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Restructuring in France's innovation system: from the mission-oriented model to a systemic approach of innovation

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Abstract

The paper discusses the transitional phase of the French innovation system focusing on the activities that influence the development and diffusion of innovations. It shows that the current system combined persistent elements of the traditional mission-oriented model with new systemic institutional structures, thus lengthening the transition towards a new model of innovation. Indeed the introduction of a bulk of reforms in a very short time, the lack of a clear long run agenda, the institutional inconsistencies have blurred the research and innovation policy trajectory and may affect the performances of France's innovation system in the coming years.

Keywords: French innovation policies and system, activities, restructuring

JEL Codes: O30, O31, O38.

Recent changes in the global economy as the internationalization strategies of large firms, the design of innovation policies at the European level and the entry of emerging economies in the world scientific and technological competition have put the traditional French model of innovation under strong pressures. The new leaning of the French innovation policy has entailed a greater reliance on indirect and selective support for research and innovation activities, an increased support to SMEs and attempts to create synergies between the public research organizations. This paper offers a critical review of the successive reforms implemented by the French policy makers during the last decade, and discusses the sources of institutional inertia and the inconsistencies in the setting of the research and innovation policy and agenda in France. As such, this work falls into the tradition of innovation policy studies and relies, at the theoretical level, on the literature dealing with the governance of national innovation systems (NIS). Earlier studies of NISs have allowed the identification of the main components of such systems (Freeman 1987, Nelson et al. 1993, Edquist and Lundvall 1993) and have greatly enhanced our understanding of the underlying interactions or dynamics (Lundvall et al. 1992, Amable et al. 1997, Balzat 2006). However, in contrast with the fundamental role granted to national institutions, a clear theoretical approach is still missing to address the role of national and local governments in the development and the diffusion of

innovations (Edquist 2011). And this, moreover as the concept has been widely use in the formulation of national innovation policies and programmes.

Taking stance from the traditional literature on NISs, some empirical studies have underlined the relevance of a framework based on the analysis of activities that influence the development and diffusion of innovations (Liu and White 2001, Edquist and Hommen 2008, Edquist 2011). Defined as the factors influencing the development and the diffusion of innovations, the activities can be classified into four broad categories including the provision of knowledge inputs to the innovation processes, the demand-side activities, the provision of constituents and the support services to innovative firms. In this framework, institutions are seen as incentives or obstacles that influence these activities. According to Edquist (2011), “this is accounted for by including creating and changing organizations and creating and changing institutions” in the list of activities” (p. 6). The approach based on the analysis of activities relies on the principle that they are performed to different extent by public and/or private organizations so that, most activities have a policy element. In this perspective, the differences in national innovation policies are expressed in the different patterns of public organizations' performances within and across activities. Thus, compared to earlier perspectives, this approach constitutes a useful point of entry into policy analysis and allows for systematic comparisons of NISs. Besides its intrinsic heuristic dimension, this representation of NISs is consistent with the multidimensional and dynamic nature of the innovation processes and their determinants (Edquist and Chaminade 2006, Edquist 2011). In tune with this approach, our study discusses the recent reforms reflecting the attempts of French policy makers to move from the traditional mission-oriented policies towards a more systemic approach in the design and implementation of innovation policies. More precisely, it focuses on the activities, which have been primarily targeted by the reforms. Then, the paper underlines the shortfalls, the institutional blurring and inertia that have been accentuated by the reforms and suggests some related policy recommendations.

The remainder of the paper is organized as follows. The two following sections consider the provision of knowledge inputs to innovation and the development of support services to innovative firms. Section 1 underlines the continuous changes in the direct public support to private R&D and the shortfalls of the recent initiatives to develop the venture capital infrastructure in France. Section 2 focuses on the restructuring in the public research and higher education systems. It points out the sources of institutional inertia and the problems of the coordination between autonomy and cooperation strategies, notably faced by the universities. The following sections examine the development of networking measures

(section 3) and the creation of new institutional actors at the policy making and research funding levels (section 4). Section 3 and 4 discuss the issues of institutional coordination and coherence of these policies that generally target the same actors on the same territories.

I. The shortfalls of the financial and services support to private companies' R&D in France

The increasing weight of the private funding for R&D has left unchanged the concentration of business R&D around a narrow set of sectors and large firms. Indeed, within the industry, which account for more than 85% (or 22,918 million of euro in 2008) of the business-funded domestic expenditures on R&D, five research sectors (automotive, pharmaceutical, aeronautics and space construction, chemistry and electronic components) represent about 52% of the total funding of the GERD (gross expenditures on R&D).

- Improvements in the fiscal support for companies' R&D

The public support to businesses' R&D is mainly allocated through defense and civil contracts and through the tax-related schemes as the research tax credit¹ (RTC). Besides the direct funding from administrations to firms (about 12% of companies' in-house R&D, MESR 2010b), the French state has gradually extended its main fiscal incentives through several modifications of the rates, the threshold, and eligible expenditures to the RTC during the 2000s (see figure below).

