Chapter 6

Research and innovation support policies in France

This chapter discusses policies that support business research and development (R&D) and innovation in France and draws comparisons with other countries. It illustrates the State's changing objectives and methods in this field, where France is now part of a trend towards "new industrial policies". It examines in detail the chief instrument by which the State influences business R&D, namely the research tax credit, whose breadth places France at the top of Organisation for Economic Co-operation country rankings. It reviews direct support instruments, including agencies such as Bpifrance (which handles financing), programmes such as competitive clusters (which provide localised support) and sectoral programmes (related to defence, aeronautics, etc.). The chapter concludes with a discussion of France's policy mix.

Overview of business innovation policies

Innovation in France: motivation and strategy

France's innovation policy has undergone fundamental changes over the past 15 years. It previously focused on "major programmes" and military programmes in response to community needs (telecoms) or State-led industrial strategies (Airbus). These programmes were driven by the State and involved large companies regarded as "national champions". The doctrine of public action has changed since then. It now views competitiveness, and meeting community needs (environment, health, etc.), as the major drivers of innovation policy and sees the market as a necessary mechanism for implementing it. This brings France in line with the contemporary trend towards "new industrial policies" (see Box 6.1).

According to economic theory, innovation policies are a response to market failures: first, knowledge spillovers, because the return on private investment in innovative activities is lower than its social return, leading to insufficient investment (according to market-driven theory); then, specific information asymmetries between entrepreneurs and investors, leading to inadequate capital investment in entrepreneurial activities. The first market failure relates more to research activities – the source of more generic knowledge than more specialised downstream activities; the second concerns small and new enterprises, which rely on external funders.

It is also helpful to recall the main features of the current industrial environment and the way in which they differ from the previous environment in which France's innovation policies were initially forged.

- "Innovation" does not refer merely to high technology inventions in research and development (R&D)-intensive sectors – it has the potential to be everywhere. The service sectors, which account for between 70% and 80% of value-added in developed countries cannot, cannot – and do not – remain in the background: they generate technological (especially related to information and communication technologies [ICT]) and non-technological innovation. An exclusive focus on the manufacturing industries runs the risk of overlooking this fact, which is all the more damaging as the competitiveness of a country's manufacturing industry also depends on the productivity of its service sectors, which are also major industry suppliers.
- The gradual establishment of global value chains has changed the concept of "national industry". The chains are segmented across countries, in line with internal decisions taken by multinational companies and according to the competitive environment. This leads to a disconnect between the various segments in the value chain (for example, Apple designs its products in the United States, but its components are manufactured in different countries and assembled in China; the German automotive industry partly regained its competitiveness in the 2000s by relocating some activities to countries in Central and Eastern Europe). In view of this, a policy that seeks full integration of innovative capacity on the one hand and manufacturing on the other hand makes no sense in many industries where knowledge flows across the various stages of the production process. Such a policy might well have negative effects, by providing incentives for companies to relocate even their design activities. The increased mobility of factors associated with innovation– skilled labour, patents, etc. – should also be taken into account.

Thus, the important factor for innovation policies is the area's attractiveness and making sure conditions encourage companies to establish their design activities in the country.

- Productivity growth – the main competitiveness factor – requires a very active industrial demographic: the least productive enterprises decline or disappear, while more promising projects are encouraged and the most productive enterprises are able to grow. In many new industries, e.g. biotechnologies or the Internet, new ideas and technologies are led by new entrepreneurial projects and not directly by established companies (which may subsequently recruit the innovators). This requires policies that foster new business creation and impede neither their expansion nor the decline of less productive companies.
- Although innovation is occurring at an unprecedented rate and often calls on knowledge from different disciplines, most innovators need to access and form relationships with multiple sources of knowledge: this is "open innovation", a term that refers to linkages between companies – particularly between large and small enterprises – and links between publicly funded and privately funded research. Open innovation is now structured on a global scale. Hence, policies must emphasise co-ordination among players – which market forces do not always allow – and national openness to international knowledge.

