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Observational vs. Interactive Learning in Locational Choice: Evidences on “ICT Clusters” Formation and Stability

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Apprentissage observationnel vs. apprentissage interactif dans les choix de localisation : évidences sur la formation et la stabilité des « clusters TIC »

Résumé

L'objectif de l'article est d'apporter un nouvel éclairage sur les mécanismes de formation des clusters TIC. L'hypothèse centrale repose sur le fait que les clusters sont le résultat d'une norme de localisation, c'est à dire un alignement des choix de localisation provenant de comportements mimétiques et d'interactions séquentielles et cumulatives. Nous distinguons les externalités informationnelles (et l'apprentissage observationnel) des externalités de réseaux (et l'apprentissage interactif) dans les processus de localisation, afin de comparer les propriétés de stabilité respective des clusters issus d'un processus de localisation en cascade des clusters issus d'un processus de localisation en réseau. Nous montrons ainsi que si l'effet informationnel joue un rôle majeur dans la formation des clusters TIC, les effets réseaux sont la condition essentielle de leur stabilité. Les cas de la Silicon Valley et du Silicon Sentier (Paris) sont brièvement étudiés et comparés afin d'illustrer notre propos théorique.

Mots-clé : *clusters TIC, externalités informationnelles, externalités de réseaux, stabilité, proximité*

Observational vs. Interactive Learning in Locational Choice : Evidences on "ICT Clusters" Formation and Stability

Abstract

The paper provides new insights into the mechanisms of "ICT clusters" formation. The basic assumption is that clusters can be explained as the result of a locational norm, i.e. as an alignment of locational choices proceeding from both mimetic behaviours and sequential and cumulative interactions. We distinguish informational externalities (and observational learning) from network externalities (and interactive learning) in location processes, in order to compare the respective economic properties of stability of locational cascades and locational clusters. We show as a result that informational effects play a major role in the formation of ICT clusters, whereas network effects are the significant condition of their stability. Silicon Valley and Silicon Sentier (Paris) are briefly studied and compared in order to illustrate our theoretical purpose.

Keywords : *ICT clusters, Informational externalities, network externalities, stability, proximity*

JEL : D83, L86, R12

Introduction

The clustering of ICT activities has been the object of a growing attention in recent theoretical papers (QUAH, 2000; VICENTE, 2003a) and empirical ones (KOLKO, 2002; KOSKI et al, 2002; LE BLANC, 2003). New Economic Geography (FUJITA and THISSE, 2003) has developed a wide range of analytical tools to explain the formation of urban areas and industrial agglomerations, such as transportation costs in the tradition of VON THÜNEN, strategic interactions in the tradition of HOTELLING, or pecuniary externalities in the tradition of KRUGMAN. Nevertheless, these tools seem to be inadequate in the explanations they provide in the very specific case of ICT clusters (Figure 1). For instance, Silicon Valley cannot be explained as the result of an interaction dynamics between firms and consumers, because of the worldwide diffusion of software and computers produced into the cluster. Nor than this cluster can be simply the result of competitive strategic interactions, whereas social networks and cooperation seem to prevail (SAXENIAN, 1994). Silicon Alley in New York or Silicon Sentier in Paris – agglomeration of start-up dedicated to e-business activities and services – gather together firms relatively undifferentiated and little concerned with transportation costs.

Cluster	**location**	**Firms (examples)**
Silicon Valley	San José, *Californie*	Intel, HP, Sun Microsystem
Telecom Valley	Valbonne, *France*	Cisco, Texas Instruments, IBM france
Silicon Sentier	Paris, *France*	Firstinvest.com, Keljob.com, Opinionway.com
Silicon Alley	Manhattan, *New-York*	Cdnow.com, Doubleclick.com, Agency.com, Iclips.com, netcreation.com,
Silicon Fen	Cambridge, *Royaume-Uni*	Worldcom, Sun Microsystem, IBM
Wirelles Valley	Stockholm, *Suède*	Erikson, Adobe, Oracle
Silicon Forest	Portland, *Oregon*	Amazon, Intel, NEC
Silicon Dominion	Washington, *Virginie du Nord*	American Online, Worldcom
Silicon Hills	Austin, *Texas*	Dell, Motorola, Trylogy Software
Silicon Glen	Glasgow, *Ecosse*	Sun, Motorola, Agilent, HP, IBM, Microsoft, Oracle

Figure 1: Examples of ICT clusters

From these limits, our purpose is to develop a new way to model and explain ICT clusters formation and to give a theoretical content to this very fashionable concept (MARTIN and SUNLEY, 2003). The basic assumption is that industrial agglomeration can be explained as the result of a locational norm, i.e. as an alignment of locational choices proceeding from peculiar dynamics of economic interactions. The general theoretical context is based on "the economics of social interactions" (MANSKI, 2000; KIRMAN and ZIMMERMANN, 2001), which we apply in the context of location theories (SUIRE, 2003; VICENTE, 2003b, 2004), particularly in the context on an *evolutionary economic geography* (BOSCHMA, 2004). Formally, the ideas developed in this paper can be gathered together around three common denominators. First, firms are heterogeneous according to the satisfaction they can obtain from their location, independently of the location of others. Second, interactions, whatever their natures in this stage, are sequential and cumulative. Individual actions or decisions always produce informations, which can modify the preferences of the agents facing a decision problem in a later stage. Third, the interaction system is decentralized. This denominator allows us to go far from the centralized market figure where informations spread only through the price system. In the opposite, our purpose is to consider the role of direct communication and observation between agents, in particular through the social networks and proximity links agents bring together (TORRE and GILLY, 2000; PECQUEUR and ZIMMERMANN, 2004). The direct consequence of these common denominators in a definition of locational norms is that individual decisions of location can follow rational and mimetic strategies of location and explain therefore the peculiar geography of ICT and Internet activities.