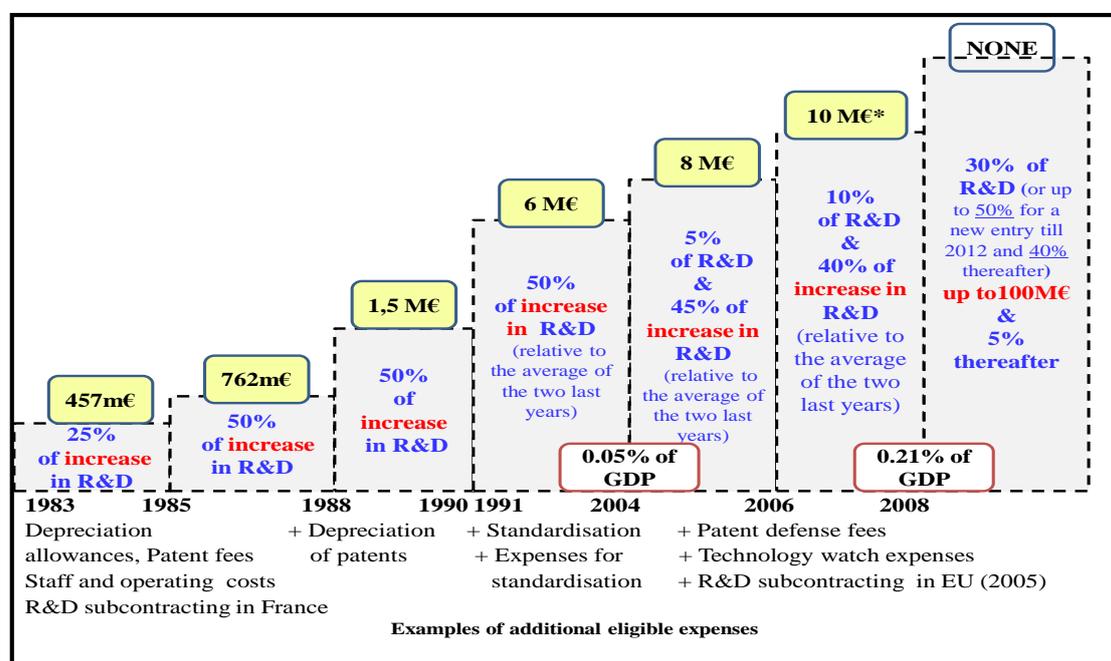


Figure 1. The main changes in the French research tax credit

Notes: Personal elaborations based on the French decrees and laws (www.legifrance.gouv.fr) and the official documents on the CIR provided by the MESR (Ministry of higher education and research). M€ for millions, m€ for thousand euro. * 16M€ in 2007

¹ Created in 1983, the RTC is a tax incentive for research based on R&D company expenses. It is deducted from the tax payable by the companies, under the year the expenses were incurred.

Since the mid-2000s, the strength of direct aid to R&D has been stable representing about 0.15% of the gross domestic product (GDP) while the RTC has reached 0.21% of the GDP in 2008, against 0.05% in 2004 (or 890 millions of euro, MESR 2010b). According to the IGF report (2010) the complexity and the limitations of the RTC, notably for mature firms, have triggered a drop in the RTC claimers by one third between 1993 and 2003. The changes in the RTC have been designed in order to overcome the shrinking effect observed. In 2004, a volume-based share was included and, four years later, the increase-based share and the ceiling were removed. Besides the huge increase in the number of beneficiaries, the 2008 reforms have led to a higher growth of R&D spending as compared to the GDP growth, of R&D intensities in several sectors and to a greater attractiveness of the national territory (IGF 2010). Indeed available figures show that the regain in the R&D intensity occurs only in 2009 when it reached about 2.26% against 2.12% in 2008.

Several evaluations reveal that the RTC has positive effects notably on the R&D spending and the recruitment of researchers (MESR 2010c, Cahu et al. 2010, Mulkey and Mairesse 2011). The 2011 reforms have led to a reduction in the share of the operating costs in the staff expenses by 25% and have increased the proportion of the subcontracting research entering in the RTC. At the international level, these changes have put France in the top countries in terms of fiscal support for R&D. Although the RTC has led to higher R&D spending, the impacts in terms of innovations and market value have so far not been assessed, and remain a topic of debate. Moreover the effectiveness in the selection of high returns R&D projects has not been proven yet; and, this despite the increasing budgets at stake.

- Venture capital infrastructure and incubation activities: a poor performance

In addition of the services provided by Oséo, the French innovation agency for SMEs, the French government has enacted several measures to enhance its venture capital (VC) infrastructure notably through the creation of several dedicated funds and the creation of the young innovative firm status (JEI). Since the end of the nineties, several VC funds have been established as for instance the public fund for VC (FPCR, 1998), the high-risk mutual investment funds (FCPR), the VC promotion funds (FPCP, 2000) and the Fund for technological funds (FFT, 2005). Dedicated FCPR for innovation are the FCPI (French innovation-focused investment funds) and the FCPI ISF² in 2008. Furthermore, the creation of

²The FCPI ISF offers significant advantages in terms of reducing wealth tax and income tax.

the FSI³ (the strategic investment funds) in 2006 has brought additional funds to strengthen the equity capital of innovating firms. Besides, the creation of the single-owner venture capital company status for business angels in 2004 (SUIR), the CDC (Caisse des Dépôts) supports, among others, the structuring and the development of business angels' networks, which have remained quite limited in France. Besides the low resources involved, the multiplication of these funds based on quite complex combinations of tax advantages affects the visibility of both national and foreign investors and of the SMEs in their search for the appropriate funding. Glachant et al's report (2008) underlines the complexity of the legal structure of the funds as well as the continuous modifications they have been subject to through the last decade. Overall, these initiatives have led to very limited results in terms of funding.

The development of the VC infrastructure has also come with initiatives to further improve the incubating activities. Initiated by the government in the frame of the research and innovation law (1999), the call for projects for incubation and seed capital in technological firms has led to the creation of 31 initial incubators, mainly by research and higher education organizations; 28 are in activity in 2013⁴. However, as for the patent activities and licenses revenues, public research spin-offs have been very concentrated and their development beyond the start-up activities has been quite limited with very few exceptions. Indeed, by the mid-2000s less than 10% of surviving firms have grown enough to generate a turnover above one million and a total number of employees above twenty. Furthermore, spin-offs from the CEA and INRIA and the CNRS' life sciences department are more likely to succeed than other spin-offs. Set up by the Finance Law 2004, the JEI status allows young innovative firms⁵ to benefit, on the basis of their R&D activities, from tax reductions and exemptions of the social security contributions for the recruitment of researchers, engineers, technicians and other legal practitioners. These advantages may be combined with the research tax credit funds. The initial conditions mainly involved a one-hundred percent exemption of social security contributions for R&D related workers during the eight years, a total tax exemption for three years and a 50%-exemption for two years. The annual number of beneficiaries has

³ Held by the CDC and the State, the FSI is divided into two branches, FSI SME and FSI France Investment. The structure has been integrated in the newly created state investment bank, the Bpifrance (2013).

