



**Research Network on Innovation  
Réseau de Recherche sur l'Innovation**

**WORKING PAPERS**

**DOCUMENTS DE TRAVAIL**

**N°39 / 2014**

**KNOWLEDGE-CAPITAL FORMATION AND VALORISATION OF FRENCH SMEs**

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**Summary:** This paper focuses on French SMEs and studies their main characteristics regarding knowledge-capital formation and valorisation. We put forward what we may call a “French Paradox”, expressed by a quite important effort in terms of R&D investments and poor results in terms of innovation as measured by traditional indicators (patents). How can we explain this paradox? To answer this question, we study their strategy of knowledge-capital building (through absorptive capacity and open innovation) and valorisation (the way they transform their accumulated knowledge into innovations). We show that apart from the structural characteristics of SMEs (forms of innovation, use of IPRs, etc.), one important reason to their weak performances in terms of innovation lies in their integration within innovation networks dominated by large companies. The valorisation of SMEs’ knowledge capital (through patents and the diffusion of innovations) is thus not always achieved by the SMEs themselves but by the larger company, enriched by the specific knowledge of these SMEs.

**Key words:** Knowledge-capital, absorptive capacity, open innovation, SMEs, France

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## INTRODUCTION

Empirical and theoretical research shows that for SMEs as for big firms, firm-level innovation activities are positively related to their growth in terms of sales (Coad, 2009) or productivity (Crepon et al., 1998; Oretaga-Argilés et al., 2011), while the overall effect of firm-level innovation on employment growth remains unclear (Audretsch et al., 2014). To innovate, SMEs can overcome their natural constraints on financial and human resources and the lack of scale and scope economies inherent to their small size by joining a business group (Guzzini and Iacobucci, 2014). Indeed, to cope with the technology complexity and market uncertainty that intensified by globalization, firms increasingly cooperate with external sources during their innovation process. The implementation of innovation networks involving large and small companies as well as the academic research from the mid-1980s was described by Chesbrough (2003) as an open model of innovation. It is thus within these networks that a large part of the knowledge-capital (the set of information and knowledge produced and acquired by a company) is built.

In this paper, we focus on the SMEs' and study their main characteristics regarding knowledge capital formation and valorisation. We put forward in particular the case of French SMEs, which is justified by what we may call a "French Paradox", expressed by a quite important effort in terms of R&D investments and poor results in terms of innovation as measured by traditional indicators (patents). How can we explain this paradox? To answer this question, it is interesting to study their strategy of knowledge-capital building (through absorptive capacity and open innovation) and valorisation (the way they transform their accumulated knowledge into innovations).

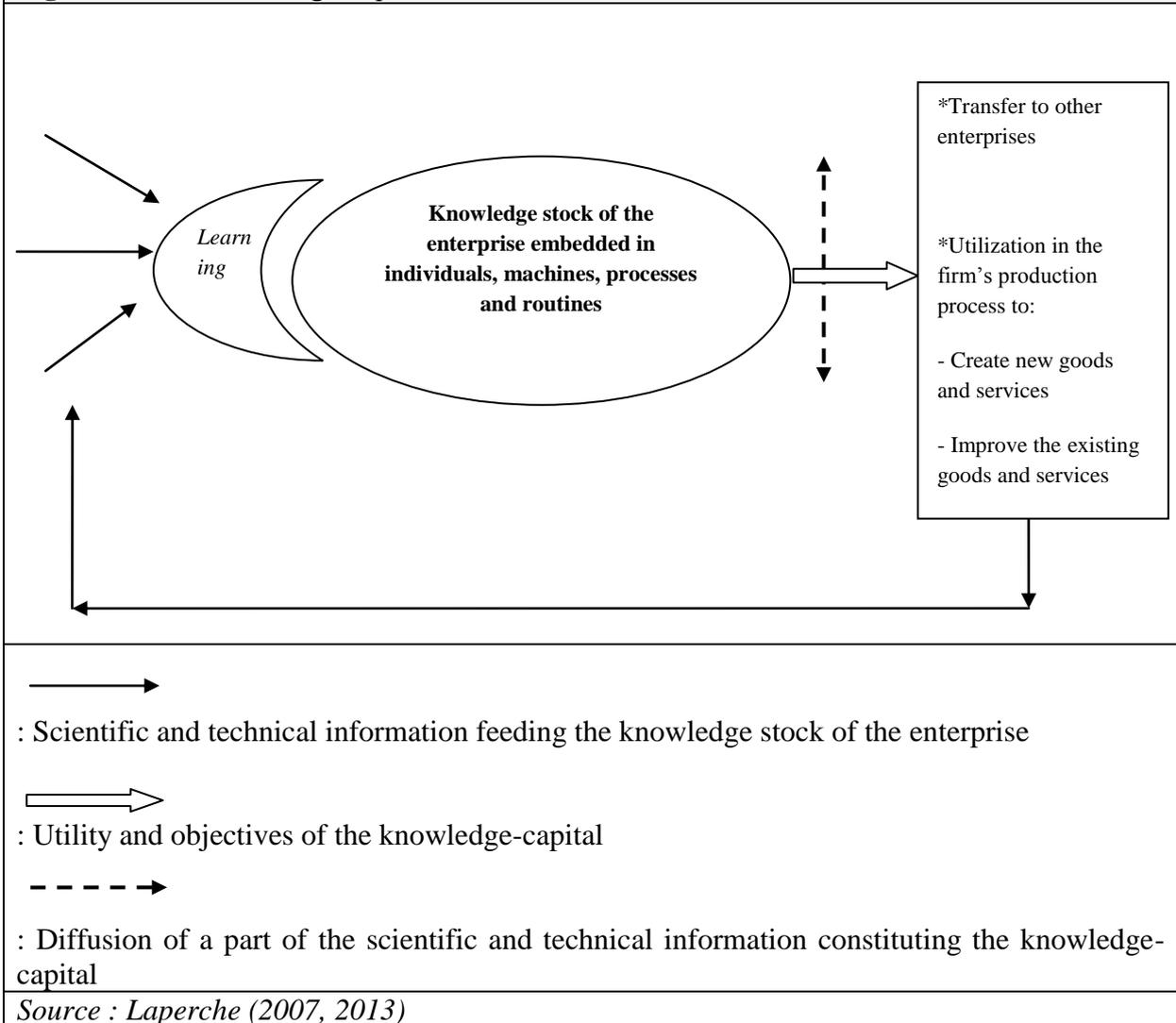
The structure of the paper is the following. In the first part, we come back to definition of the concept of knowledge-capital. We lay out its theoretical foundations as well as two major concepts that show its topicality - the development of absorptive capacities and the tendency towards open innovation strategies – and apply them to SMEs. In the second part, based on the analysis of existing studies, reports, and database, we study how French SMEs' build and use their knowledge capital and propose some explanation to this French paradox.