It is against this background that the "new industrial policies", with their heavy and sometimes exclusive focus on innovation, emerged. Industrial policies, i.e. direct government intervention in business investments, had fallen into disuse since the 1980s as a result of international agreements (World Trade Organisation [WTO]) that severely restricted them as well as a number of spectacular failures, especially among nationalised enterprises. In recent years, the 2008 crisis and the economic success of countries in which where the State has a strong role (China) have led to renewed interest in industrial policy among OECD countries and beyond. In some countries, political decision-makers feared that manufacturing output had fallen too low, and more broadly that knowledge-intensive sectors were not sufficiently developed. Industrial policies were then introduced in a bid to strengthen technological areas or industries, such as advanced manufacturing, services to knowledge-intensive companies or the "green" economy, whose aim is to promote new sources of economic growth. When formulating their policies, governments must also take into account international treaties that restrict their room for manoeuvre, especially the WTO agreements of 1995 (which restrict trade policies and impose ceilings on direct business subsidies) and the European Union treaties related to trade, government aid and public procurement. The new industrial policies have the following characteristics (Warwick, 2013):

- Recognition of the fact that framework conditions, including a sufficient level of competition and the availability of human resources, are also important The new industrial policies place great faith in market mechanisms, which they seek to build on, rather than replace, by providing them with a solid foundation. The aim is to improve the conditions for the activities of the companies concerned rather than to support specific companies, the "national champions" of the old industrial policies.

- Support that relates more to upstream activities and technologies (especially to research, often involving developing linkages with publicly funded research) rather than industrial sectors. Thus, industrial policies essentially become innovation policies.
- The search for a balance between "neutral" aid that is not sector-specific – especially indirect aid, such as the research tax credit (CIR) – on the one hand and targeted aid and the focusing of resources on certain activities on the other.
- The opening up of measures and programmes to small and medium-sized enterprises (SMEs) and entrepreneurs, even if large companies often remain key conduits for certain targeted policies. Entrepreneurship is itself the object of specific policies.
- The emphasis on co-ordination among actors, in order to allow them to internalise externalities, e.g. through joint research projects. Governance of sectoral programmes often involves the players themselves.
- Political will for effectiveness: in a challenging budgetary environment for all countries, governments must seek to minimise the cost of these policies. This requires strategic consistency (issue clear instructions, avoid redundancy) and focusing exclusively on measures whose effectiveness has been demonstrated – hence the importance of effective assessment (leading to decisions to reorient or terminate programmes whose evaluation came back negative).

These features occur in varying degrees in the industrial recovery plans (Box 6.1) announced by a number of countries since 2008 in response to the crisis – including France, despite its markedly different national tradition (emphasis on State control rather than market mechanisms, promotion of national champions, etc.). But the French plans also feature more specifically French traits that allow adapting these principles to the national context, some of them linked to the old model of support for innovation; as a result, the various characteristics are not always consistent with each other.

At the national level, innovation policy is led by a number of ministries (the ministry in charge of industry [actually the Ministry of the Economy, Productive Recovery and Digital Media], Ministry of Higher Education and Research [MESR], Ministry of Agriculture, Agri-food and Forests, Ministry of Sustainable Development and Land Use, Ministry of Defence) and other bodies (General Commission for Investment [CGI]) A number of operators (OSEO/Bpifrance, the National Research Agency [ANR] and the French Environment and Energy Management Agency [ADEME] in particular) implement support measures for industrial R&D. The system is highly complex and features a host of measures, programmes, calls for tender and bodies responsible for administering them.

