*.
- Slaper, T. and Ortuzar, G. (2015). Industry clusters and economic development. *Indiana Business Review*, 90(1) :7–9.
- Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, 70(1) :65–94.
- Torre, A. (2008). First steps towards a critical appraisal of clusters. In Blien, U. and Maier, G., editors, *The Economics of Regional Clusters, networks, technology and policy*, page 320p. E. Elgar, U.K.
- Verspagen, B. and Schoenmakers, W. (2000). The spatial dimension of knowledge spillovers in Europe : Evidence from firm patenting data. *Paper prepared for the AEA Conference on Intellectual Property Econometrics, 19-20 april 2000, Alicante, Spain*.
- Vonortas, N. S. (1994). Inter-firm cooperation with imperfectly appropriable research. *International Journal of Industrial Organization*, 12(3) :413–435.
- Wolfe, D. A. and Gertler, M. S. (2004). Clusters from the inside and out : local dynamics and global linkages. *Urban Studies*, 41(5/6) :1071–1093.
- Wolman, H. H. and Hincapie, D. (2015). Clusters and cluster-based development policy. *Economic Development Quarterly*, 29(2) :135–149.
- Wu, Y. (2010). Innovation and economic growth in China. *The University of Western Australia Discussion Paper 10.10*.
- Yang, F. and Planque, B. (2010). Impacts des clusters sur le développement régional dans un pays émergent : le cas des parcs industriels des nouvelles énergies en chine. *Séminaire EUROLio 2010, Université Paul-Cézanne (Aix-Marseille III), France*.
- Zucker, L. G., Darby, M. R., and Armstrong, J. (1994). Intellectual capital and the firm : The technology of geographically localized knowledge spillovers. *NBER Working Paper Series, Working Paper no. 4946, NBER, Cambridge*.