The paper is divided as follow. In the first section we developed separately two approaches of locational norms. The first one is relative to the so-called locational cascade (CAPLIN and LEAHY, 1998; SUIRE and VICENTE, 2002), which can be briefly illustrated by the emblematic French example of Silicon Sentier. The second one is relative to the so-called locational cluster, initially formalized in the well-known paper of ARTHUR (1990) and illustrated by the famous case of Silicon Valley in California. The second section focuses in a theoretical and empirical way on the respective stability of each kind of locational norms, according to the nature of interactions, the evolution of individual satisfaction, and the form of organisational proximity each model exhibits. We show that in spite of the analogy of the label “Silicon …” or “… Valley” conferred or self-conferred to most of ICT clusters, different levels of local development are in course in these clusters.

I. Locational cascades and clusters in ICT and Internet activities

In this section, we developed sequential and cumulative approaches of location in a decentralized spatial system. The location strategy of each firm will follow a learning process in which the strategies of other firms will have an influence on its own location choice. These learning processes are different according to the kind of externalities the communication and the interaction between firms generate. We distinguish the locational cascades, proceeding from informational externalities and observational learning, from the locational clusters, proceeding from network externalities and interactive learning. The French Silicon Sentier model and the Californian Silicon Valley model give good illustrations of these two distinctive cases of ICT clusters.

A. Information externalities and observational learning

Initially developed in order to explain conformity effects in population, such as convention, norms or standards, models of informational cascades are nowadays used in several economic phenomena where agents can converge rapidly towards a same strategy, leading sometimes to unexpectedly collective behaviours. Technological standards (GEROSKI, 2000), business agglomerations (CAPLIN and LEAHY, 1998), or imitative strategies in media (KENNEDY, 1997), can be explained according to this theoretical approach, whereas monopolistic competition approaches generally defend the differentiation strategies.

Informational cascades are based on the role played by informational externalities (MANSKI, 2000). These later can be defined as the benefits agents can obtain from the observation of others. Informational externalities appear when actions are sequential and produce informations for others. It's the so-called "penguin effect" identified by FARELL and SALONER (1986) and developed by CHAMLEY (2003): when agents face an uncertainty on the payoff of their action, they confront their individual expectation to the collective choice, proceeding from the sequence of past actions.

At the opposite of network externalities of the next section, coordination or compatibility costs are not necessary to observe the role played by informational externalities in the emergence of conformity effects in populations. Such phenomena can be explained basically by an informational problem, and accurately by an arbitrage between private information – a probabilistic private signal of action retribution – and public one – the sequence of past actions. Public information has the externality property because of the economies of information searching costs she induces. This kind of model is fruitful because imitative or herding behaviours can occur and procure similar payoffs even if agents are characterized by heterogeneous preferences, because of the possibility agents have to communicate each others or to observe the actions of others (BIKCHANDANI et al, 1998).

In this context, behaviour convergence appears as the result of a sequential and cumulative process proceeding from the aggregation of individual strategies. These strategies follow an observational learning process, that is to say a process in which agents decide on the basis of both their own private and probabilistic informational signal and the aggregate actions of predecessors facing a similar decision problem. Observational learning processes are developed in the field of models of informational cascades (BANERJEE, 1992; BIKHCHANDANI et al, 1998), based on the rationality of herd behaviours. Informational cascades occur when agents take their decision sequentially and have signals on good actions with a probability smaller than the unit. The authors show that beyond two agents that have decided, and under specific conditions, heterogeneity of preferences can be neutralized by public information so that conformism situation emerges. These situations can be collectively inefficient, particularly if the two agents have received a probabilistic signal giving a majority to the bad action and that the third agent can observe the actions but not the signals.

Some research advances have been explored in order to introduce additional heterogeneity *via* the influence agents can develop in the beginning of cascades. BIKHCHANDANI et al (1998) propose to overpass the heterogeneity of signals by the existence of the so-called "fashion leaders", i.e. agents who have such an expertise capacity and reputation that they can orient in the first period or re-orient during the process the trajectories of collective choices. BALA and GOYAL (1998) go beyond in the exploration of informational cascades by introducing a local interaction structure in order to study the role of neighbourhoods in the emergence of conformist situation or coexistence of behavioural norms.

B. The agglomeration of e-business start-up in the Silicon Sentier

As we have briefly shown in the introduction, "ICT clusters" do not find convincing explanations in the framework of spatial competition and strategic interactions. If we suppose that e-business activities and start-up do not require the proximity of consumers, their competitive and strategic interactions cannot so directly lead to their agglomeration. In addition, if agglomeration of activities in these models can be the result of product differentiation, the reality of e-business start-up agglomerations shows that these firms are little differentiated[1]. To overpass these intrinsic limits of the framework of the new economic geography, the models of informational cascades provide new answers, as soon as the decision sequences are replaced by location sequences. This is the main purpose of the models of locational cascade (CAPLIN and LEAHY, 1998; SUIRE, 2003; VICENTE, 2003a).

In a net-economy context where a strong uncertainty on a start-up performance remains HEGE, 2001), this uncertainty can be also perceptible as regards the gain expected from a location decision. In the face of such uncertainty, and even in the absence of location fixed costs, it would be rational for each firm to decide its location on the basis of the location of predecessors, whose can be perceived as "relevant neighbours". So the public signals firms receive from their predecessors are integrated in their decision as relevant informations on the quality of the area. These informations reduce the uncertainty and increase the probability to do the best choice. The process shows that a cluster can emerge since a firm located in an area produces an informational externality so strong that, by a rational mimetic behaviour, a locational cascade of the other firms occurs, whatever the differentiation degree in the sector[2].

The locational cascade in the Sentier area in Paris has been initiated from fortuitous events: the textile sector crisis and the following decrease of commercial property prices in the area *"This is the lowest commercial property prices in the area which have attracted us"*[3]), and the broadband access crossing the Bourse area near the Sentier "*It's the area the most equipped in wireless network*"[4]). The cascade has started from the location of a "fashion leader", Yahoo, which the success has encouraged the location of other dotcom. The sequential process has created quickly a label that generates positive feedbacks on dotcom, so that individual preferences have been rapidly neutralized " *'My name is --.com', I'm located in the Silicon Sentier would be more convincing than 'My name is --.com, I'm located in Paris'*"[5]).

