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Mathematical Model of the Influence of Knowledge Transfer on the Location Choice of a Multinational Company

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Authors' contributions

This work was carried out in collaboration between all authors. Author DL introduced the conceptual problematic and the mathematical modelization has been proposed by author EP. We read and approved the final manuscript.

Research Article

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ABSTRACT

Introduction: Research works haven't yet shed much light on the performance of the location choice of multinational companies. The aim of this publication is to highlight the link between the transfer of knowledge flows and the location of a multinational company.
Methodology: We put forward a conceptual approach allowing to formulate the equations of a mathematical modelization of its consequential performance.
Results and Discussion: Our research has led us to highlight some types of managerial behaviour which will ensure the location performance within a cluster.
Conclusion: We have shown that the embedded knowledge is very important for the location choice of a multinational company. We concluded model for this location choice.

Keywords: Cluster; knowledge flows; location; mathematical equations; performance.

1. INTRODUCTION

The trend of research concerning organizational approach based on knowledge has gradually emerged as the main perspective aiming at explaining the movements of multinational companies [1]. The most recent publications underscore that the idea of

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bringing together learning on the one hand and the cluster's prospects on the other hand opens up a fruitful and promising way of studying the competitiveness of multinational companies [2]. For instance, Gupta and Govidarajan conceptualize multinational firms as being networks for transactions, functioning via knowledge flows [3]. Davenport and Prusak define a knowledge flow as being a fluid combination of experiments, a running exchange of essential values, of contextual information, and of shrewd expert evaluations [4].

Firstly, new implantations provide multinational companies with an access to their partners' knowledge, as they combine their own amount of knowledge with that of their partners [5]. In this perspective, the geographical location of a multinational company is a key-concern of research in international management [6,7].

Secondly, research work concerning organisational approach based on knowledge has focused on the study of contexts in which knowledge flows are highlighted. In this perspective, a good deal of research work has been undertaken in order to elaborate the theory of clusters, based on knowledge. [8]. A cluster has therefore been conceptualized as a site in which the creation of embedded knowledge is stimulated, as a consequence of the geographic and organizational closeness of local companies [9](p 50). This research work has shown the assets of clusters, which influence the choice of multinational companies as far as their location is concerned [10].

However, the significant indicators in order to predict the long-term efficiency of a new location contemplated by a multinational company are still unknown [11]. Our conceptual representation of the localization of a multinational company derives from the general concept of space and spatiality, applied to this issue of localization by [12]. Originating from this statement, the question which has prompted our reflection can be expressed in the following words: how to predict the location performance of a multinational within a cluster?

Min and Melachrinoudis propose a research work regarding the optimization of a location choice made by a multinational company for its production units [13]. However, this optimization does not take into account the influence of knowledge transfer.

We shall first put forward a conceptual approach of the location performance of a multinational. This research aims at showing the influence of knowledge flows transfer on the efficiency of the location choice. Then we shall formulate the equations of a mathematical modelization. The mathematical model actually shows that, when the multinational company is not capable of integrating such knowledge into its structure, the local business relationship breaks off. We shall then be able to submit our views to a discussion, and to underline the fact that there is indeed a link between the transfer of knowledge flow and the success of the location of a multinational company within a cluster.

2. LOCATION OF A MULTINATIONAL COMPANY AND THE TRANSFER OF KNOWLEDGE: AN INGENIOUS LINK?

For a long time, it has been generally assumed that this was a one-way transfer, from multinational companies towards local businesses [14]. Nowadays, as competition between multinational companies has become harder and harder, their location choice has become a major strategic issue, and local actors' knowledge may very well have an influence on its success [15]. Referring to Spicer's new terminology, we shall therefore consider knowledge transfer of a convergent type, that is to say, from local to international level [16].