## **1. THE KNOWLEDGE-CAPITAL: DEFINITION AND FORMATION**

### **1.1. Analysing the innovation capacity through knowledge-capital formation and use**

The knowledge-capital can be defined as the set of scientific and technical knowledge and information produced, acquired, combined and systematized by one or several firms for productive purposes (Laperche, 2007). It (see Figure 1) refers to the accumulated knowledge of one or several linked firms (embedded in the individuals – know-how – machines, technologies and routines of the enterprise), which is continuously enriched by information flows and which is used in the production process or more globally in the value creation process. Thus, it is a dynamic concept – a process – that defines the knowledge accumulated by one or several firms and continuously enriched and combined in different ways, and eventually used or commercialized. This productive aim – the creation of value – is the main characteristic, which turns knowledge into "capital".

**Figure 1.** The ‘knowledge-capital’



The information collected on markets (through intelligence strategy, access to patent information, purchase of technology, partnerships and the signature of licensing contracts...) is integrated into the knowledge stock through learning processes which are basic in the transformation of information (flow) into knowledge (stock). The use of the knowledge stock depends on market and production opportunities and on the degree of maturity of the existing technologies.

A firm may use its knowledge-capital in a value creation process by:

- Simply selling this knowledge base to another enterprise (e.g., the selling of a computer program). Thus, the knowledge-capital (embodied in the software) is *transferred* to another enterprise, which can use it in its production process.
- Using this knowledge-capital in its *own production process*. In this case, the knowledge-capital can be considered as a means to produce or to improve goods and services (major and minor innovation) and as a tool for reducing the production process completion time.

Studying the Knowledge-Capital of enterprises gives the possibility to understand how enterprises generate new knowledge and how they transform this knowledge into concrete (technological and organizational) innovation. Regarding the analysis of the generation and of the use of new knowledge two concepts are useful: absorptive capacity and open innovation.

The most recent researches as a matter of fact show the importance of absorptive capacity and the role of external knowledge for a firm to increase its knowledge capital. Knowledge production and innovation are thus considered as collective processes and are built within complex networks of cooperation.

### **1.1.1. Dynamic capabilities and absorptive capacity**

The literature on the management of innovation (evolutionist theories and more globally resource-based theories) has emphasized the role of dynamic capabilities. The capabilities to develop and renew the specific resources and assets gathered into organizational routines are named “dynamic capabilities” by Teece et al. (1997). They refer to “the firm’s ability to integrate, build and reconfigure internal and external competences to address rapidly changing environment” (ibid, p. 516). These capabilities may concern the creation of new knowledge or the abandonment of certain activities which are no more profitable.

Among these, “absorptive capacity” is central in our understanding of knowledge-capital formation, being a prerequisite for its formation. Absorptive capacity was firstly defined by Cohen and Levinthal (1990) as the ability of a firm to recognize the value of new, external information, assimilate it and apply it to commercial ends. Some authors have redefined the concepts through the distinction between a “potential absorptive capacity” and a “realized absorptive capacity” and identified four dimensions: acquire, assimilate, transform and exploit (Zahra and George, 2002). It is considered as an essential capacity to build competitive advantages over competitors in a context of growing open innovation. Indeed, the capacity-building of a firm within an open innovation process is related to the “knowledge capacities” and the dynamic knowledge management process of a firm. Lichtenthaler and Lichtenthaler (2009) define six “knowledge capacities” as a firm’s critical capabilities of managing internal and external knowledge: inventive, absorptive, transformative, connective, innovative, and desorptive capacity. These six capacities articulate through three knowledge process – knowledge exploration, retention, and exploitation – performed either internally or externally. The combination of these capacities used by firms can explain their difference in knowledge trajectories, alliance strategies, organizational configurations, and innovation performance.