This adoption process is longer than the reputation of the fashion leader is weaker, that is to say that the risk aversion of costly location decisions is lower than the first firm located exhibits a strong reputation. This is the case for Yahoo in June 1998, following by Nomade in January 1999 and Lycos just later, which have highly influenced the sequential and cumulative trajectory of location in the area, until 300 Internet start-up at the end of 2000, before the NASDAQ stock-market crash. Such an agglomeration process could not emerge if these fashion leaders had been located elsewhere. Be located near Yahoo, Nomade or even Lycos lead to confer credibility of other less-known firms, which can benefit of the label net-economy self-conferred to the area "*The Silicon Sentier, it's a joke, but who knows, by dint of speaking, it would become a reality*"[6]).

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[1] Yahoo, Lycos, Nomade, three firms of search engines activities, have been located in the French Silicon Sentier at the end of 90[s].

[2] For scholars who appreciate economic modelling, we can summarize the mimetic process as follow : we suppose sequential choices of firms i=1, 2, …, n, …, which decide to adopt or reject a location. Each firm observes the decision of others and has the same fixed costs of location (C). Each firm obtain a payoff V, which has a finite set of possible values $v_1 < v_2 < ... < v_s$, with $v_1 < C < v_s$. Now suppose a_i the action of firm i (adopt or reject a location) and $A_i = (a_1, a_2, ..., a_i)$ the history of actions taken by firms 1, 2, …, i,. Given history , let be the set of signal realisations that lead firm i to choose a_i . then the conditional expectation of V for firm n+1 given is own signal realisation x_q and the history A_n is :

$$V_{n+1}(x_q ; A_n) \equiv E\left[V / X_{n+1} = x_q , X_i \in J_i(A_{i-1}, a_i), \text{for all } i \leq n\right]$$

[3] Yahoo *Libération*, 19.12.1998.

[4] Yahoo, *AFP*, 3.03.2000.

[5] S. Boujnah, ICT delegate, Finance Ministery, *Libération*, 14.01.2000.

[6] Mediangles, *Libération*, 19.12.1998

A location norm emerges as soon as location strategies converge on an area because of the uncertainty decrease this aggregate choice leads. By compelling such a label, net-economy agents facilitate the job of firms belonging to the community: when new start-ups will submit their business model to capital-riskers, they will appear as anchored in a successful territory. And deviate from the norm will appear as a risky strategy

C. Network externalities and interactive learning

Informational externalities and observational learning have been developed above in order to overpass the limits of spatial competition and strategic interaction models in the explanation they provide of the emergence of ICT clusters. The models of network externalities and interactive learning, since they provide close results, are based on a very different kind of mimetic behaviour. So they provide an other explanation of the mechanisms of firm agglomerations. The theoretical approaches of network externalities in economic geography are generally used in order to show that agglomeration economies do not only proceed from pecuniary externalities, as in the well-known model of KRUGMAN (1991). In other words, agglomeration does not only depend on failures in perfect market competition, but either on direct interactions and non-market coordination.

Initially developed in the framework of technological competition (DAVID, 1985; KATZ and SHAPIRO, 1994), network externalities are nowadays at the core of several phenomena in which the gain proceeding from an alignment of individual decisions neutralize the heterogeneity of agents' preferences. Among these phenomena, we can quote the economics of telecommunications (ECONOMIDES, 1996), the economics of conventions (YOUNG, 1998), or the theoretical approaches of industrial districts (ARTHUR, 1990; VICENTE, 2003b). Whatever the domain, the formalization of network externalities is very instructive on the mechanisms of norms formation.

Economic systems exhibit network externalities when the satisfaction or the benefits an agent obtains from his adhesion to a network is positively correlated to the number of members connected to this network or to an interconnected one. The advantage of these externalities is that they can include pecuniary or technological externalities. The basic idea is that this is the connexion degree and the coordination possibilities that generate these externalities, whatever these later lead to a decrease of the marginal cost of network users or an increase in their technological capacity (ANTONELLI, 1993; CAPELLO and NIJKAMP, 1996). In such a theoretical context, the firm strategy is not isolated but depends on the necessity of direct interactions with others. The individual decisions follows an interactive learning process, which can be described by the fact that agents decide on the basis of both their own intrinsic preferences and on the necessity of coordination with other agents.

Interaction learning processes are developed in the field of technological competition models with increasing returns to adoption (ARTHUR, 1989). Each agent facing a decision of network technology adoption must decide and arbitrate between its own intrinsic preferences for a technology and the necessity of compatibility with the technologies used by the other agents. This is not the intrinsic efficiency of each technology but the sequential process of adoption that justifies the emergence of a regime of standardization. This adoption process exhibits positive feedbacks, i.e. that beyond a technology adoption upper limit, each new adoption reinforces the more adopted technology. After a while and a critical mass achievement, the heterogeneity of individual preferences can be perfectly neutralized and one technology dominate the others on the market, so that the diffusion process follows the peculiar form of a *S*-shaped curve, as described in figure 2.

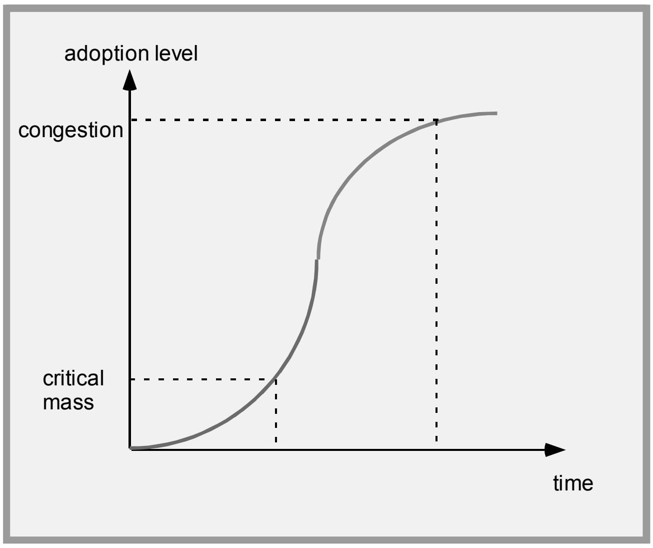

Figure 2: S-shaped curve of diffusion in processes with network externalities

D. Increasing returns to adoption and agglomeration economies in the emblematic case of Silicon Valley

ARTHUR (1990) has transposed his model of technological competition to regional competition in order to explain in a very theoretical and stylised way the Silicon Valley emergence. In this case, technological options are replaced by locational options. The increasing returns to adoption are associated with agglomeration economics; i.e. the benefits firms achieve in close proximity to other firms, as a result of the contact frequency, the cooperation and the presence of a local labour market. All of these arguments are sometimes supposed according to the degree of natural excludability of tacit knowledge (FORAY, 2000). As for the technological competition model, the location decision will depend on two main factors: the intrinsic advantages of each area, which recall the heterogeneity of individual preferences, and the aggregate result of sequential past decisions of other firms[7].