2.1 Learning and Location

As they look for new sources of external knowledge flows, multinational companies select some specific geographical sites for their implantation. As the major part of an organisation's knowledge is deeply rooted in expertise and the individual experience of its members, within multinational companies, learning implies the creation, transfer and integration of knowledge flows. The newly acquired databank provides a key-stone for an effective development and for the renewal of the organizational structure, and therefore represents a major competitive asset. Porter underlines the fact that competitive advantage is determined by an appropriately located innovation process, and underscores the crucial importance of the location choice made by the multinational company [6](p. 37). Most costs and risks are consequently linked to obstacles raised by distance and her immediate result on the effective transmission of explicit and tacit knowledge [17].

2.2 Organisational Knowledge

The usual distinction between tacit and explicit knowledge derives from the articulate or implicit nature of the considered knowledge. Tacit knowledge is inarticulate, it is essentially personal by nature; such a knowledge is difficult to transfer [18]. On the contrary, explicit knowledge can be codified and transmitted much more easily [19].

However, the distinction between tacit and explicit knowledge should not be considered as a dichotomy but rather as a spectrum with both types of knowledge – tacit and explicit – at the extremes [20]. The consideration of transfer speed in an organization as far as knowledge flows are concerned (a notion first mentioned by Davenport and Prusak is undoubtedly useful in order to evaluate how long these transfers will take, and how much they will cost) [4]. In their research work, Inkpen and Wang have observed that tacit knowledge is difficult to assess, and, consequently, that a company in a phase of learning often keeps on concentrating on its explicit knowledge which is easier to transmit (and which is less valuable) [19].

Embeddedness is another significant feature of knowledge which has an influence on learning capacity. Its transmission requires face-to-face interactions [21,22]. Companies holding a common knowledge use it to form corporate alliances and to organize themselves so as to create innovative networks within an industrial cluster [23].

Companies should transfer their knowledge according to difficulty, starting with the easiest category: explicit knowledge, then tacit knowledge, then embedded knowledge. The estimation of transfer duration and costs in each category is obviously dependent on increasing difficulty, therefore on the order in which this transfer is made. Consequently, embedded knowledge transfer, which does exist in some branches of industry, is the final learning stage. Distance hardly ever influences the duration and costs of a transfer of explicit knowledge, whereas distance is important when the duration and costs of a transfer of tacit and embedded knowledge have to be estimated.

2.3 The Context of an Industrial Cluster

Research work has more and more highlighted the geographic issue as being crucial in the location strategies of multinational companies. For instance, Knickerbocker underscores the direct movements of investments made by American multinational companies towards clusters [24]. Porter gives the following definition of a cluster: “a geographically close compact group of inter-related companies with common institutions of their own”. Knowledge is embedded within a cluster, that is to say within small innovative companies each of them part of a cooperative, regional, industrial ruling system [25](p.254).

This knowledge is essentially accessible to the actors at work within the limits of the cluster. At the same time, recent studies demonstrate the geographic concentration of innovation, and show that knowledge developments are directly dependent on the networks formed by companies which are embedded in the same region [26]. The major specific feature of innovation, revealed in research work about clusters, corresponds to the necessity of transferring tacit knowledge flows through organisational frontiers. The geographic nearness of partners reduces the importance of issues linked to tacit knowledge transfer because it allows as higher frequency of face-to-face interactions [17](p.11). On the contrary, explicit knowledge can be easily codified and transferred in a formalized language. Therefore, geographic nearness is not crucial as far as the transfer of explicit knowledge flows is concerned.

3. MATHEMATICAL MODEL

The aim of our model is to propose a mathematical tool to determine the long-term financial results for a multinational which is looking for a new location. This is a problem of complex complementarity mentioned by [27](p.381). The objective for our model proposed is to enable the group to choose the best location for a future site.

A feature of locating a multinational in a cluster is the transfer of knowledge between the companies in the cluster and the multinational. Transferring knowledge from the cluster towards the multinational leads to interactions between this new knowledge and the knowledge already present in the multinational. This results in innovation, gains in productivity and so financial gains. For the multinational, the performance which results from this location is equal to the difference between the financial gains and the costs produced by the knowledge transfer.