### **1.1.2. Towards open innovation**

The management of innovation activities by the firm has been changing over time (Barbaroux, 2014). The first R&D laboratories were developed within big companies at the end of the 19<sup>th</sup> and at the beginning of the 20<sup>th</sup> centuries. During the 20<sup>th</sup> century, the innovation activities of firms were supported by the States which in OECD countries accounted for more than 70% of GERD (gross domestic expenditures on R&D) up to the end of the 1970s (30% on average today). The innovation model was qualified as “linear”: the stages of R&D were achieved successively and at different places (basic research was realized in universities and in research centres, applied research and technological development within enterprises).

At the early 1980s, when the mass production and consumption model reached its limits, innovation has become the engine of competition between firms implementing global strategies. This period is also characterized by the development of the “open innovation” paradigm which means that “valuable ideas can come from inside or outside the company and can go to market from inside or outside the company as well” (Chesbrough, 2003, p.47). According to the author, the development of this model is linked to several changes: a

growing mobility of high skilled workers, the growing presence of venture companies, new possibilities offered to market internal ideas and the increasing capabilities of external suppliers. In this model of “open innovation”, the creation of knowledge and the whole innovation process proceeds through feedbacks between R&D, design, production and commercialization. In this chain-linked model, the genesis of innovation results from systemic links between knowledge and the market. The open innovation strategies put forward the growing importance of networks, within which the knowledge-capital is built.

The tendency towards the collective constitution of knowledge-capital is gaining ground in the context of the economic crisis, and particularly in large companies (Laperche et al., 2011). As a matter of fact, collaborative research gives firms the possibility to reduce the cost and risk of innovation development. At the same time, it provides new opportunities for them to renew their supply, finding new technological paths and thus opening new markets. Companies collaborate at all stages of the innovation process (from design to development of new goods and services) and with multiple partners.

The open innovation approach is complementary to the existing research, development and innovation capacities. Since the term has been coined by Chesbrough in 2003, the analysis on the collaborative innovation with “open” approach define three processes of open innovation (Chesbrough 2003; Gassmann and Enkel, 2004; Chesbrough and Crowther 2006; Lichtenthaler, 2008a; Van De Vrande et al., 2009).

- 1) The first is known as *inbound* or *outside-in* open innovation which refers to the exploration and the integration of external resources for the internal knowledge development (Parida et al., 2012).
- 2) The second process is known as *outbound* or *inside-out* open innovation process that exploits externally the technology capacities through both various paths of commercialization, IP licensing, technology multiplying, or spinoffs. It is often accompanied by the development of corporate innovation ecosystem (See for example the analysis of Rohrbeck et al. on the innovation ecosystem built of Deutsche Telekom or the case of IBM Corporate Venture Capital).
- 3) The coupled process which mixes the outside-in and inside-out process while dealing with different partners engaged in the same R&D project.

The nature of the openness of companies to outside resources of innovation is often linked to the product life cycle. At the beginning of the product life cycle where technology is in the immature state, firms will need to depend on a small number of knowledge holders. With the technology becomes more and more mature, they can scan in large scale for technologies and combine various sources for internal knowledge development (Laursen and Salter, 2006). The adoption of open innovation is positively related to technology complexity and market uncertainty and that larger firms are more likely to adopt open innovation strategies as shown by empirical study on Spanish firms (Sandulli et al., 2012). Moreover, the innovative firms are more keenly on using open innovation approach than the non-innovative ones (Huang and Rice, 2009; Esbjerg et al., 2012).

## **1.2. The knowledge-capital of SMEs**

Small firms are *qualitatively* different from big companies in terms of management systems, internal resources and behaviours (Anderson and Ullah, 2014). This implies that the issues of absorptive capacity and the open innovation strategies of SMEs must also be treated differently with big firms.

### **1.2.1. Absorptive capacity of SMEs**

The indicators of the absorptive capacity of SMEs are a subject of debate. While being a multidimensional concept, the measure of absorptive capacity has remained mainly based on R&D proxies, that is to say R&D inputs (notably R&D intensity) and outputs (especially patents) even if some recent works try to improve this measure by including new criteria (Flatten et al., 2011). In this perspective, the “Innovation Index” of European Commission measures the innovation efforts of firms by the R&D and non-R&D investments linked to the firms’ innovation activities, the in-house and collaboration efforts between innovative SMEs and public-private research collaboration and the generation of intellectual assets as a throughput in the innovation process including PCT patent applications, Community trademarks and Community designs. To a larger extent, some researchers also use the knowledge management and the organizational responsiveness as criteria (Liao et al., 2003; Som et al., 2013). However, these indicators that built upon the model of innovation activities of big firms are not well adapted to the practices of SMEs (Bougrain and Haudeville, 2002; Huet and Lazaric, 2008; Gallié and Legros, 2012). Due to their weaker human and financial resources, compared with bigger firms, SMEs appear to be less productive in terms of absorptive capacity if measured by traditional indicators.