⁴See list of incubators, as in end of 2013 at

http://cache.media.enseignementsup-recherche.gouv.fr/file/Creation_et_developpement/06/0/incubateurs24425_54060.pdf

⁵ Young innovating firms refers to genuinely new (that have not been created from a merger, a restructuring or an extension of previously existing activities) and independent SMEs that have less than 8 years and spend at least 15% of their total expenses in R&D activities.

continuously increased between 2004 (1210 JEI) and 2009 (2373 JEI) with a relatively high renewal rate (Oséo 2011). Most JEI operate in the business-to-business services, in ICTs and technical and scientific activities. Besides, the JEI from industry only account for 10% and originate mainly from electric, electronics and pharmaceuticals industries, which constitute the main markets of scientific and technical related activities. The integration of these services, as the upstream phase of the innovation process actually increases the proportion of JEI producing for the industry by 30% (Oséo 2011). The Finance law 2011 reforms have entailed earlier decreasing rates of tax exemptions, per worker and per firm ceilings for the exemptions of social security contributions, thus favoring a rise in staff expenses, which represent more than half of the JEI's expenses.

This section has underlined the actions undertaken by French policy makers to improve the financial support to companies' R&D and innovation activities as well as entrepreneurship initiatives. In addition of the greater funds invested for the research, they have designed numerous schemes to support the innovation phase. However, their effectiveness in terms of innovation is not assessed and few SMEs are able to grow beyond the small firm size. This calls for at least three improvements in the current support to SMEs. The first one includes a higher support for the prototype-making phase while further support should be designed to help SMEs' growth. The newly set-up innovation tax credit is meant to bring an answer to this specific issues (Finance law 2013). Finally, the VC measures would beneficiate, beyond the need for specific seed capital, from a greater simplification both for national and international investors.

The next section focuses on the main performers of the public research, the PROs and the universities and discusses some of the main internal factors that have further lengthened the implementation of the reforms and the issues at stake regarding the restructuring process at universities.

II. The restructuring in the public research and the higher education systems

In France, the universities, the EPST⁶ (the scientific and technological public research organizations) and the EPIC (the public industrial and commercial establishments) are the

⁶ The EPST and EPIC are public establishments. There are submitted to different legal regimes. A larger part of EPIC's resources is coming from the users' payments while the EPST are primarily funded by the State. Moreover the EPIC's employees are largely assimilated to the private sector workers while most EPST's researchers are civil servants.

main actors of the public research system. The most important increase has been operated in the universities, which accounted for about one third of the R&D performed by the higher education sector⁷ in 2009, against 22% in 1992. As for the EPIC, the EPST's R&D expenditure is still highly concentrated, with the Atomic Energy Agency (CEA) accounting for about 62% of the establishments. The CNRS concentrates more than half of the research performed by EPSTs⁸.

- Restructuring of the public research system

During the 2000s, an important restructuring process has taken place within the public research organizations (PROs), including the reorganization of the CNRS into thematic institutes, of the French national institute for health and medical research (INSERM) and the formation of the IFSTTAR⁹ in 2011. Contributing to about 70% of French publications¹⁰ in natural and life sciences (medical research excluded) and to 1.8% of the patents granted to French organizations in the United-States in 2007 (OST 2010), the CNRS constitutes the largest interdisciplinary centre in France with an historical unequalled structuring role on the public research system. The restructuring process in the French innovation system has challenged the traditional role and missions of the centre, as well as its internal organization and frontiers. Besides the organizational restructuring, the centre has witnessed several changes in its founding decrees and ruling teams during the 2000s, thus affecting both the implementation of the contract between the State and the CNRS and its positioning within the system. In the case of the CNRS, the top down approach in the implementation of the reforms has surely played a key role in lengthening the restructuring process. In Pierson's words (2000), such an institution can be associated to the notion of change resistant institution or to the notions of institutional lock-in or inertia. Change-resistant institutions are designed to be difficult to overturn, as they may be a willingness to bind the successors or themselves (Pierson 2000). But in this case and given the importance of the centre, it has affected the transition towards the new organizational model of the French public research system, whatever it intends to be. Moreover the missions of the new intermediary agencies, the ANR (national research agency) and the AERES (evaluation agency), are overlapping with some of the initial missions of the CNRS. Overall and not without any internal resistance, the reforms

⁷ The share of the higher education sector has increased from 40% in 1992 to 54% in 2009.

⁸ The remaining EPSTs include IFSTTAR, the Institute of science and technology for transport, development and networks, the INED for the research in population studies, the INRIA for the research in computational sciences, the IRD for development issues, and the IRSTEA for issues related to the environment and agriculture.

⁹ From the merger of the French national institute for transport and safety research (INRETS) and the French public works research laboratory (LCPC).

¹⁰ <http://www.cnrs.fr/fr/organisme/chiffrescles.htm>

have led to a greater role of the CNRS as a funding agency, to increased powers of the ruling team which is in charge of the budgets and resources of the newly created national institutes¹¹ in the frame of the pluriannual contracts. However, this new organizational structure would require important coordination efforts of the newly created institutes and the existing traditional mission-oriented institutes as well as further clarifications regarding the future balance between the two roles of the CNRS, as a research operator and a funding agency. Furthermore the creation of the poles for research and higher education (PRES, JORF 2006) and the law for the responsibilities and the autonomy of the universities (LRU law, JORF 2007) put at stake the traditional structuring role of the CNRS on the French public research system and its influence in the management of the mixed research units. Indeed, among the 1029 research units of the CNRS¹², more than 90% are mixed research units between the CNRS and the higher education organizations, generally the universities, and other research organizations. These rapid changes also entail a lower visibility of external partners and especially of firms or international agencies, which usually have to account for the different budgetary, legal and human resources policies.