However, the gain in performance for the multinational company may result in an increased competition between the multinational company and the cluster, and the effect of this may be a drop in the financial results and a loss of performance for the companies of the cluster.

The knowledge to be transferred is selected so as to maximize the global performance, that is to say the total amount of performance achieved by both the multinational companies and the companies in the cluster, deriving from all the transfers which were carried out as the new implantation was under way. In order to ensure the stability of the new location, the performance of the multinational company and of each company in the cluster must be positive, which means that the knowledge transfers should globally by profitable to all partners. Obviously the necessity of stability lessens the performance of the implantation under way, but it also avoids a rupture of the local partnership. It ensures a long-term knowledge transfer until the ultimate stage of embedded knowledge is reached, generating more and more performance.

The evaluation of gains and drops of the financial results linked to knowledge transfer can only be made from a thorough examination of the structure of the companies in the cluster, and of the structure of the multinational company. The cost of a knowledge transfer can be calculated from the general structure of the knowledge (K) involved which is partitioned into a "n" number of groups – Kj with "j" ranging from 1 to n. This partitioning is established so that K_1 only contains explicit knowledge whereas Kn only contains embedded knowledge. Each group of intermediate knowledge (Kj with j ranging from 2 to n-1) contains both tacit and explicit knowledge which are not independent, and the proportion of tacit knowledge gradually increases with "j" (in reference to Inkpen and Dinur's knowledge spectrum, 1998)[20] . The transfer of the knowledge group Kj from the cluster to the multinational company takes place in Tj days and has a financial cost of Fj. As distance has a greater influence on the transfer of tacit and embedded knowledge than on the transfer of explicit knowledge, Tj and Fj are functions related to j. Therefore, the complete knowledge transfer takes a time $T=T_1+\ldots Tj+\ldots Tn$ for a total cost of $F= F_1+\ldots Fj+\ldots Fn$. In the transfer costs we can certainly include the costs related to geographical distance.

We suppose that the knowledge transferred from the cluster to the multinational during the time period i, defined as:

$$[Tt_{i}, Tt_{i+1}[\quad \text{for} \quad i=0,n \quad \text{with} \quad Tt_j = \sum_{k=1}^{j} T_k \quad \text{for} \quad j=0,\, n \quad \text{and choosing} \quad T_{t_{n+1}} >> T_{t_n},$$

are only operational – and intervene effectively in the calculation of performance- after the total transfer of each of the packets of knowledge (Kj for j=1, n); so the total operational knowledge transferred during the time period i after implantation of the new site is:

$$Ct_i = \sum_{j=1}^{n} K_j \quad \text{for} \quad i=0, \quad n,$$

Generally, the total knowledge acquired by a firm is broken down at a moment of time t into three parts according to its end use ([28], [29]):

$$\mathrm{Ca}_\alpha(t) = \mathrm{Ca}_\alpha^1(t) + \mathrm{Ca}_\alpha^2(t) + \mathrm{Ca}_\alpha^3(t) \quad .$$

From this, the Greek lower index (here α has a value of 1 for the multinational and 2 for the cluster company. As for the upper index, it relates to the type of knowledge:

If i=1, it represents knowledge leading to improvements in production processes,
If i=2, it represents knowledge associated to product innovations,
If i=3, it represents knowledge with no direct incidence on production.

To take account of the speed with which the knowledge is created at the moment t, represented mathematically by the total derivative of the function Ca_α^i corresponding to the rate of fresh knowledge generated at time t and denoted traditionally as $\frac{\mathrm{dCa}_\alpha^i(t)}{\mathrm{dt}}$, we use a Cobb-Douglas type function ([30], [31]):

$$\frac{\mathrm{dCa}_\alpha^i(t)}{\mathrm{dt}} = \lambda_\alpha^i H_\alpha(t)^{\gamma_\alpha^i} \mathrm{Ca}_\alpha^i(t)^{\Phi_\alpha^i} X_\alpha^{\theta_\alpha^i} \,, \tag{1}$$

with $\lambda_\alpha^i > 0, \quad \gamma_\alpha^i > 0, \quad \Phi_\alpha^i > 0, \quad \theta_\alpha^i > 0,$

in this function $H_\alpha(t)$ and $Ca_\alpha^i(t)$ represent respectively research activity and the total knowledge acquired at the moment t; $X_\alpha(t)$ is a local variable which influences innovation positively, for example the share capital or the structure of the local economy at moment t.