The collective location dynamics depends on the introduction of the so-called "small events", which are modelled by the first entries in the sequential process of location adoption. From these assumptions and the Polya Urn model, Arthur constructs a statistical function of the adoption behaviour which taking into account both the intrinsic preference of each firms and the aggregate choice of predecessors. Two main results appear. First, the spatial equilibrium differs according to the boundaries supposed in agglomeration economics. In the case where there is no boundary, the location dynamics of firms tend quickly towards an absorbing state where a region monopolizes the industry as a whole. However, in the case of a superior boundary of the agglomeration economies, several agglomeration structures can coexist as an absorbing state of the system. Second, the trajectories of location distributions are path-dependent and the absorbing states are more the direct consequence of the first firms'

[7] For scholars who appreciate economic modelling, we can summarize the locational process of Arthur as follow: we suppose N regions and the sequential locational choices of firms i=1, 2, …, n, …, which have different intrinsic preferences for region $j \in N$. We consider V the payoff of firm i in location j according to two components: $V_j^i = x_j^i + g(y_i)$. x_j^i is the payoff of firm i in region j independently of the location of others, whereas $g(y_i)$ represents the increasing function of agglomeration economies.

entries than the consequence of the *ex ante* median of their intrinsic preferences. Agglomeration economies counterbalance the heterogeneity of individual preferences.

Interaction learning processes take the form of a stochastic process, which allows to understand in a multiple equilibrium context how one or several equilibriums are selected and self-reinforced. These phenomena are dissociable from market relations, but indissociable from sequential interactions and the role played by the spatial proximity between firms. This dynamics is the consequence of network externalities. On the one side, network externalities in production and innovation allow firm to locate in close proximity. On the other side, by positive feedbacks, the region becomes more and more attractive until neutralization of heterogeneity in intrinsic preferences. The weight of positive feedbacks will be stronger since firms are not only physically connected. Network externalities increase the attraction power of regions since firms are not only in close geographic proximity but also in organisational proximity (TORRE and GILLY, 2000), which is the source of both innovation *via* variety and complementarities in firm networks (ANTONELLI, 1993) and firm anchoring *via* technological interdependencies (ZIMMERMANN,1998).

The Californian Silicon Valley represents for the scientific community the emblematic case of regional development. Economists (ARTHUR, 1990; AOKI and TAKIZAWA, 2002), sociologists (SAXENIAN, 1994; CASTILLA et al, 2000), managerial scientists (ADAMS, 2003; FERRARY, 2003) or anthropologists (ENGLISH-LUECK, 2000) agree that the formation and the development of Silicon Valley fit to mechanisms close to network externalities and interactive learning processes. To go far, we must recall the initials conditions, identify network externalities and study the form of the trajectory of the regional growth. Initial conditions of Silicon Valley go back 1937 in Stanford University. The standard historiography of Silicon Valley always begins with Frederick Terman who creates a community of industrial scholars linking industry with academia. William Hewlett and David Packard initiates this community and develop an audio-oscillator, which encounters a real success not only for Disney' Fantasia but for military research. According to Arthur, if American pioneers of micro-electronic had located elsewhere, the face of this industry would be completely changed.

Network externalities can be defined in Silicon Valley in terms of labour, technology and industrial relations. According to SAXENIAN (1994), *"Silicon Valley has a regional network-based industrial system that promotes collective learning an flexible adjustment among specialist producers of a complex of related technologies"* p.3). While conventional economics suggests that incentives to innovate depend on the ability firms have to appropriate innovation benefits, industrial relations in Silicon Valley seems the prove the opposite. First, if firms compete each others, the specificity of software and computer industry is in the necessity of compatibility and standardization, which require a high degree of cooperation in the definition of products (KATZ and SHAPIRO, 1994). In Silicon Valley, job mobility is stronger than elsewhere (COOPER, 2001) and property right efficiency is not the essential aim of entrepreneurial firms considering their substantial degree of information sharing (ENGLISH-LUECK, 2000; AOKI and TAKIZAWA, 2002). If Silicon Valley appears as a location norm of micro-electronic firms, this norm cannot be defined only as the result of pecuniary externalities proceeding from firm competition. Network externalities appears as the result of cooperation between firms, and agglomerations as Silicon Valley emerge from the necessity of proximity collective learning processes engender (KIRAT and LUNG, 1999).

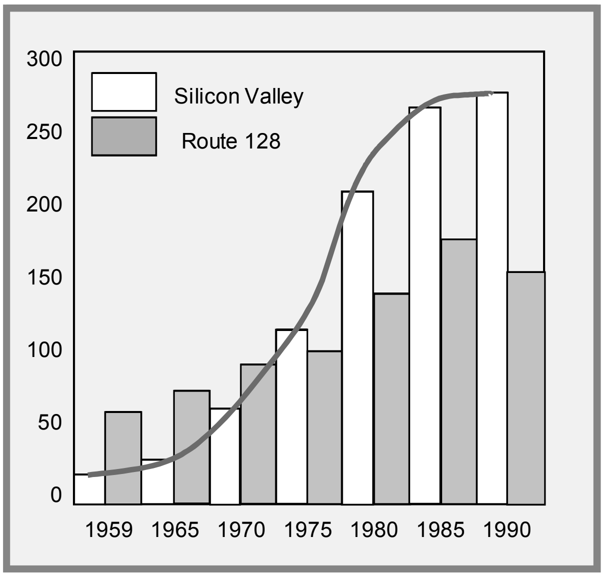

Figure 3: employment growth in Silicon Valley and Route 128 (thousand) (SAXENIAN, 1994)