However, the issue of the distribution of absorptive capacity according to the firm’s size does not seem to catch the interest of researchers and a large part of the empirical research on SMEs and absorptive capacity mostly focus on their role in the enhancement of their performance. If we look at the relation between the absorptive capacity and the “innovativeness” of firms, we can make three observations. First, regardless of sector and size, the absorptive capacity depends on the minimum threshold size of the research group and the cognitive limits on the ability of firms (Pavitt, 1998). Second, the absorptive capacity also implies that firms need to know where to find new knowledge and how to assimilate to their internal structure. Here again, regardless of their size, firms who search widely and deeply are likely to be more innovative. However, the benefits to openness will increase to certain point from which any additional search will become unproductive (Laursen and Salter, 2006). Third, the absorptive capacity is path-dependent, which means that the previous experience and knowledge of an individual firm can influence its use of new knowledge. Hence, firms can increase their ability to exploit external knowledge by stimulating internal knowledge sharing (Schmidt, 2005).

Moreover, the management of knowledge within SMEs will influence the formation of their absorptive capacity in three ways: the organisational knowledge including skills, knowledge, and experiences processed by the firm which impacts the accumulative ability, the organisational routine on which the innovation trajectory depends, and the social integration mechanism which determines the ways that knowledge is diffused and shared (Vega-Jurado et al., 2008). Based on these observations, we can find that, more specifically, two elements – one internal and other external – can influence the capacities of SMEs to exploit new knowledge developed outside the firm as well as prior related knowledge within the boundary

of the firm. On the one hand, the number and the quality of R&D personnel of SMEs can have a direct impact on the internal capacity of SMEs to absorb the knowledge acquired and to create new ones. Thus, in order to access and to exploit the knowledge of outside partners, the SMEs need to have qualified R&D personnel and to continuously invest in human resources (Muscio, 2007). On the other hand, as the absorptive capacity is also considered as a pre-condition to open innovation, the technology intermediaries play an important role to help the SMEs to build up their ability to cope with the knowledge searching and exploitation during the inbound open innovation process (Kodama, 2008; Spithoven et al., 2011).

The innovation capacity of a firm also depends on its enabling capabilities which are composed of transformational and configurational capabilities. The transformational capabilities, which are close to the concept of absorptive capacity, define the ability of firm to transform available general knowledge into locally specific knowledge. The configurational capability is the ability to capitalize on the coordinated links of actors to find out new configuration from existing knowledge. The configurational capabilities emphasize the firms' aptitude to efficiently identify and access distributed knowledge and reconfigure the repositories of knowledge and competence. SMEs in particular those in traditional sectors are reluctant to seek external sources due to the lack of proficiency in networking and trans-organizational interactions (Bender, 2008). As the empirical research on Italian SMEs in traditional sectors shows, human capital and networks favor learning and promote absorptive capacity and knowledge, which in turn fosters innovation in SMEs (Farace and Mazzotta, 2014).

### **1.2.2. SMEs' Open innovation strategies**

The competition based on innovation intensifies and the product and technology development process accelerates, it becomes more and more difficult for SMEs to develop new product and technology by themselves (Bianchi et al., 2010). Globalisation is identified as another force that pushes SMEs to evolve their business models in order to increase their innovativeness. Some SMEs build their knowledge base gradually through incremental or disruptive innovation from the domestic market. Other take a more radical approach and build innovation capacities that allow them target the international market directly (Lee et al., 2012). The open innovation approach thus allows the SMEs to build up new knowledge-capital by adopting external technology (Lichtenthaler, 2008b) or through combining the external technology and competence with existing internal research and innovation capacities (Christensen et al., 2005; Kogut, 2000; Lichtenthaler, 2008a).

Due to their natural limitations in terms of financial resources and technological capability linked to its small size, the SMEs use less structured innovation strategies and are often specialised on one family of knowledge. In general, SMEs use more frequently collaboration and inbound open innovation process while large companies have more collaborative partners and different channels of open innovation (Vanhaverbeke et al.; 2012; Parida et al., 2012). Research on R&D networks suggests that due to their natural limits inherent with their small size, SMEs need to look out for new knowledge for new product development. In this context, their small size is indeed an advantage as they are more flexible than big firm to mobilize and exploit external resources (Narula, 2004, Nooteboom, 1994, Rothwell and Dodgson, 1991). However, small businesses are in general less active than the large companies in innovative activity, in the production of internal resources and in the access to external ones. Compared with big firms, SMEs prefer cooperating with market sources (clients, suppliers, customers) than with horizontal partners which are mainly universities, public research centres or

government agencies (Diez, 2000, Zeng et al., 2010, OECD, 2013). They also cooperate less in an international context (OECD, 2013, Zeng et al., 2010).