France is notable for its ongoing strategic and generally analytically astute strategic reflection conducted by numerous institutions – the Commission for Strategic Action (which became the General Commission for Strategy and Foresight in 2012), the MESR, the ministry in charge of industry, the CGI – based on report issued by the parliament or commissioned by the government (the Juppé-Rocard report in 2009, the Gallois report in 2012), recurrent forecasting operations (the "key technologies" of the ministry in charge of industry), etc. This informs the public debate and allows well articulated viewpoints to be compared and contrasted.

By contrast, it would appear that the decisions implemented lack strategic consistency: the accumulated strategies allow setting useful long-term prospects, but sometimes apparently at the expense of consistency. Today, French policy is guided by several strategy plans (the national research and innovation strategy [SNRI], launched in 2009, was replaced by the national research strategy [SNR] in 2014), the "Investments for the Future Programme" ([PIA] which is usually, but not always clearly, consistent with the SNRI) and more recent industrial plans, such as that for a "New Industrial France". It also features a large number of sectoral plans and measures that do not seem to fit into a broader vision.

Box 6.1. The renewal of industrial policies: Examples of industrial policies in OECD countries

A number of OECD countries have also launched industrial policy initiatives in recent years, some in direct response to the economic and financial crisis, and others with a more long-term vision.

- Japan recently presented a new industrial policy plan with a view to moving away from its current "monopoly" structure based on the automotive and electronics industries towards a structure based on five strategic areas: infrastructure, environment/energy (including green vehicles), culture (fashion, food, tourism), traditional areas in Japan (robotics, space, aeronautics) and health.
- Korea, which has traditionally promoted an active industrial policy, recently formulated sectoral strategies for what it views as flagship industries: the automotive industry, shipbuilding, semiconductors, steel, machinery, textiles and materials. Additionally, Korea has identified a certain number of growth drivers as a priority for the future. Based on an analysis of its comparative advantages, Korea has identified 17 in three categories: green technology, high-tech convergence technologies and value-added services (Ministry of the Knowledge Economy, 2011).
- Until recently, the United Kingdom had not expressly embraced a formal industrial policy. However, various plans were presented in 2009 and 2011 in response to the economic crisis. Successive governments stressed a plan for economic recovery that included horizontal measures and identifying key sectors for working to eliminate obstacles to growth. Under the Labour Government, a Strategic Investment Fund (SIF) was established in 2009 to support a number of targeted investments – in carbon-free technologies, advanced manufacturing, digital infrastructure and export promotion – to strengthen the United Kingdom's capacity for innovation, create jobs and drive growth. Although the SIF was not retained by the coalition government that took office in 2010, the Secretary of State for Business, Innovation and Skills pledged his support for an appropriate industrial policy and set out his industrial strategy in September 2012.
- The United States does not have a formal industrial policy, but its recently launched innovation strategy (National Economic Council, 2011) includes classic horizontal measures such as improvements to ICT infrastructure, education and public services, in conjunction with vertical priorities including clean energy, biotechnology, nanotechnology, space and advanced manufacturing. Additionally, the 2009 American Recovery and Reinvestment Act included support for energy technologies, housing and other sectoral measures, in addition to horizontal measures and demand stimulation. The support afforded to two of the country's largest car manufacturers is a further example of industrial policy.

Objectives, finance and policy mix

The stated aims of government support for industrial R&D are: *i)* increase business R&D; *ii)* encourage co-operative R&D between companies; *iii)* develop co-operation between companies and public research organisations (PROs); *iv)* support innovative entrepreneurship; *v)* promote certain thematic or sectoral priorities linked to competitiveness or societal needs. For each of these aims, a number of instruments have been introduced, each generally pursuing more than one aim, as shown in Table 6.1. An important point to note in relation to these aims is the high level of importance given to R&D in each case.

France has a substantial and very diverse system of public aid for business R&D. The Government transferred EUR 7.2 billion (euros) to companies for R&D in 2010, broken down into direct aid (EUR 1.3 billion), government defence contracts (EUR 1.2 billion) and indirect aid – mainly through the CIR and secondarily the young innovative enterprises ([JEIs] (EUR 4.5 billion). The question for the French Government is how effective such a massive system can be: which components (measures and instruments) are efficient and which are not? How well does the policy mix dovetail and how efficient is it?