Silicon Valley' attraction has became stronger than the number of firms located has grown up, in accordance with positive feedback phenomenon above-mentioned. The employment growth of Silicon Valley (figure 3) follows a *S*-shaped diffusion curve generally found in dynamical processes with network externalities and positive feedbacks (ECONOMIDES, 1996; SHY, 2001). Beyond a critical mass of firms located in a region, as Silicon Valley, its attraction power increases to the detriment of the other regions, as Route 128. After this fast growth, a stagnation phase occurs, which can be explained in USA at the end of eighties after the administration and industry computerization period (ARTUS, 2002). The comparison between Silicon Valley and Route 128 in terms of microelectronics and computer industry employment shows that in a spatial competition context, agglomerations that exhibit network externalities succeed better than ones that exhibit pecuniary externalities (THISSE and VAN YPERSELE, 1999).

II. The stability of ICT clusters : theoretical considerations and empirical evidences

"ICT clusters" seem to find new ways of research when they are analysed as locational norms. In this framework, we can distinguish their mechanisms of development according to the specificity of the mimetic behaviour of location. Nevertheless, it would be inopportune to not go far in the analysis. Theoretical studies on norms, or conventions, are generally concerned with their stability – or fragility – properties (YOUNG, 1998), and it would certainly be interesting to investigate this issue in the particular case of locational norms. Clusters proceeding from network effects are they more stable than clusters proceeding from informational effects? Are informational cascades more fragile than firms' agglomeration arising from increasing returns to adoption? These questions are theoretical as well empirical ones. Empirical, because in the aftermath of NASDAQ bubble and crash, some "ICT clusters" have well resisted, as Silicon Valley, whereas others, as Silicon Sentier, have been victim of a significant "relocation cascade". Theoretical, because the nature of mimetic behaviour at the origin of locational norms network effect vs. informational effect) is not without consequence on their respective stability. And because the stability of ICT clusters depends certainly on a complex combination of these two effects.

For that, it is necessary, first, to extend the distinction between informational and network externalities in location dynamics around the questions of the stability of norms; second, to clarify this distinction according to the organizational proximity dynamics clusters exhibit (TORRE and GILLY, 2000); third, to propose a simple reading of respective stability of clusters, and fourth, to illustrate our purpose by a brief return on the respective cases of Silicon Valley and Silicon Sentier.

A. The theoretical stability of cascades and networks

In the first section, we have presented separately the informational effect and the network effect and their associated location learning processes. The direct confrontation of these two effects in terms of individual gains, collective efficiency and speed of clustering process will allow us to discuss the fragility or stability of locational norms.

The evolution of the benefits firms obtain when they are engaged in location mimetic process can differ according to the model. In models of informational externalities, gains are probabilistic and fixed. The alignment of locational choices does not modify the gain structure. The only thing that is modified is the uncertainty degree of the respective gains of each location. In the model of network externalities, this is quite different. In this case, the gains are an increasing function of the agglomeration economies, i.e. of the increasing alignment of locational choices. This formal relation can be interpreted by the possibilities of cooperation and collective invention the so-called network effect) agglomeration stimulates.

The question of collective efficiency is a consequence of the first question. In the model of network effect, the region which monopolizes *in fine* the industry is not necessary the one which displays *a priori* the better characteristics the maximal average of heterogeneous individual preferences). Nevertheless, this region increases *a posteriori* its collective efficiency and its attraction as soon as firms locate in the area. In the opposite, in locational cascades, it is always possible that firms converge towards an inefficient area, i.e. an area that is not representative of the individual preferential signals. This property is a direct consequence of the non-evolving gains in informational cascades.

The question of the speed of clustering process finds also different answers in the framework of the two models. In the models of spatial network effects, as in all models of network externalities, the cumulative dynamics is dependant of the critical mass above-mentioned. Under this critical mass, and according to the theoretical weight conferred to agglomerations economies, each area can be attractive. In locational cascade, agent can enter quickly in a cascade, especially if the model supposes the existence of a “fashion leader” in the beginning of the process.

The question of the stability and fragility of clusters follows from all of these considerations and can be analysed according to the degree of individual expectations evolution (SUIRE, 2003). In the model of spatial network effect, the pressure of agglomeration economies continuously distorts the structure of individual expectations and, consequently, the clustering process is path dependent. In other words, the weight of productive interdependencies reinforces the attraction of the area and insures the anchorage of firms. The area becomes a locus of specific relational assets ZIMMERMANN, 1998), which renders relocation strategies costly. In the opposite, because of the non-evolution of individual expectations in informational cascades, there is a strong possibility of breakdown of a cascade, particularly if we suppose exogenous informational shocks (BIKCHANDANI et al, 1998). For instance, in the case of public information release in a period of the process, the cascade in course can be swiftly reoriented. In consequence, cascades are fragile with respect to small shocks and the fixed structure of individual expectations is a strong source of instability of locational cascades. As a result, the probability or the effectiveness of firm anchorage is reduced.

At this stage, we have shown that behind close results – a locational norm proceeding from sequential and cumulative locational choices – economic properties are different when we study in details the links between individual behaviours and the stability of collective norm. These differences in the collective process of location can be also studied according to the forms of relational proximity interactions in clusters exhibit.

B. The organisational proximity in ICT clusters

The organisational forms of ICT clusters can differ according to the fact that there are the consequences of informational or network effects, or a particular mix of each ones. In terms of TORRE and GILLY (2000), the geographical proximity is a common denominator of the two types of clusters. But there are different with respect to the degree and the features of their organisational proximities. Once again, these differences are not without consequence on their respective economic properties of stability.

Several typologies have been realized in order to identify the coexistence and the complexity of organisational forms of districts or clusters. The criteria of these typologies are generally based on the local governance and communication flows inside and outside the area (STORPER and HARISSON, 1991; MARKUSEN, 1996). These typologies are helpful in the understanding there provide on the diversity of clusters. But typological approaches cannot be relevant without a theoretical framework that explains this diversity. The investigations on proximity dynamics (TORRE and GILLY, 2000) overpass these limits with the definition of an analytical grid of proximity links. The concept of proximity is introduced in two-dimensional way – geographical and organisational proximities – in order to focus on spatial dynamics beyond the traditional relations of market competition and pecuniary externalities. In other words, researches on proximity are now well designed to understand the complex dimensions of relational features of clusters (GROSSETTI and FILIPPI, 2004).