The performance of the multinational (α =1) or of the cluster company (α=2) over the period of time i (i=0, n), resulting only from the benefit of the acquired knowledge, can be written using the concept of complementarity which mathematically leads to the use of the supermodular class of functions [32,29].

$$\Pi_{\alpha i}(A_{\alpha i}) = \pi_{\alpha i}(q_{\alpha i}, i_{\alpha i}, r_{\alpha i}) - R_{\alpha i}(r_{\alpha i}, e_{\alpha i}, f_{\alpha i}, m_{\alpha i}) - I_{\alpha i}(i_{\alpha i}, f_{\alpha i}, a_{\alpha i}, h_{\alpha i}), \tag{2}$$

In the equation below, $A_{\alpha i} = (q_{\alpha i}, i_{\alpha i}, r_{\alpha i}\ a_{\alpha i}, e_{\alpha i}, f_{\alpha i}, h_{\alpha i}, m_{\alpha i})$, $q_{\alpha i}$ represents the quantities produced over the period of time i (i=0, n), $i_{\alpha i}$ represents the average frequency of knowledge linked to an improvement in production processes over the period of time 0:

$$i_{\alpha 0} = \frac{Ca_{\alpha 0}^1}{T_{\alpha 0}}.$$

For subsequent periods of time (i=1, n):

$$i_{\alpha i} = \frac{Ca_\alpha^1(Tt_i)}{(T_{\alpha 0} + Tt_i)},$$

where $Ca_{\alpha 0}^i$ and $T_{\alpha 0}$ represent respectively the total knowledge leading to an improvement of production processes, and the age of company α at the moment of the purchase.

$r_{\alpha i}$ represents the average frequency of knowledge leading to product innovation over the period of time 0:

$$r_{\alpha 0} = \frac{Ca_{\alpha 0}^2}{T_{\alpha 0}},$$

For subsequent periods of time (i=1, n):

$$r_{\alpha i} = \frac{Ca_\alpha^1(Tt_i)}{(T_{\alpha 0} + Tt_i)},$$

where $Ca_{\alpha 0}^2$ represents all the knowledge leading to product innovation in company α at the time of the purchase. Moreover $\pi_{\alpha i}(q_{\alpha i}, i_{\alpha i}, r_{\alpha i})$ represents the operating profit and is a supermodular function of its three variables $q_{\alpha i}$, $i_{\alpha i}$, $r_{\alpha i}$.

$I_{\alpha i}(i_{\alpha i}, f_{\alpha i}, a_{\alpha i}, h_{\alpha i})$ represents the costs resulting from innovations in production processes. Moreover $(-I_\alpha)$ is a supermodular function of its four variables $i_{\alpha i}$, $f_{\alpha i}$, $a_{\alpha i}$, $h_{\alpha i,}$ $f_{\alpha i}$ represents the level of training of the workforce, $a_{\alpha i}$ represents the level of autonomy of the workforce given their knowledge of production processes, $h_{\alpha i}$ the level of horizontal communication.

$R_{\alpha i}(r_{\alpha i}, e_{\alpha i}, f_{\alpha i}, m_{\alpha i})$ represents the costs resulting from product innovation, moreover $(-R_{\alpha i})$ is a supemodular function of its four variables $r_{\alpha i}$, $e_{\alpha i}$, $f_{\alpha i}$ and $m_{\alpha i}$, $e_{\alpha i}$ represents the efficiency of the design process, $m_{\alpha i}$ represents the manufacturing flexibility.