In 2011, the total paid amounted to 0.38% of the gross domestic product (GDP), ranking France 3rd globally after Korea (0.39%) and Russia (0.41%), while the United Kingdom spent 0.16% and Germany 0.09% of its GDP (Figure 6.1). Of the countries for which statistics are available (Figure 6.1), France ranks 7th for direct support (0.12% of GDP) and 1st for indirect support (0.26%).

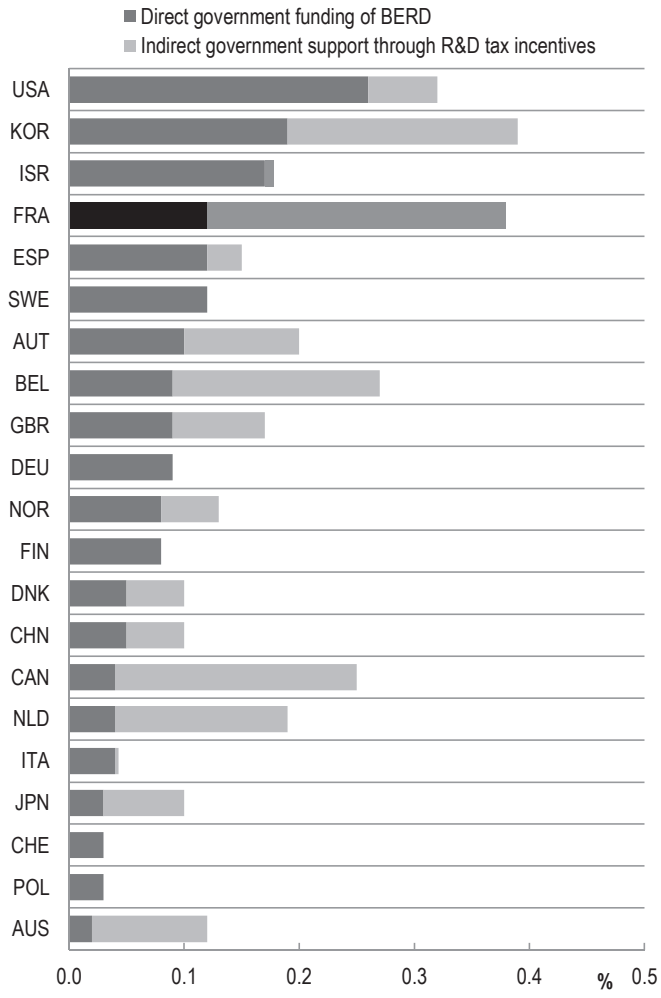
The policy mix used by governments to support the funding of private investment in R&D varies widely among countries (OECD, 2010). Some countries, including Sweden, Finland and Germany, do not offer a tax credit. Others, such as Canada, Japan, the Netherlands and France, have a funding system heavily anchored in tax assistance and direct aid represent only a small share. In Korea, Belgium and Austria, policies are more balanced between these two types of public aid. The policy mix has also changed a great deal over time in France: while the CIR has been strongly enhanced since 2008, the amount of direct aid has fallen considerably.

Table 6.1. Policies supporting business innovation in France

Aims	Corresponding programmes
(i) increase business R&D	CIR; OSEO programmes for SMEs
(ii) encourage co-operative R&D between companies	Competitiveness clusters (Single Interministerial Fund [FUI]; ANR); platforms (PIA)
(iii) develop co-operation between companies and PROs	Competitiveness clusters (FUI, ANR, PIA); Institutes of excellence for carbon-free energy (PIA); technological research centres (PIA); CIR (external R&D); Carnot institutes (PIA); ANR programmes for research partnerships
(iv) support innovative entrepreneurship	JEI; CIR (certain clauses); "Émergence" (ANR); National Seed Fund (PIA)
(v) promote certain thematic or sectoral priorities (environment, key industries, etc.)	French Civil Aviation Authority ([DGAC] aeronautics); defence credits; 34 key industries (Ministry of Productive Recovery [MRP], 2013); competitiveness clusters

Figure 6.1. Direct government funding and tax incentives for R&D

Budgetary impact as a percentage of GDP, 2011 or latest available year



Note: DIRDE is the French acronym for gross domestic expenditure on research and development (GERD) of companies established in France.