The capacity of SMEs to involve in outbound open innovation is constrained by their practice of intellectual assets management. The most innovative SMES are implementing open innovation strategies, as it is the case in biotechnology (Gassman and Keupp, 2007). For them, commercialising their technologies is one of their core competencies and provides a means of rapid growth. SMEs that belonged to an innovation network in particular those that cooperate with big firms also more actively practice outbound open innovation. Through the innovation with big firms, SMEs contribute not only to the knowledge capital formation of the latter big firms but also reinforce their own knowledge capital. Although less frequent, innovation collaboration between SMEs can also lead to the creation of spin-offs, as the case of SMEs in French clusters. In general, SMEs lack IPR awareness and have no specific IPR strategies (OECD, 2011). Except those small specialized R&D services firms, non-statutory methods (mainly trade secrets) are most preferred by SMEs to manage their intellectual assets (Gallié and Legros, 2012).

## **2. THE FORMATION OF KNOWLEDGE-CAPITAL OF FRENCH SMES: HOW TO EXPLAIN THE FRENCH PARADOX?**

### **2.1. Absorptive capacity and innovation open strategy of French SMEs: the French Paradox**

In 2011, French SMEs represent 99.8% of French firms are SMEs (excluding financial and insurance activities) that hire 50% of total employees (Insee, 2014). The French microenterprises (with 1 to 10 employees) have one of the highest weigh of the economic compared to other advanced OECD countries. Furthermore, French young firms have a relatively high contribution to job growth among OECD countries. Although their share of total non-financial business sector employment from 2001 to 2011 was only about 20%, French firms of 5 years old or less generated nearly half of all new job and 60.8% of non-financial service sector during the same period. Indeed, during the crisis, most of the jobs destroyed are due to the downsizing of existing firms and job growth remains positive for your firms in France (OECD, 2013).

France has adopted the European definition of SMEs with less than 250 employees by creating another category of firms – the “intermediate-sized enterprises” (entreprises de taille intermédiaire, ETI) – which have between 250 and 4999 employees, with an annual turnover less than 1.5 billion euro or total balance sheet not exceeding 2 billion euro. In 2009, ETIs represent 0.17% of total number of firms and 28% of total employment (including finance and insurance) in France (OSEO, 2013). Since the mid-2000s, one of the priorities of French innovation policy is to increase the number of ETIs by promoting the growth of SMEs through innovation.

Regarding absorptive capacity, SMEs represent only a fraction of the business R&D and patent filing in the countries of OECD. In 2011, SMEs counted only 22.6% of total business R&D in France, 21.8% in United Kingdom, 14.9% in Unite States, 11% Germany and 4.4% in Japan.<sup>3</sup> As the table shows, in 2011, French SMEs employed 31.1% of total R&D

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<sup>3</sup> Source: Data compiled from *OECD STI Scoreboard 2013*.

personnel and 31.7% of total researchers. In terms of business R&D, only 22.6% of business sector R&D is funded by firms with less than 250 employees, which place France 21th out of the 28 OECD countries. Hence, while lagged behind other European countries, compared with its main trade partners, French SMEs in fact make greater effort in R&D. The paradox is that the result of the innovation activities of French SMEs does not correspond to their efforts. If we look at the output of innovation activities, measured by number of patents, during the period of 2009-2011, French SMEs (with 20 to 249 employees) have one of the lowest proportions (57.49%) of patents owners as total number of firms (with more than 20 employees) of OECD countries, which is only better than Germany (55.37%) and Japan (27.02%).

Another explanation of the paradox is that the innovation performance of French SMEs is underestimated due to the difficulties of collecting data related to R&D efforts of SMEs and the lower visibility of incremental or non-technological innovations (Reboud and Mazzerol, 2014). As the European Innovation Union Scoreboard (2014) shows, in 2010, the part of French SMEs that introduce product or process innovation as percentage of all SMEs (32.7%) is under the European average level (35.5%). However, French SMEs are more active in introducing organizational and marketing innovation (42.8%) than their European counterparts (36.5%). This trend is confirmed by the result of French SMEs measured by trademarks, which is better than Germany, Japan and the United-Kingdom as shown in the table 1.

Table 1 - Selected indicators of innovativeness of SMEs (1 to 249 employees) in selected countries

*As percentage of total business sector, in 2011*

	<b>France</b>	UK	Germany	US	Japan
Total R&D personnel and researchers	<b>31,1</b>	34,2	17,8	-	-
Researchers	<b>31,7</b>	35	17,8	-	-
Business R&D expenditure	<b>22,6</b>	21,8	11	14,9	4,4
Business R&D expenditure funded by firms	<b>23,6</b>	19,8	9,7	16,3	4,4
Patents*	<b>57,5</b>	62,4	55,34	61,78	20,7
Trademarks*	<b>68.8</b>	64.6	65.9	84.7	17.3

\*20 to 249 employees

*Source: Data compiled from OECD STI Scoreboard 2013, OECD StatExtrats, and Eurostats*

To cope with this situation, French innovation policy emphasizes innovation collaboration and the leverage effect of the big firms on the SMEs. Indeed, France offers the most generous tax incentive for business R&D of all OECD countries and the second highest combined support for business R&D (both R&D tax incentives and direct support through grants, contracts and loans) as a percentage of GDP, after Korea. In 2010, SMEs and ETIs represented 85.4% and 9.7% of total recipients of research tax credit and received 28.8% and 37.4% of total research tax credit respectively, which represent 24.9% and 34.5% of total eligible R&D expenditure (OSEO, 2013).<sup>4</sup> As members of clusters, French SMEs and ETI receive more public support (grants and in particular the research tax credit) than those that are not members of clusters, even though they might not participate in collaborative R&D projects (Dordet-Bernadet, 2013).