So, the mathematical problem consists in finding the location which optimises the performance of the local structure at the moment Ttn_{+1} (which is seen as well downstream of the time Tt_n of transfer of all the knowledge), which means, using the performance of company α given by equation (2) looking for:

$$\left(\sum_{i=0}^{n} \sum_{\alpha=1}^{2} \Pi_{\alpha i}(A_{\alpha i}) - F_i\right)$$

with the constraints or conditions for stability expressing that the performance of the cluster company (α=2) must remain positive at the moment Tt_j (j =1, n+1):

$$\sum_{i=0}^{j-1} \left(\Pi_{2\mathrm{i}}(A_{2\mathrm{i}}) + \beta_i F_i\right) > 0, \tag{3}$$

$\beta_i \in]0, 1[$ being a coefficient making it possible to pay back to the cluster company the cost of knowledge transfer for the period i.

The non-respect of one of these conditions for a time Tt_j can result in the breaking off of the local alliance, as mentioned later in the discussion.

We obtain $\mathrm{Ca}_\alpha^k(\mathrm{Tt}_i)$ (for k=1, 2 and i=1, n) ; by integrating the differential equation (1) over the period i ($\Phi_\alpha^i \neq 1$) we see that the change in quantity of knowledge in company α is given by the following recurrence relation, for i=1, n:

$$\mathrm{Ca}_\alpha^k(\mathrm{Tt}_i)^{-\Phi_\alpha^i+1} = \lambda_\alpha^i\left(-\Phi_\alpha^i+1\right)\int H_\alpha(t)^{\gamma_\alpha^i} X_\alpha(t)^{\theta_\alpha^i}\mathrm{d}t + \mathrm{Ca}_\alpha^k(\mathrm{Tt}_{i-1})^{-\Phi_\alpha^i+1} + (2-\alpha)C_i^k \tag{4}$$

with the initial condition at the moment of implantation:

$$\mathrm{Ca}_\alpha^k(0) = \mathrm{Ca}_{\alpha 0}^k \ .$$

The last term of the second member of the equation (4) ($(2-\alpha)\,C_i^k$) corresponds to the quantity of operational knowledge transferred from the cluster company to the multinational (we obtain C_i^k for α=1); of course it vanishes for α=2 (cluster).

For example: the knowledge transfer might be associated to production of an identical product by the multinational and by the cluster company. If, after the knowledge transfer, the production cost per unit is lower for the multinational than for the cluster company (these costs can be quantified using the supermodular functions depending on $A_{\alpha i}$), production of this product should be halted in the cluster company. Thus the corresponding knowledge will no longer be included in the calculation of the frequencies $i_{\alpha i}$ or $r_{\alpha i}$ mentioned above, which will result in a reduction in the overall performance of the cluster company. However, if these production costs remain more or less identical for the cluster company and for the multinational, production can be maintained.

Using data available on the multinational and the cluster company, the parameters used for equations (1) and (2) can be evaluated over each period of time. The supermodular profit functions (equation (2)) can be assumed to be quadratic [33].

4. DISCUSSION

Research works must systematically go on exploring how embedded knowledge within a cluster has an influence on the efficiency of the location choice by a multinational company. In this respect, Kale and Anand have suggested that the companies of a cluster are conscious of the fact that implantation attempts by multinational companies are intended to exploit learning opportunities [34]. Consequently, local businesses may become very cautions towards the implantation of multinational companies, and they will then do their best to increase their own learning capacities.

In this publication, we have tried to clarify the complex issues brought up by the location of a multinational company within a cluster, raising all along the following crucial question: what is the efficiency of such a location? Indeed, the decision to enter a regional cluster is usually taken whereas performance results are considered uncertain. Our whole reflection work has demonstrated that it is significant to take the transfer of knowledge flow into consideration in order to answer this question. The mathematical model shows that the multinational company chooses its new implantation with a view to reach an optimal level of performance.