Organisational proximity is defined in two distinctive – and sometimes intertwined – ways. According to adherence logic, the organisational proximity degree will depend on the intensity of direct interactions and interdependencies between agents individuals or firms). According to similarity logic, the organisational proximity will be strong if agents share the same reference space in terms of representations or strategies. Although these two definitions can intersect each other in the reality, there are however distinctive, because if the effectiveness of interactions is necessarily required in the first definition, agents can be close in organisational terms without direct interactions or strong interdependencies. Geographical proximity is defined in order to focus on geographical distance, with a strong attention paid to the functional distance linked to social and economic infrastructures. As a consequence and in the reality of industrial and spatial dynamics, clusters can now be defined as singular combinations of these two proximities.

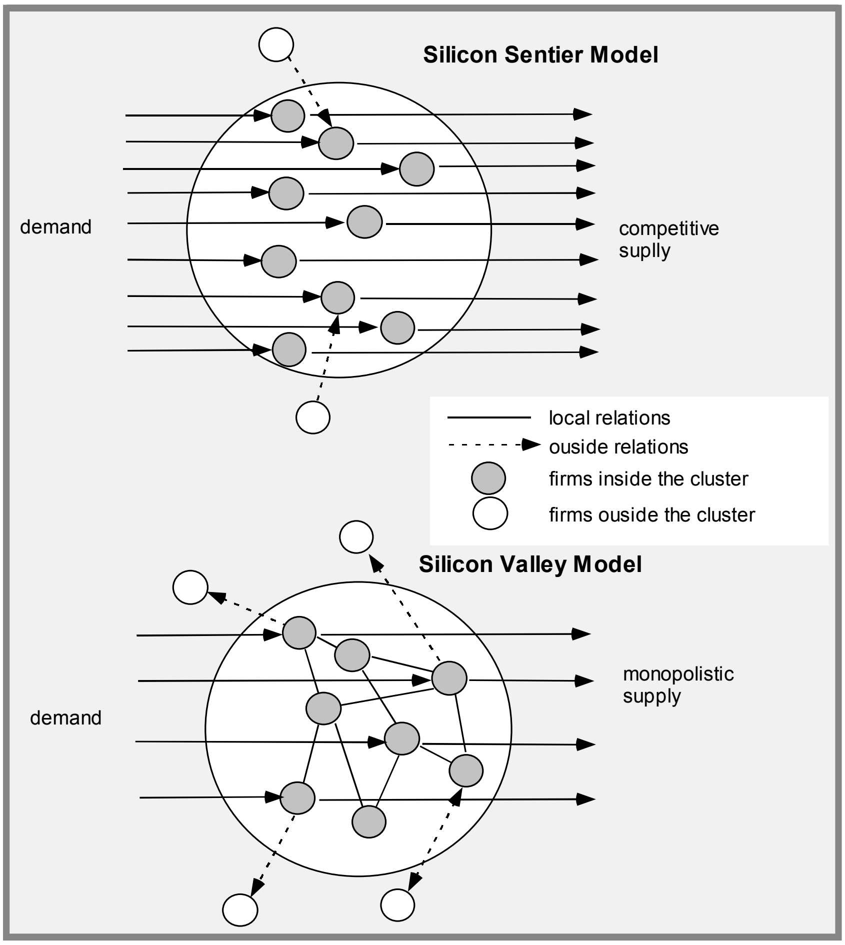

Figure 4: organisational structure of ICT clusters

From their specific and respective relational structures, the two models of locational norms we have developed can be reinterpreted in terms of proximity dynamics (figure 4). The Silicon Sentier model, particularly before the NASDAQ bubble crash, is representative of a regional model that combines geographical proximity and organisational proximity in its similarity logic. In this mimetic locational process, the e-business and media start-up converge in their representation and cognitive models that characterize these activities. In particular, these similarities are obvious in their business models, their financing and payment practices, as far as their young and creative human resources which is emblematic of urban and social amenities (FLORIDA, 2002; SUIRE, 2003). Conversely, the degree of organisational proximity in its adherence logic is very weak in this model of ICT cluster because of the weakness of productive interdependencies. Firms are only embedded in competitive relations in markets where products and business models are close together search engines, e-business, media services, …). For some firms, an adherence logic appears, but outside the cluster, through the vertical relations between international firms and their local plants, as the location of Yahoo France in the Silicon Sentier before 2000. Informational externalities are there the only ones that display the agglomeration of firms in the Sentier area? No, other externalities appear, in particularly pecuniary ones, through the common share of broadband infrastructures which firms are great consumers. Nevertheless, it is not sure that the pecuniary externalities are able to counterbalance the inherent fragility and instability of locational cascades.

The Silicon Valley model is quite different and combines geographical proximity and organisational proximity in its adherence logic. Direct interactions and productive interdependencies are strong because of the specificity of the software and computer industry. This sector is illustrative of the role played by network and system goods in terms of industrial organization (SHY, 2001; AOKI and TAKIZAWA, 2002). Markets are monopolistic ones, innovation driven, and interdependencies and technological modularity and compatibility are the rule of competitiveness. In a similarity logic, organisational proximity is also strong but, conversely of the previous case, outside the cluster. Several firms have located plants near different local markets, in order to deal with the spatial heterogeneity of technological norms or standards in the world. These relations are less hierarchical than ones of the Silicon Sentier model and insure knowledge flows from outside to inside the cluster. At last, as in the previous case, other externalities are involved in network model of Silicon Valley, such as pecuniary externalities, through the share of telecommunication or financial services, and knowledge externalities, through the presence of universities and a strong labour mobility.

We have briefly shown that beyond the geographical proximity, the respective logic of organisational proximity is a source of differentiation of ICT in terms of their coordination features. The proximity dynamics approach is so relevant insofar as it permits to distinguish informational and network effects in clustering processes. In spite of some common denominators, there is a strong correlation between the nature of the cumulative locational process and the relational structure of the cluster.