- The law relative to the Liberties and Responsibilities of Universities (LRU) and the creation of research and higher education poles (PRES): between cooperation and autonomy

France's higher education expenditures have reached about €26 billion in 2009, an increase of one fourth since the beginning of the 2000s (at 2009 prices). In 2009, higher education expenditures represent about 20% of France's domestic education expenditures, against 16.7% in 2000. Overall, the qualification level of France is improving as 40% of the population aged 25 to 34 in 2008 is graduated, especially on short and specific course while the country performs worse regarding long-term qualifications leading to research. A well-known historical trait of the French higher education system is the separation between the Grandes Ecoles (GE), from which most elites originate and the universities. Although they account for the majority of students, the universities have historically competed with the GE in the training of elites. The GE and the universities differ in terms of recruitment mode, the first being more selective than the second, of the teacher to student ratio, of the organization and content of the programs and studies, as well as regarding the average expenditure per student. Besides the GE have historically showed a higher rate of penetration of the labor market and their students, higher salaries than the universities' students (Giret et al. in

¹¹ A list of the new institutes are available at <http://www.cnrs.fr/en/aboutCNRS/institutes.htm>

¹² Besides there are 111 services units (see CNRS website)

Cytermann et al. 2007). In a nutshell, France's education system combines lowly endowed and non-selective public universities (at least for the first years) with very small GE with a low international visibility. Several initiatives have been undertaken to overcome these deficiencies in the higher education system, including the growing number of vocational degrees in the universities, of partnerships between the universities and the GE and the very recent formation of the research and higher education poles (PRES).

The French higher education system has recently known major reforms including the convergence towards European standards under the Bologna Accords (LMD system), the implementation of the law on the Liberties and Responsibilities of the Universities or LRU law (JORF 2007) and the establishment of research and higher education poles (PRES). The LRU law allows the universities to obtain the autonomy in terms of budget and human resources management. At the beginning of 2012, most universities have become autonomous. This autonomy has required an important internal restructuring notably regarding the governance pattern within the mixed research units. The implementation of the LRU law combined with the establishment of the research and higher education poles (PRES) has called for even more efforts from universities regarding the coordination of autonomy and cooperation strategies. Indeed, in some regions the implementation of the LRU law has slowed down the formation of the PRES as universities have tended to favor their internal policies. Designed to increase the international visibility and attractiveness of French higher education system, the PRES aim at fostering synergies and at bringing further coherence between the education, research potentials, infrastructures and operational services of organizations usually located on a given site (metropolitan areas, regions). They also enable organizations to grant the degrees under the name of the PRES as well as to assign the publications to this establishment, notably with a transfer of competences and resources to the founder establishments. Since their creation 26 PRES have been created involving about sixty universities, several higher education schools and hospital centres¹³.

Although the LRU law has paved the way for a greater autonomy of universities, the current outcomes are still far below the government's announcements. Several efforts are still necessary to improve the governance, the efficiency of expenditures and to achieve a better transfer of responsibility in the budget management. Moreover, several universities including some of the most well-known are recording budget deficits; and this, even though the *Investissements d'Avenir* programme has brought massive investments in the higher education

¹³ <http://www.enseignementsup-recherche.gouv.fr/cid20724/les-poles-de-recherche-et-d-enseignement-superieur-pres.html>

system. Besides, the labeling of degrees under the PRES, the harmonization of training programs within the poles and the extent of mutualization of education and research activities appear to be very unequal across poles. The formation of these PRES raises more general issues regarding the coordination with the other formal networks and their objectives (RTRA, CTRS, competitiveness poles and Carnot institutes), as well as with the PROs, which are committed in research contracts with the universities through the mixed research units. Furthermore, some medium-size universities meet several difficulties in setting up federative and structuring projects of a sufficient size thus leading to the creation of multi-regional PRES as Limousin-Poitou-Charentes and Bourgogne Franche-Comté.

In the next section, we discuss the main reforms undertaken in the activities of provision of constituents. The first paragraph examines the multiple networking related structures to improve the exploitation of research and the development of the new institutions and operational structures in the French innovation system.

III. The implementation of networking related measures: a blurred institutional landscape

- Early networking initiatives for technological research and innovation: the lack of systematic assessment procedures

The gradual retreat of the State from the research and innovative activities during the 80s and the 90s has come with the creation of early structures to support the transfer of technological knowledge notably to SMEs. Created in the early years 1980, the CRITT or the regional centres for innovation and technological transfer aimed at improving the technological capabilities of SMEs and small and medium size industries (SMIs). In 2003 an assessment undertaken by the national committee for the evaluation of research (CNER) underlined the difficulties in measuring the results and the effectiveness of the CRITT. In addition, other networking structures such as the technological platforms (PFT), the networks for technological development (RDT) and the technological diffusion units (CDT) were created or developed to enhance the relationships between SMEs and PROs. Based on a top-down approach, the RDT consist in networks of public or para-public actors involved in the technology transfer and development as the ANVAR¹⁴, the CRITT, the regional directions, the PROs and the education organizations. They are mainly funded by the State and the

¹⁴ Created in 1967, the Anvar was the national agency for the exploitation of research, which has been absorbed in 2005 by OSEO.

regional councils, and can also rely on some European funds. In 1998, about 9 million of 2011 euro have been dedicated to the networks technological services to SMEs in the frame of the RIDT (Commission des affaires économiques, 1999).

Besides, this regional networking support, the French government has also undertaken the creation of networks at the national scale. Since the mid-nineties, formal collaborative research has been organized around the networks for research and technological innovation (RRIT) funded by private actors and the research technological fund (FRT). Following the models of the inter-ministerial programme for research and development in road transport launched in 1996 (PREDIT) and the national networks for research in telecommunications launched in 1997 (RNRT), the RRIT bring together the main public and private actors involved in an industry or a technological domain. They are based on a more bottom-up approach in the definition of objectives, a greater autonomy of regional authorities and organizations in their implementation. The OECD (2004) provides an evaluation of seven RRIT which points out the positive effects of the coordination of national policy, local actors and a higher involvement of SMEs. However, the report also underlines the low ability of RRIT to engage into international collaborations as well as the limited involvement of venture capitalists. Furthermore, no systematic assessment procedure has been implemented for these structures.