In order to make this mathematical model operational, it is necessary to evaluate all the issues and distances involved: geographical, administrative (institutional), economic and linguistic, and their subsequent costs as the transfer are being actived [9]. Porter's research works highlight the fact that interactions between the companies of a cluster result in a larger volume of innovations (and of their subsequent competitive advantages) than the one which would have been generated in the companies of the cluster had operated separately [25](p. 32). This dynamics develops even more as knowledge flows are being transferred between the multinational company and the whole cluster. Therefore, the localization will be effectively optimized if the multinational company really participates in the local processes of knowledge transfers within the cluster [35,36]. The question may actually be raised in the following words: considering the volume of innovations generated separately by the multinational company and the cluster, what volume of innovations can be expected in the event of their collaboration?

Other investigations would certainly be welcome to improve by a quantitative study that would make the link between the proposed mathematical model and the efficiency of the location of a multinational in a cluster. In order to illustrate the impact of knowledge flows on the performance of multinational companies after a new implantation, we could study an industrial cluster. For example, the French perfume industrial cluster (in Grasse) has attracted multinational agribusiness, cosmetic and pharmaceutical industries. These multinational companies have attempted to transfer the knowledge flows originating from the producers of aromas and perfume compositions, and from perfume creators. This knowledge remains tacit, private and personal, and cannot be transferred unless a direct contact is established.

5. CONCLUSION

Our research work has demonstrated that the transfer of knowledge flows (explicit, tacit and embedded) is crucial to assess the efficiency of the localization choice made by a multinational company. First of all, we elaborate a conceptual model in order to have a better understanding of the impact of knowledge flow on the efficiency of a localization choice made by a multinational company. Secondly, we deduce a mathematical model from this conceptual one. The mathematical model optimizes the performance of the multinational company by using supermodular functions introduced by [32]. On the other hand, we supposed that there was no blocking during the transfers of knowledge and the rate of new knowledge is assumed to be controlled by Cobb-Douglas type function.

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REFERENCES

1. Eisenhardt KM, Santos FM. Knowledge-based view. A new theory of strategy.In: Pettigrew A, Thomas H, Whittington R, editors.Handbook of strategy and management. Thousand Oaks:CA: Sage; 2002.
2. Yang H, Lin Z, Peng, M,W. Behind acquisitions of alliance partners: exploratory learning and network embeddedness. Acad Manage J. 2011;54(5):1069-80.
3. Gupta AK, Govidarajan V. Knowledge flows and the structure of control within multinational corporations, Acad Manage Rev.1991;16:768-92.
4. Davenport TH, Prusak L. Working knowledge. Boston: Harvard Business School Press; 1998.
5. Inkpen AC, Tsang EWK. Learning in Strategic Alliances, In Walsh JP, Brief AP, editors The academy of management annals. vol. 1. New York, London: Lawrence Erlbaum Associates; 2008.
6. Porter ME. The Role of Location in Competition. Journal of the Economics of Business.1994;1(1):35-9.
7. Dunning JH. Location and the multinational enterprise: a neglected factor?. J Inter Bus Stud. 1998;29(1):45-66.
8. Maskell P. Towards a knowledge based theory of the geographical cluster. Industrial and corporate change. 2001;10:921-43.
9. Rallet A, Torre A. Proximity and Location. Reg Stu. 2005;39(1):47-59.
10. Rugman AM. The Regional Multinationals. Cambridge: Cambridge University Press; 2005.
11. Goerzen A, Asmussen CG. The Geographic Orientation of Multinational Enterprises and its Implications for Performance. Research in Global Strategic Management. 2007;13:65-83.