<sup>4</sup> For all SMEs and ETIs. The share of independent SMEs and ETIs was lower. Indeed, in 2010, only 76.5% of all recipients of research tax credit are fiscally independent. The effect of group is particularly important for ETIs, which 2.6% are independent recipients that represent 6.5% of eligible R&D expenditure and receive only 7.3% of research tax credit.

Regarding the practices of open innovation, SMEs constitute the major part of the 71 French clusters. As in 2012, with 6 270 members, SMEs counted 85.6% of total firms which are members of clusters (up from 6 080 in 2011), 886 ETI and 168 big firms, with 120 start-ups created within the clusters.<sup>5</sup> SMEs privilege the collaboration with members from the same cluster. Nevertheless the practice is various depending on the structure of the cluster. The two most common forms of partnership between firms and with public research partners in French cluster are: 1) one or several big firms as leader, surrounded by partners SMEs and public research institutions; 2) small-small partnership collaborating with academic partners. These two forms often coexist within a cluster where the “sub-clusters” based on different research projects can be identified.

In the first form, large company often play crucial roles in the governance of clusters, as it is the case for Valeo, Saint-Gobain, Renault or PSA, where they initiate R&D programs involving SMEs (Laperche and Lefebvre, 2011). SMEs in these clusters are often in a position as sub-contractors, which leads to interdependency. SMEs innovate and are specialized on the high quality services or products to satisfy the needs of big firms. There technological specialization is built around the core technology of the cluster like in the sub-cluster MRG specialized in fables within the cluster of Communicant and system solution (SCS) (Dang, 2011). In the second form, academic partners play a more important role in a cluster with small partnership dominance and often the key source of knowledge for SMEs. Meanwhile, as the partnership structure is looser in this case, SMEs are in fact more active in searching relationship with partners outside the sub-cluster or even the mother cluster (Dang, 2011).

Indeed, existing knowledge base and a clearly defined strategy are key issues for a small business to handle research collaboration. On the one hand, the cooperation decision in SMEs is conditioned by the capacity of interaction of the firm, which is conditioned by the cognitive distance (Nooteboom, 1994; 2000). Thus, French SMEs will more easily go for innovation cooperation under the condition of co-technological development and the similarity of skills (Huet and Lazaric, 2008). On the other hand, the configurational capability is also on the stake of decision making. A recent study on the innovation capacity evaluation of SMEs from French Lorraine region identifies four groups of innovative firms which are: proactive, preactive, reactive and passive. For the *proactive* firms, innovation is a structured and permanent process. The *preactive* firms have a less-structured innovation process due to the lack of proper organizational configurations. The *reactive* firms adapt to their environment by creating a supporting environment for innovation but without clearly defined innovation strategy. The *passive* firms just content in maintaining their position and ignore the knowledge management (Boly et al., 2014). We can say that proactive and preactive SMEs with effective knowledge management are more organized for networking and interacting with external resources thanks to on knowing where to find knowledge and what to do with the knowledge acquired.

If open innovation leading to cooperation strategies may be considered as a positive aspect towards the improvement of innovation results in French SMEs and the resolution of the paradox identified, some other explanations of this paradox may be proposed, which are presented in the next part.

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<sup>5</sup> However, the official statistics do not allow us to know how many of these 6 270 are independent company. Source: « Tableau de bord des pôles de compétitivité », 2013 edition. Available on: <http://competitivite.gouv.fr/accueil-3.html>

## 2.2. Some explanations to the French Paradox

The French Paradox that we have identified may be explained by structural characteristics of SMEs, and hence of French SMEs. For example, the poor results of French SMEs in terms of patents might be biased by the intellectual asset practice of French SMEs as they prefer non-statutory methods in particular trade secrets to protect their intellectual property (Gallié and Legros, 2012). Indeed, the traditional indicators for absorptive capacity based on the R&D efforts and patents which are developed for big firms do not reflect the reality of SMEs (Huet and Lazaric, 2008). A study on the innovative projects of French SMEs supported by ANVAR<sup>6</sup> confirms this tendency and shows that instead of having an R&D department as big firms to generate radical innovation, the fact that having a *design office*, composed with of engineers and technicians and focusing on incremental innovations, has positive impact on the innovation performance of French SMEs and helps them to better extract the benefit of innovation collaboration (Bougrain and Haudeville, 2002). Hence, the capacity of cooperation of SMEs is more correlated to the skills and the strategy of the firm than the R&D intensity.