- Improving the international attractiveness and the exploitation of research

By the mid-2000s, French policy makers have implemented new networking structures under the Pact for research (JORF 2006), which has provided legal structures for the implementation of the thematic networks (RTRA, CTRS/RTRS), research and higher education poles and competitiveness poles.

With a legal status of scientific cooperation foundation, the RTRA bring together higher education and research organizations on joint excellence projects within one or several scientific fields. As the CTRS/RTRS dedicated to biomedical research and medical care, the RTRA offer a legal frame for the development of geographical networks, selected through a call for projects, on the basis of their scientific quality, their contribution and their originality. As such, these networks aim at supporting fundamental and applied research, increasing the scientific collaborations and developing public-private partnerships. In 2006, over the thirteen RTRA¹⁵ selected, six are localized in the Ile de France region. Besides, the size and the thematic, the RTRA also differ in terms of scope, as some appear to be more oriented towards

¹⁵ See <http://www.enseignementsup-recherche.gouv.fr/cid56330/les-reseaux-thematiques-de-recherches-avancees-et-de-recherche-et-de-soins.html> for the list of 13 RTRA.

academic research (Triangle de physique and Ecole des Neurosciences de Paris) while other display a greater dual scope of scientific research and industrial innovation (Digitéo, Fixari et al. 2008). Nine RTRS/CTRS have been selected among which four are localized in the Ile de France and some are structured around several regions (e.g. Centaure for organs transplantation, etc.).

The Pact for research also led to the creation of the Carnot labels managed by the ANR. Granted by the Ministry of higher education and research and under the proposition of ANR, the label is dedicated to research structures with general interest missions and with effective collaborations with the firms. They intend to favor technological transfer between public laboratories and firms through the development of research contracts and to strengthen their scope through the creation of Carnot Institutes. The labels allow the structures to benefit from a subsidy to complement the initial budget allocations. 33 Carnot labels were granted between 2006 and 2007 for four years. Within these labels, the aid has remained very concentrated notably with the laboratory for electronics and information technology (LETI) and the national centre for the studies and researches in aerospace (ONERA) which concentrated about 40% of the funding, while five institutes received about 60% of the funding (Cour des Comptes 2011b). A new call for Carnot labels has been launched at the end of 2010 by the ANR in the frame of the Investissements *d'Avenir* with a greater attention for SMEs and SMIs (projects call Carnot PME) and a higher budget allocation. 34 labels have been granted, covering about 15% of the public research personnel (19,000 in full time equivalent).

Under the research exploitation programme of the Investissements *d'Avenir*, the French government has implemented other actions to enhance the technology transfer from the public sphere. They include the national fund for the exploitation, France Brevets and the technological research institutes (IRT). The national fund for the exploitation is dedicated to the creation of accelerating technology transfer companies (SATT) and the thematic consortiums for research exploitation (CVTs). They respectively benefited from 26% and 1.4% of total funds dedicated to the research exploitation programme representing 9% of the €35bn national loan. The SATT are owned in majority by groups of higher education and research organizations, and aim at improving the effectiveness of the technologies transfer towards firms in order to reinforce their innovation potential. They are also expected to contribute to the creation of innovating firms, high-skilled jobs and to be much more market-oriented than previous structures. Indeed, the associated financial support of the State focuses on the maturing and testing phases of the public research's inventions. Besides, the CVT offer high value-added exploitation services to the exploitation structures on specific thematic. The

IRT are interdisciplinary thematic institutes, which bring together public and private education, research organizations, industrial actors and resources in terms of industrial prototypes and demonstrations. They are designed to strengthen the ecosystems of the competitiveness poles, which are responsible for their labeling process. The initiative focuses on a limited number of international campuses and is based on public-private investments; the funding plan is based on a maximum of 50% contribution of the State that should be complemented by private sector and local authorities' funding. In this frame, ten years objectives in terms of employment and value-added creation are defined and the institutes are also expected to contribute to the development of collaborative research within the European community frame.

The cluster policy has been implemented in France through the creation of the competitiveness poles, which aim at structuring and reinforcing the relationships between research and industrial actors, and at increasing the international visibility of French regional strengths. As such the competitiveness clusters and the thematic networks are key elements in the attractiveness strategy of France's territory for research and innovation activities. The collaborative projects within the clusters are mainly funded by the State through Oséo and the ANR. In 2005, 67 clusters were labeled. An evaluation of the first phase (2005-2008) has been achieved in 2008 (BCG and CM international 2008). The poles have been able to generate collaborative dynamics between quite isolated actors, to better integrate SMEs¹⁶ and to build up new bridges between universities, laboratories and firms. Thus, the report suggests to maintain the main features of the cluster policy, the funding of collaborative projects, the public support for bottom-up initiatives and the coordination between national and local policy actors. However, several improvements are necessary regarding the training schemes, the private funding and the development of following-up indicators, as well as sustainable development thematic. Although it proposes a reallocation of the poles between international and national poles¹⁷, the report does not call for any refocusing on a lower number of poles as the selective nature of the project funding ensures a concentration of the funding; indeed ten poles account for 55% of the project funding of the first phase. The main problems relate to the governance structure and the design of consistent strategies. Besides the relatively low private funding, some poles are still missing a balance between the stakeholders, a clear leading thematic and a relevant international strategy. Regarding the cluster policy, a major

¹⁶ About 30% of the labeled projects are carried out by SMEs and about one third involve at least one SME. In 2009 SMEs represent about 40% of the R&D expenditures of the projects (against 35 % in 2007) (Oséo 2011).