12. Codovic A, Mayrhofer U. Les stratégies de localisation des firmes multinationales une analyse du secteur automobile. Revue Française de gestion. 2008;184(4):151-65. French.
13. Min H, Melachrinoudis E. Dynamic Location and Entry Mode Selection of Mutinational Manufacturing Facilities under Uncertainty: A Chance-constrained Goal Programming Approach. Int Trans Oper Res. 1996;3(1):65-76.
14. Lin X. Local partner acquisition of managerial knowledge in international joint ventures: Focusing on foreign management control. Management International Review. 2005;45:219-37.
15. Gimeno J, Hoskisson RE, Beal BB, Wan WP. Explaining the Clustering of International Expansion Moves: A Critical Test in the U.S. Telecommunications Industry. Acad Manage J. 2005;48(2):297-319.
16. Spicer A. Beyond the convergence-divergence debate: The role of spatial scales in transforming organizational logic. Organ Stud. 2006;27(10):1467-483.
17. Ambos TC, Ambos B. The impact of distance on knowledge transfer effectiveness in multinational corporations. Journal of International Management Fox School of Business. 2009;15:1-14.
18. Dhanaraj C, Lyles MA, Steensma HK, Tihanyi L. Managing tacit and explicit knowledge transfer in IJVs: The role of relational embeddedness and the impact on performance. J Int Bus Stud. 2004;35:428-42.
19. Inkpen AC, Wang P. The China-Singapore Suzhou Industrial Park: A knowledge transfer network, J Manage Stud. 2006;43:779-811.
20. Inkpen AC, Dinur A. Knowledge management processes and international joint ventures, Organ Scie. 1998;9:454-68.
21. Nielsen B.B. The role of knowledge embeddedness in the creation of synergies in strategic alliances. J Bus Res. 2005;58(9):1194-204.
22. 22a. Leszczyńska D. La trajectoire organisationnelle et l'enracinement du savoir. L'étude de cas d'un cluster régional. Revue Management & Avenir. 2010;36(6):168-84. French.
    22b. Leszczyńska, D. "Historical Trajectory and Knowledge Embeddedness: A Case Study in the French Perfume Cluster." Management & Organizational History. 2013;8.
23. Rowley T, Behrens D, Krackhardt, D. Redundant governance structures: An analysis of structural and relational embeddedness in the steel and semiconductor industries . Strategic Manage J. 2000;21:369-86.
24. Knickerbocker FT. Oligopolistic reaction and the multinational enterprise. Cambridge: MA: Harvard University Press; 1973.
25. Porter ME. Location, clusters and economic strategy. In: Clark GL, Feldman M, Gertler M, editors. The oxford handbook of economic geography. Oxford: Oxford University Press; 2000.
26. Bell SJ, Tracey P, Heide JB. The Organization of Regional Clusters. Acad Manage Rev. 2009;34(4)/623-42.
27. Buckley PJ, Carter MJ. A formal analysis of knowledge combination in multinational enterprises. J Int Bus Stud. 2004;35:371-84.
28. Ghiglino C. Random walk to innovation: Why productivity follows a power law. J Econ theory. 2012;147:713-37.
29. Milgrom P, Roberts J. Complementarities and fit strategy, structure, and organizational change in manufacturing, J Account Econ. 1995;19:179-208.
30. Jones, CI. Chapter 16 Growth and Ideas. In: Aghion P, Durlauf S.N, editors, Handbook of Economic Growth Volume 1B:Elsevier; 2005.

31. De Dominicis L, Florax RJGM, De Groot HLF. Regional clusters of innovative activity in Europe: are social capital and geographical proximity key determinants? Appl Econ. 2013;45:2325-355.
32. Milgrom P, Roberts J. The economics of modern manufacturing: Technology, strategy and organization, Am Econ Rev. 1990;80(3):511-28.
33. Miravete EJ, Pernias JC. Innovation complementarity and scale of production. J Ind Econ. 2006;LIV(1):1-29.
34. Kale P, Anand J. The decline of emerging economy joint ventures: The case of India, Calif Manage Rev. 2006;48(3):62-76.
35. Jacquier-Roux V, Paraponaris C. L'objectif de l'internationalisation de la R&D des firmes: de la circulation au partage des connaissances tacite situées. Management International. 2011;16(1):75-83. French.
36. Le Gall S. Les stratégies de localisation des firmes multinationales et leurs rapports au territoire local étranger: une approche par les ressources ». Management International. 2011;16(1):59-73. French.

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