Moreover, this paradox may be explained, according to us, by the place of SMEs within innovation networks. As a matter of fact, innovative small firms generally play key roles in innovative networks. On the one hand, by making use of specialized high-performance small businesses in their areas, groups have access to technology outside their usual fields of research and can integrate within their knowledge-capital particularly innovative technologies and complementary skills (inbound open innovation). Cooperation with small businesses also allows them to produce a product at a lower cost by increasing the speed of development. On the other hand, the SMEs are also a channel for large companies to monetise their unused technology (outbound open innovation) (Vanhaverbeke et al., 2012). In a more specific case, academic spin-offs are one major channel of the commercialization of public research in France. These start-ups are often well embedded in the academic networks. However, they lack often the market knowledge which is essential for the commercialization of innovation (Liu, 2013a). Hence, to be part of an innovation network is essential for them to access market knowledge.

Partnership agreements may be signed in the framework of national or international research program, or within clusters. As a matter of fact, in industrial countries, industrial policy has shifted from reducing costs of production to the increase of managerial know-how and the intensification of links between firms. Such cooperation may concern SMEs notably through local production systems but also the relations between SMEs, large companies and public research (Viale and Etzkowitz, 2010). In France, it is through research programs at national and European levels or through clusters that SMEs are encouraged to work with large groups. Although there are various schemes that support collaborative innovation such as the cluster policy (*pôle de compétitivité*), national research agency (ANR) or strategic industrial innovation fund (ISI, managed by OSEO), the clusters provide the most important source of partnership and funding for SMEs' collaborative projects.

In France, SMEs play an important role in the inbound strategies of open innovation implemented by big companies. Large companies use combined methods (corporate venture capital, spin-outs, licensing, R&D and/or commercial alliance) to draw benefit from open innovation process. One of the main forms of relations between small and large firms in innovative activity is that of investment in start-ups through venture capital. *Corporate*

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<sup>6</sup> The French national agency for innovation which became OSEO in 2005 after its merge with the public Bank of Development for SMEs.

*venture* has grown strongly in the United States during the 1990s and has spread in Europe before being held back by the bursting of the bubble of the net economy in 2001: many of these investments were oriented toward the achievement financial gain. Unlike the clusters where cooperation mainly takes place between large firms and existing small firms, corporate ventures are targeted the start-ups. And compared to traditional investment funds, they have more strategic concerns and sectoral specification in their investment.

Corporate venturing can be driven by both strategic and financial motivations, although the concern on accessing new and potential technology and market seems to weight more importantly to high-tech firms. For example, 10 of the 15 French big firms studied by Observatoire des Entrepreneurs de PME Finance (2012) use corporate venturing as a means to facilitate the development of start-ups through licenses, joint development agreements, production or distribution agreements, joint ventures, minority investment – or any combination of these. They are either attached directly to the board of director (Dassault Système, Rhodia, Saint-Gobain, Veolia) or to the department of innovation (Alcatel-Lucent, Bouygues Telecoms, SFR, SNCF Suez Environnement, Total), which more or less provide coaching for start-ups with a strategy of potential M&A (Veil, 2012).

In France, some 20s corporate ventures which count for 10% of total French venture capital, 7.2% of funds raised and 1.2% of investment venture in 2010. We can observe a concentration of corporate ventures in ICT and cleantech (including energy) related sectors but they cover a large field such as chemicals and biotechnology. For example, almost all the French telecommunication operators or equipment manufacturers creates there corporate ventures. Saint-Gobain created in 2007 the NOVA External Venture program to develop strategic partnerships with innovative SMEs in the fields of energy, services for the construction industry and cleantech. PSA is developing a technology and service monitoring strategy particularly by technology co-investment funds which aims to support start-ups (EcoMobility Venture). Schneider Electric has a common venture capital fund (Aster Capital) with Alstom for the same aim and in the field of energy efficiency (Laperche and Picard, 2013).

Table 2 - The Top 10 French corporate ventures, 2012

	Funds invested
Innovacom (France Telecom-Orange)	+15M€
Total Energy Ventures	5-10M€
Aster Capital (Schneider Electric/ Alstom/ Rhodia)	5-10M€
Mérieux Développement (Biomérieux)	5-10M€
CEA Investissement (Thalès, Safran, Airbus, CEA, EADS)	1-5M€
Suez Environnement	1-5M€
XAnge Capital	500k€-1M€
Bouygues Telecom Initiatives	500k€-1M€
SEB Alliance	500k€-1M€
SFR Développement	<500k€
<i>Source: Observatoire PME Finance,</i>	

Large companies, when investing in small businesses look for financial gain but also aim to develop at a lower cost and with fewer risks new technologies, or seek to consolidate the group's activities (through for example the dissemination of a standard) (Chesbrough, 2002). This can be done through the acquisition on the start-up at the end of the financing period. In

that case, the development cost of the acquired firm (and of its technology) has been shared between several investors. Or it may also be achieved through the signature of partnership agreements (including licensing). Moreover, start-ups and SME may be used in the outbound strategies of groups. Indeed, French industrial groups that have a department of licencing-out to actively try to valorise non-strategic technologies to partner SMEs and start-ups but, with however quite disappointing results (Ollivier and Simon, 2013). But as a whole, for groups, investment in venture capital fits into their financial and technological strategy.