¹⁷See p12-13 of the evaluation syntheses (BCG and CM International)

limit relates to the priority granted to competitiveness issues and the level of the funding committed in the poles; for the first and second phases (2009-2012) the budget amounts €1.5bn each. Although they constitute a relevant scheme for the improvement of the relationships between public and private research, the poles cannot be the sole solution for the international competitiveness issues of the French industry, at least given the relatively low level of funds involved. Furthermore the success of the poles will depend on the coordination with the different public support schemes for innovation. On the basis of a sample of PRES, RTRA and RTRS localized in Ile de France, Firaxi et al. (2008) discusses the effects of the coexistence of these schemes. They underline the low and non-formalized relationships between the different schemes and the lack of a systematic assessment of the integrated effects of these policies, which usually target the same actors on the same territory. The number of clusters has increased to 71¹⁸ in 2010 after the first evaluation. An evaluation of the second phase has been achieved on the behalf of the CIACT. As the first report, they underline the structuring and federative role of the poles for the collaborative research in France. They also point out the need to reconsider the distinction between the three categories of poles, which are based on unclear criteria and do not entail any differentiated measures. Moreover, this distinction does not reflect any clear sectoral or technological priorities. Indeed the poles cover a broad range of technologies as each pole identifies about 12 technologies on average (BearingPoint-Erdyn-Technopolis 2012). This may hamper the development of a real technological specialization of the poles. Besides, the poles still suffer from a lack of private funding and this, although numerous venture capital schemes have been implemented. The report also points out the low market-orientation of the poles. Overall, the report calls for a greater simplification of the procedures especially to improve the participation of SMEs and their access to the funding for collaborative projects. Furthermore, the poles are also called to contribute to the labeling of the shared platforms for innovation launched in 2011-2012. These platforms offer open-access shared resources (equipment, personnel, services) for the member of the competitiveness poles particularly for SMEs. Mainly funded by the CDC, they aim at facilitating the development of new technologies-based products, services as they offer the possibility to achieve tests, prototypes and some pre-series.

The next section focuses on the provision of institutions and more precisely on the new policies and actors involved in the orientation, the design and the implementation of the R&D and innovation policies.

¹⁸ See list at <http://competitivite.gouv.fr/poles-en-action/annuaire-des-poles-20.html>

IV. The new institutional actors for the design and the implementation of research innovation policies

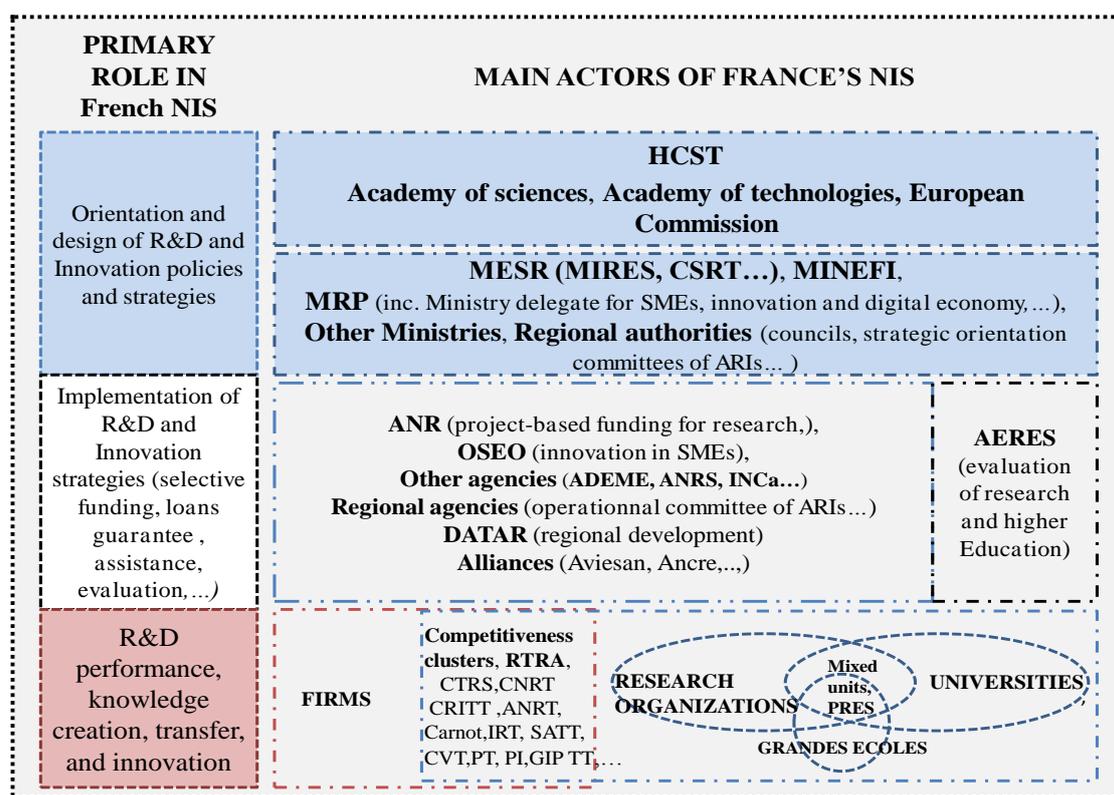
- Orientation and design of R&D and innovation policies

During the last decade the French innovation system has undergone major structural changes carried out by the implementation of an innovation policy mix, which has involved the emergence of new types of actors, instruments and a different pattern of priority setting. This new leaning of the French innovation policy has led to numerous, overlapping and sometimes conflicting measures, which have affected the ability of targeted actors to adapt to the new environment, and has lengthened the transition process of the whole system.