C. How to convert cascades into networks?

The nature of sequential and cumulative processes of location and the organisational proximity logic are the key concepts and the underlying features of an economic analysis of the coexistence and the stability of ICT clusters. Clusters will have even more chances to quickly grow that their processes are governed by an informational effect, but clusters will be even stable that there combine a strong share of network effects compared with informational ones. As BIKCHANDANI et al (1998) say : *"In many realistic settings, in addition to the informational externality described here, there are direct payoff interaction in a form of positive consumption of production externalities – sometimes called network externalities. The intuition here is that joining a network may help both the joiner and the others who have already joined. Uniformity is likely in the presence of network externalities. However, this uniformity does not display the fragility of an informational cascade"* p. 168).

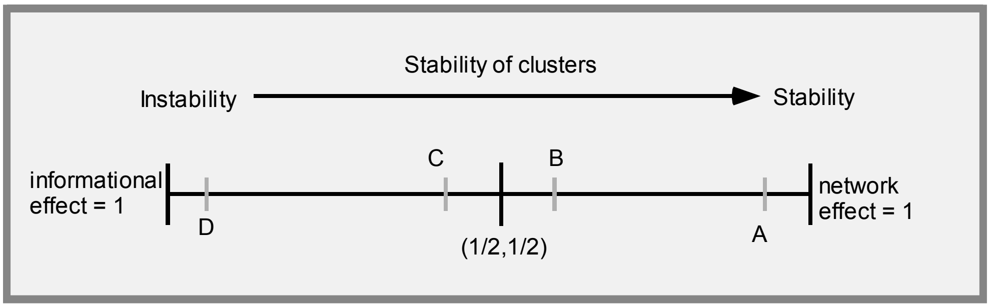

Figure 5: the effects of the distribution of mimetic behaviours on the stability of clusters

If we reason, as reality always invites us, on a continuum of agglomeration logics nor than on a discrete case, the development and the stability of ICT clusters will depend on the combination of the two types of externalities. As a matter of fact, it becomes possible to interpret ICT clusters according to a distribution of locational behaviours (figure 5). At point D on the figure, when the informational effect dominates widely the network one, clusters can display a strong and chronic instability. Firms have only responded to locational signals of the first firms located in the area and have not built up strong interdependencies. This point is typical of the Silicon Sentier model as it has performed before the NASDAQ and other new stock markets bubble crashes. At point C, the anchorage of activities is not yet insured, but network effects appear, whereas these later become majority at point B. At this point, the stability is not yet complete, but clusters have obtained a sufficient critical mass that is necessary to the increase of network externalities. Lastly, at point A, the network effect widely dominates the informational effect, so that productive interdependencies appear as a strong basis of regional anchorage. This point is typical of the Silicon Valley model.

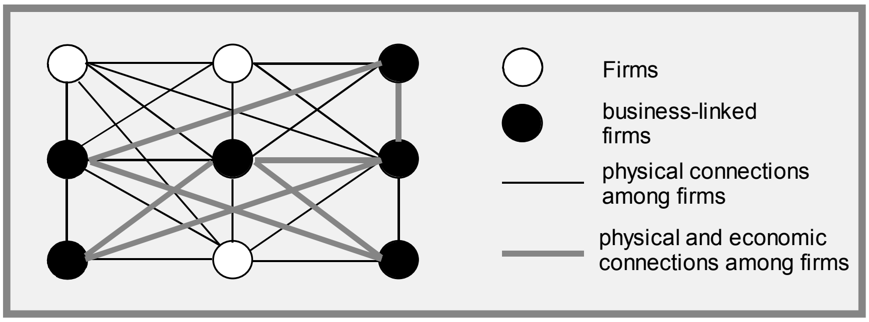

Figure 6: graph of connectivity among firms in clusters CAPELLO and NIJKAMP, 1996)

CAPELLO and NIJKAMP (1996) propose an investigation on the stability conditions of clusters close to our analysis (figure 6). According to their purpose, the stability of firms' agglomerations depends on the degree of physical and economic connections between firms. In terms of proximity dynamics above-mentioned, the physical and economic connections can be distinguished according to the respective similarity and adherence logics. Geographical proximity insures a physical connection between firms and is a source of static efficiency proceeding from traditional pecuniary externalities. But the dynamic efficiency cannot be obtained if these physical connections are not coupled with economic connections, which permit tacit and strategic knowledge exchanges and new market and product creation. Nevertheless, CAPELLO and NIJKAMP rightly admit that the physical connections are often a precondition to the activation of economic connections. In that sense, we converge on the idea that informational effects and network effects are often sequential and causal effects.

D. Empirical evidences : the ambivalence of "Silicon" label

The stability conditions of locational norms developed in this paper find yet again empirical counterparts in the respective cases of Silicon Valley and Silicon Sentier. The direct confrontation of these two cases in terms of their respective stability properties shows that different regional dynamics are concealed behind the analogy in their label. If we consider that the NASDAQ bubble crash is one of the most outstanding fact of the new growth regime, it becomes interesting to study the resistance capacities of ICT clusters respectively based on informational and network effects. If Silicon Valley has resisted to the aftermath of NASDAQ bubble and crash (AOKI and TAKIZAWA, 2002; HENTON et al, 2002), this is not the case for

Silicon Sentier that has been victim of several firm departures and deaths (IAURIF, 2002; SUIRE and VICENTE, 2002).