One particularity concerning France is that corporate venture is also considered by French government as a means to resolve the funding constraint of innovative SMEs. Indeed, French SMEs constantly face difficulties to ensure bank loans for their innovation projects (Liu, 2013a). Loans approved for SMEs represent 20.9% of total business loans in 2011, which make France the twelfth out of the seventeen countries surveyed by OECD, and even lagged behind the Russia Federation (22.5%) (but slightly better than the United Kingdom which is at 20.6%) (OECD, 2013). After using various financial instruments (research grant, research credit, fiscal advantages for young and innovative firms, fiscal advantages for venture capital and seed funds, etc.) to support SMEs' innovation activities<sup>7</sup>, French government turns to corporate world for new sources. The most recent fiscal measure will provide fiscal advantages for firms that invest in start-ups as well as innovative SMEs will be enacted in July 2014. The government hopes that this measure can stimulate big firms to play the long-wished leverage effect on SMEs by providing them not only the financial but also the technological support that the latter needs.

As an incentive to promote investment of big firms into SMEs for their innovative projects, the new fiscal measure should be able to reinforce the R&D efforts of the SMEs. However, whether public support has an *incentive* or *addictive* effect on business R&D investment is under debate. The increase of business R&D of French SMEs and ETIs that belong to a cluster during the period of 2005-2009 was largely the result of *addictive* effect of public supports to their R&D expenditure, than the pure reinforcement of their own R&D intensity (Dordet-Bernadet, 2013). Given the past experience of the French fiscal incentive for innovation (notably research tax credit), the implementation of the measure must be well defined in order to avoid the pure financial exploitation for public funding (Liu, 2013b).

As a consequence the French Paradox may be according to us explained by the particular place that SMEs play within innovation networks and notably by their strong relationship with larger companies. As a matter of fact, SMEs' knowledge capital formed through their own R&D investment and their collaborative strategies is largely used to enrich the knowledge capital of big companies which are the main innovators.

## CONCLUSION AND DISCUSSION

Our study was based on a literature review which gave us the possibility to identify the main conceptual categories useful to understand the formation and valorisation of SMEs' knowledge capital, which are specifically the absorptive capacity and the open innovation strategies. Applied to the case of France, we have highlighted what we call the French Paradox, expressed by a relatively important investment in R&D (compared to other countries) and a weak performance in terms of innovation results. Although this may be partly

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<sup>7</sup> The France became the most generous country in terms of indirect public funding and the second in terms of direct public funding for innovation (Liu, 2013b).

explained by structural characteristics of SMEs, our study reveals that this paradox results from the particular place that SMEs have in innovation networks. The most innovative ones as a matter of fact play important roles in the formation of knowledge-capital of large companies. The valorisation of SMEs' knowledge capital (through patents and the diffusion of innovations) is thus not always achieved by the SMEs themselves but by the larger company, enriched by the specific knowledge of these SMEs. At this point of our analysis, the question of the consequences on these strong links between innovative SMEs and large companies may arise.

For an SME, taking part to the innovation strategy of a larger company may be an essential means to improve their technological product or process development, since the small business may benefit from the financial, technological and marketing support of the big company. Taking part to an innovation network is thus a powerful means to be profitable and even sometimes to survive. Hence, the participation of SMEs to large company's knowledge-capital's formation also reinforces the knowledge capital of the small firms. However, this collaboration may be difficult due to the unequal and asymmetrical power relation between the two partners. In case of conflicts, for example dealing with intellectual property rights of products developed in common, the small business may be disadvantaged, due to its weaker resources. The strong links developed within a "closed" cluster built upon big firms will increase the dependency of SMEs on the leveraging power of large companies to generate value from their technology and thus to limit the yield of their intellectual property (Katilla et al., 2008; Vanhaverbeke et al., 2012). Sector-based clusters allow SMEs to be better integrated to innovation networks and hence to access and share knowledge with large companies. However, the lack of clearly defined offers in terms of competence, cooperative process, access to market and funding (Bassot et al., 2008), as well as the lack of coordination and coaching of SMEs engaged in R&D projects (Bearing Point-Erdyn-Technopolis, 2012) limit the benefit that the SMEs can draw from collaborating with large companies. Moreover, the ability of SMEs to participate to several projects simultaneously is limited regardless the nature of the projects in terms of the intensity of research or the sources of funding (Levy et al., 2012).

For the larger company, the integration of the small business within its organisation may also lead to a lower creativity due to the different habits and routines of the two organizations. This is for this reason that General Electric, which massively bought small companies in the 1990s abandoned the systematic acquisition strategy, and in case they integrate small companies in their huge organization, they try to let them some autonomy to preserve their creativity (Laperche and Lefebvre, 2011).

Our paper put forward the case of France and highlighted the particular place that SMEs play within innovation networks notably dominated by large companies. Future research will compare this situation with others countries in order to show whether it is a French or a more widespread characteristics.

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