Under the Pact for research, the French government has set up new intermediary agencies, the national agency for research (ANR), the national evaluation agency (AERES) in 2007 and new actors dedicated to the design and orientation of R&D and innovation strategies as the higher council for science and technology in 2006 (HCST). In addition, a new Ministry for industrial renewal has been set up in 2012 (MRP). Figure 2 offers a synthetic map of the main actors of the current French innovation system according to their primary roles. Besides the budget-oriented governmental actors, the European Union, the HCST, the academies of sciences and technologies also contribute to the orientation of the R&D and innovation policies. The HCST are established for four years and advise the government on issues related to the scientific research, technology and innovation transfer as well as their coherence with the European policies (JORF 2006). The academy of sciences and technologies¹⁹ are learned societies which bring together French and foreign scientists, researchers and experts. As the HCST, these academies contribute to the definition of the scientific and technological policies through the production of reports and recommendations. More generally, they also promote through different actions the development of sciences, emerging technologies and their relationships with the society and human needs. In addition of the traditional ministries (MESR, MINEFI), their related consultative bodies and inter-ministerial missions, the recently created minister of industrial renewal (run by Mr. Arnaud Montebourg since May 2012) is also expected to play an important role notably through the minister delegate for small and medium-sized enterprises, innovation and the digital economy.

¹⁹ The Pact for research has granted the status of public administrative establishment to the academy of technologies (JORF 2006).

The MIREs is responsible for the implementation of governmental budgetary support for the fundamental, applied and oriented research, technological development and mobilizing programmes. In terms of budget the MIREs, which most funding is dedicated to the MESR, is among the most important inter-ministerial missions with a budget of about €25bn in 2011 (against €15bn in 2008, MESR, Sénat). Created in the early eighties and delegated to the MESR, the CRST is a consultative body for the broad orientations of the scientific and technological policies. Also, regional authorities have been increasingly involved in the orientation, the design and the implementation of the R&D and innovation policies through the regional councils, the strategic orientation and operational committees of the regional innovation agencies. Furthermore, in the frame of the European Union's coherence policy for the period 2007-2013, the French regions have designed regional innovation strategies in order to improve the implementation of EU's funds for R&D, innovation and firms' supporting programmes. The recent report elaborated by the French Delegation for Territorial Development and Regional Attractiveness (DATAR) provides a synthesis of the implementation of the regional innovation strategies and present their main weaknesses, strengths and strategic priorities (DATAR 2012). The DATAR points, among others, the low operational role of regional agencies and the problems of overlapping with the State-Region contracts. Moreover some inequalities among regions exist regarding their contribution to the design regional innovation strategies. The DATAR has contributed to the preparation of the SRIs and has been involved in their implementation (DATAR's plan of action 2010-2012). The DATAR also participates to the implementation and the evaluation of the second phase of the competitiveness poles policy and work with the French agency for international investments (AFII) to enhance the international attractiveness of France for innovating firms.



Personal elaboration

Figure 2. The main actors of France's innovation system

Notes:

HCST: High Council for Science and Technology
Academy of Technologies or National Academy of Technologies of France
MESR: Ministry of higher education and research
MIREs: Mission for research and higher education
CSRT: Research and technology council
MINEFI: Ministry of economy and finance
MRP: Ministry of industrial renewal
ARI: Regional agency for innovation
ANR: The French National Research Agency
OSEO: French innovation agency (now integrated to Bpifrance)
ADEME: French Environment and Energy Management Agency
ANRS: National Agency for Research on AIDS and Viral Hepatitis
INCa: French National Cancer Institute
DATAR: French Delegation for Territorial Development and Regional Attractiveness

AERES: French evaluation agency for research and higher education
PRES: Pole of research and higher education
RTRA: Thematic network for advanced research
CTRS/RTRS: Thematic research and care centers/network
CNRT: National center for technological research
CRITT: Regional innovation and technology transfer centers
IRT: Technological Research Institutes
SATT: Accelerating technology transfer companies
CVT: Thematic consortium for research exploitation
ANRT: French national agency for research and technology
PT/PI: Technology platform / Innovation platform
GIP TT: Public interest group for technology transfer

After this bulk of reforms, France has officially designed and edited, for the 1st time a National Research and Innovation Strategy. In the frame of the National Research and Innovation Strategy²⁰ 2009 (MESR 2010a), the French government has implemented the Alliances in order to structure national actors involved in selected research fields. The

²⁰ Edited for the first time in 2009 the French national research and innovation strategy (SNRI) document is the result of national debates and workshops among more than 600 people from the research, industry and non-profit sector. The SNRI 2009 provides the guidelines of the government's policy in research and innovation structured around five principles, Fundamental research, Research geared towards society and the Economy, Better consideration for the risks and the need for security, Importance of human and social sciences within the strategy and Multidisciplinarity – an essential part of modern research (MESR 2010a).

National Research and Innovation Strategy has identified three priority areas for research and innovation over the next four years, namely (i) Health, well-being, food and biotechnologies, (ii) Environment emergency and eco-technologies and (iii) Information, communication and nanotechnologies.

- The creation of new intermediary agencies

Created in 2005 from the merger of the BDPME and Anvar, Oséo²¹ has become the first actor for the support dedicated to SMEs' innovation. The group has been structured around three subsidiaries corresponding to its main broad activities including the support for innovative technologies based projects (Oséo Innovation, ex-Anvar), the loans guarantees in support of bank financing and equity contributions (Oséo Garantie, ex-Sofaris) and the financing for business investments and operations in partnership with financial institutions (Oséo Financement, ex-BDPME). Oséo has developed a network of regional delegations and has established several partnerships with both public and private actors at the national and international level. In this respect, it also constitutes the main intermediary of European policies and collaborative programmes for SMEs and innovation (Eurêka, FPs' SMEs programmes, Tactics, Innet, ERA-Net, EraSME, and EuroTransbio, etc.). Oséo has extended its missions and scope notably through the absorption of the industrial innovation agency (AII) in 2008, the creation of an international department and the management of the Inter-Ministry Fund's collaborative projects. The AII has been set up in 2005 to support large industrial and innovation programmes mainly organized around large and medium size firms which received about 80% of the distributed aid and funding through the mobilizing programmes for industrial innovation²² (PMII) initiated in 2006. Besides the follow-up of the PMII, Oséo has implemented in 2008 the ISI programmes (strategic industrial innovation). These latter programmes aim at supporting, as the AII, federative actions but with a focus on SMEs and firms with less than 5000 employees. They respectively receive 68% and 19% of the ISI state funds in 2009 (Oséo's annual report, 2009).