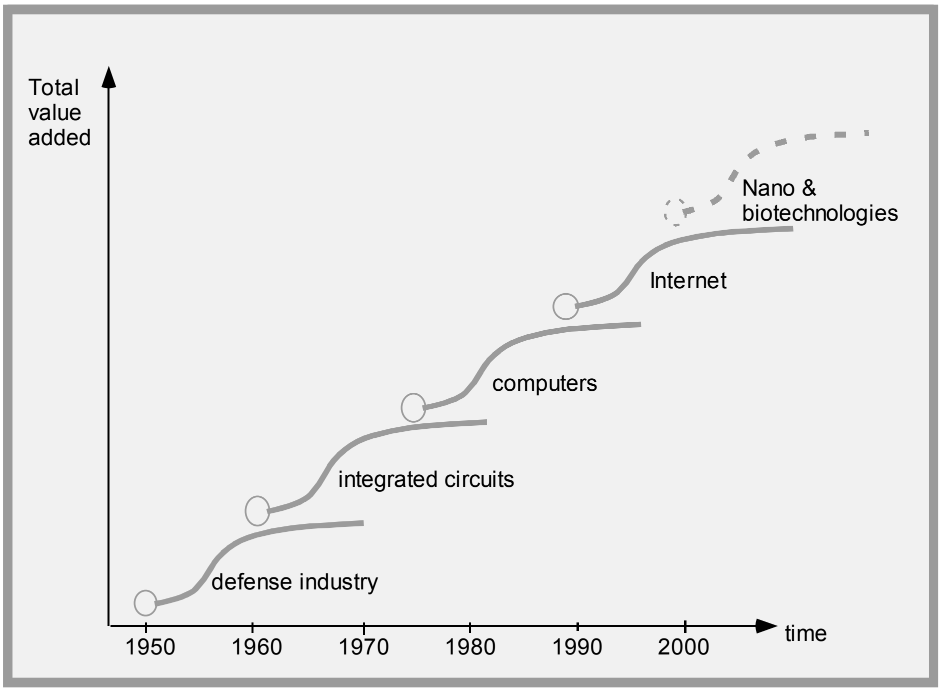

Figure 7: technological regimes in Silicon Valley HENTON et al, 2002)

On the one hand, Silicon Valley has going through a stagnation period before the growth recovery due to nano and biotechnologies innovations (figure 7). On the other hand, Silicon Sentier has going through a strong phenomenon of "relocation cascade" from 2000 to 2003. As a matter of fact, Yahoo – the "fashion leader" at the origin of the cascade – has leaved the area and has relocated elsewhere in Paris 17th district), as a consequence of its growth and the size of available buildings in the area. Nomade has been relocated in the periphery of Paris, near Liberty Surf, as a consequence of a joint-venture operation. Other firms have also relocated, always as a consequence of economic or commercial operations, and the area of Sentier has quickly lost its creative and urban amenities.

Recall that the evolution of payoffs and the collective efficiency in clusters are appreciably different depending on whether firms are embedded in a locational cascade or in a locational process where network effects play a major role. As a matter of fact, when an exogenous shock is introduced in the structure of individual expectations, the consequences on the stability of clusters are going to differ as well. In the case of network effect, the relocation can be costly for the firm that chooses this strategy, because she can lose – and certainly she will lose – the benefits of economic interdependencies based of strategic and tacit knowledge exchanges. In the case of informational effect, as a consequence of non-evolving payoffs, the strategy of relocation is not costly for firms, especially if they find pecuniary advantages elsewhere. For instance, Yahoo has preferred to leave the Sentier rather than to take part to the speculation on commercial property prices that proceeds from the congestion of the area. The increasing land prices are the rule in Silicon Valley since a long time, but firms have more often preferred to take part to this speculation rather than to lose the benefits of local interdependencies and strong complementarities.

Others empirical considerations are conform to the stability properties of locational norms. For example, the reasons of the NASDAQ bubble crash have had different repercussions on the reversibility of locational trajectories. When statistics on Internet based markets have been available, in particular electronic commerce ones, e-business activities has revealed a diffusion largely under the expectations. These statistics have constituted a *public information release*, in the sense of BIKCHANDANI et al (1998), which has made the locational cascade of Sentier fragile. In the opposite, the bubble crash has less affected the software and computer industry (HEGE, 2001), so that clusters of such firms, as Silicon Valley, have been less concerned by such a phenomena.

At last, we have shown that geographical proximity is not a sufficient condition of the regional anchorage of firms. This later is stronger than geographical proximity is coupled with organisational proximity, that is to say that physical connections are coupled with economic connections. This organisational proximity, in its adherence logic, has been strongly absent in the development of the Silicon Sentier before the bubble crash, whereas it has always been the main feature of Silicon Valley. Does this finding signify that clusters proceeding from cascades are destined for failure? The answer is negative. We have also shown that locational cascades can be the condition for clusters to reach the critical mass where network effects perform. Silicon Sentier after the bubble crash is once again illustrative of such theoretical ideas. Since 2002 and the intervention of local public communities, we can have hopes to see the Sentier in a new trajectory of development. An association (NET : *New enterprises and territories – Silicon Sentier*) has been created by the *DATAR*[8], the *Caisse des Dépots et Consignations*[9], and the *Ville de Paris*, in order to confer a new dynamism to the area. This association has for objectives to promote relations between remaining firms in the Sentier 60), to facilitate knowledge transfers and new market emergence. In our terms, these objectives are to transform informational effects into network effects, to transform a locational cascade into a relational specific asset, which render relocation costly.

Conclusion

In this paper, we have try to show that ICT clusters can be defined as locational norm, in order to overpass the traditional assumptions (strategic and market interactions) of most of models of economic geography. To achieve our aim, we have supposed sequential and cumulative location processes and decentralized interactions between firms endowed by heterogeneous preferences. The interest of this approach is first, to observe that the fact that interactions are sequential is a strong source of locational choice alignment, second, to show the intrinsic ambivalence of the stability properties of locational norms. According to the logic of the mimetic process of individual location, the effect on the stability is far to be the same. When informational effects play a major role, clusters can emerge rapidly, but their stability, as we have empirically and briefly shown, is not insured. In the opposite, when network effects prevail, the weight of local interdependencies in the structure of individual payoffs insures a strong stability in the cluster. Obviously, it seems difficult to precisely consider and empirically observe the primacy of one of the effect over the other, and each cluster presents in reality each effect according to diverse degrees. Nevertheless, the approach developed in this paper reveals that regional strategies cannot neglect the network effect if the regional anchorage of activities is the main objective. We hope that further researches on the stability of clusters will follow.

[8] The French delegation of regional action
[9] The French delegation that contributes to the financing of regional infrastructures developed by local communities

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