Although decreasing the AII funds have remained the most important budget line in the four years. The partner financing has become more important although it has recorded a decline in the last two years due to the decrease in the European regional development funds and in the

²¹ Since May 2013, Oséo has been absorbed by a newly created entity the Bpifrance (state investment bank) which brings together Oséo, CDC Entreprises, FSI Régions and C&D Gestion. Bpifrance's missions include innovation support and funding, funding guarantees, investments and operation cycle funding and funding support to export activities (see at <http://www.bpifrance.fr/>).

²²The total aid amounts €728 million included €435 million in subsidies and €294 million in repayable loans in 2006 (MESR 2007).

funds managed in the frame of the Civil Aviation Programmes Department (Oséo annual report 2011). The sectoral distribution of the innovation support has been quite stable and concentrated around the industry, which accounts for almost the half, the life sciences and ICTs (25% each in 2010). In terms of size, firms of less than 50 employees account for about three quarters of the Oséo Innovation's support. Besides Oséo Garantie provides guarantees mostly for banks loans and for the development phases and firm creation while Oséo Financement is involved in co-financing and short-term financing plans. Contrary to the innovation activity, the guarantee and the financing activities have known important increases. The guarantee activity has recorded a 30% increase between 2008 and 2011, the co-financing part has more than doubled, while the short-term financing has gone up by one fourth.

Oséo is also involved in the technological development networks (RDT) notably through the network technological services' subsidies co-financed by the group and the regions. These services aim at improving the relationships between SMEs, especially micro-firms (less than 50 employees), and technical advisory centres. The eligible expenses for the subsidies included for instance preliminary technological studies, tests, modeling, market studies, partners search and expenditure related to the first patent application. Besides Oséo also awards the label of innovation firm²³ and contributes to the activities supported by the Pacte PME. This non-profit organization has been set up in 2010 following the Pacte PME programme (2006-2009) of Oséo and the Richelieu committee (French non-profit organizations for innovating SMEs created in 1989). It aims at establishing more balanced relationships between large groups and SMEs. The innovating firm label gives a preferential access to a proportion of the high technology public procurement²⁴ and to the funding from the FCPI (French innovation-focused investment funds). Moreover, Oséo is the operator in most actions of the programme Financement des entreprises within the frame of the Investissements *d'Avenir*.

Initially created as a public interest group in 2005, the ANR, the main project-based funding agency, has been granted the status of public administrative establishment since 2006. The agency provides the financial resources through research contracts to both public and private research teams on the basis of a competitive process. It also supports the development of

²³ Firms are said to be innovating if they have received an Oséo's innovation support (AI, guarantee, etc.), have obtained the Oséo's label "innovating firm" or have benefited from the research tax credit.

²⁴ According to the Law for the modernization of the economy (JORF 2008), at least 15% of the technological studies, high technology and R&D public procurement are dedicated to innovating SMEs.

thematic or non-thematic research programmes and collaborative public-private research. Since its creation, the agency's budget has increased to reach about €854 million in 2010 (against €596 million in 2006), among which non-thematic research grants account for about 50% (ANR 2010). The main beneficiaries are PROs and universities, which receive together about 85% of the grants while companies represent about 11% of the grants (ANR 2011). The ANR is also the main public agency in the *Investissements d'Avenir* as the operator for the research and higher education component of this programme, which covers €21.9 bn. Regarding the evaluation of research and higher education organizations, a systematic peer-based assessment procedure has been implemented through the creation of the AERES in 2007. Finally, the Alliances aim at a better understanding of the national policy orientations by R&D performers and are responsible for the coordination of the implementation of the State's resources. These alliances are also expected to contribute to enhance the coherence of the higher education and research establishments' strategies and to the international visibility of French actors.

Conclusion

The paper has discussed, with a normative stance, the attempts of French policy makers to move from the traditional mission-oriented model towards a more systemic approach of innovation, knowledge generation processes and in the design of innovation policy. The early initiatives developed during the first half of the 2000s to enhance the exploitation of research, have not been sufficient to generate a real and clear dynamics of the system. Moreover most of the structures have been established without any coordinating and evaluation frameworks. Actually, for the few that have been evaluated, the outcomes did not stand up.

Since the mid-2000s France has undertaken a massive restructuring of its NIS, but this time, the set of actors have been broadened, including both public and private actors. This process has come with greater funds dedicated to the research. Besides the increased financial support, France has issued several good practices regarding the development of public-private partnerships, the implementation of some evaluation schemes, an improved support and higher recognition of the role of universities and SMEs and more selective and competitive funding schemes. The development of SMEs-specific measures has led to the creation of numerous start-ups and innovative SMEs revealing less restrictive barriers to entrepreneurship. However the rapid introduction of numerous reforms and the complexity of the measures affect the visibility of SMEs, as well as of the investors and may lead to an under-exploitation of the new opportunities. Moreover the various initiatives for SMEs have led to limited developments beyond the very small firm size and to a low participation in international markets. In addition the French government has introduced several networking measures and policies and has initiated important, and sometimes conflicting, restructuring of its public research and higher education systems. The earlier efforts for a better coordination of the different public organizations involved in the innovation related-activities at the national, regional and local levels should be kept on track and further strengthened. It should facilitate the identification of overlapping and less appropriate incentives schemes and allow for a reduction of the institutional blurring. Also, it will help to further enhance the visibility of small firms on the grey box of innovation incentives.

In a nutshell, the impact of the recent reforms will crucially depend on the simplification of the institutional landscape, on the visibility of the microeconomic actors and their ability to seize the new opportunities offered by this new institutional frame. This latter point calls for urgent policy actions to render clear the long run research and innovation agenda for the targeted actors.

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