Source: OECD (2013), *OECD Science, Technology and Industry Scoreboard 2013: Innovation for Growth,* OECD Publishing, doi: 10.1787/sti_scoreboard-2013-en.

In 2011, public funding (excluding CIR, tax assistance and reductions of social security contributions) accounted for 7% of BERD. The State's direct share in financing BERD has been divided by almost 3 compared to 20 years ago, principally because of the fall in public defence contracts. State aid to companies for (civil) research and innovation are set out in Table 6.2.

Table 6.2. Public support to innovation in France (EUR million)

Funding source	Type of instrument	2010	2007-10 in %
CIR	Research tax credit	4 500	+350
JEI	University JEIs and others	157	+46
Other tax expenditure		54	+13
ANR	Subsidy for companies	62	-32
OSEO	Aid for the creation of sole proprietorships, aid for aeronautics sector, Aid for innovation, strategic industrial innovation (ISI), programmes to promote industrial innovation	488	-24
Business Competitiveness Fund	FUI (R&D projects + platforms), EUREKA clusters, Nano 2008 and 2012, thematic calls for projects	312	-28
DGAC	Aid for upstream aeronautics research, direct aid for component manufacturers, aid for major airplane, helicopter and aircraft engine programmes	271	-4
ADEME	Research demonstrator funds, other aid for research	82	+550
Other government loans	Industrial agreement on training through research (CIFRE) grants, incentive loans from the Ministry of Ecology, Sustainable Development, Transport and Housing, loans from the Strategic Council for the Healthcare Industry	71	+20
Total		5 997	+142
Total excl. tax and social security instruments		1 286	-16

Source: French Court of Auditors (2011), www.ccomptes.fr/Publications/Publications/Les-aides-aux-entreprises-en-matiere-d-innovation-et-de-recherche-la-coherence-des-dispositifs-fiscaux-et-budgetaires (in French).

The next part of this chapter will review these innovation-promoting policy instruments according to the objectives they seek to achieve: the CIR, which seeks to increase BERD; the instruments offering direct support, such as competitiveness clusters (regionally based instruments aiming to spur co-operation among companies and between companies and publicly funded research) and various programmes run by the ministry in charge of industry; and finally, measures and programmes with sectoral and thematic goals.

Research tax credit (CIR)

The CIR is a tax reduction granted to companies on the basis of their R&D expenditure. It represented a credit of EUR 4.5 billion in 2010. IT and has represented around EUR 5 billion per year since then and could reach EUR 7 billion per year once fully operational (French Court of Auditors , 2013b), i.e. between 4 and 6 times the amount of direct aid and around one-third of public R&D expenditure (in which is it not counted). The CIR is the main form of fiscal support to business R&D in France, but it is not the only one; other measures are the reduced rates of taxation for long-term capital gains from patent transfers and assignments (EUR 810 million in 2010) and the mechanism for reducing social security contributions for JEIs (EUR 152 million).

The CIR in France

The CIR was introduced into the French tax system in 1983. At the time, it was incremental in nature: the reduction in tax was proportional to the increase in the company's R&D expenditure compared to a benchmark period (the preceding year or an average of the two preceding years). The system was altered beginning in 2004 with the introduction of a volume component (the tax credit was proportional to the amount of expenditure) alongside the incremental component, which gradually shrank over time. The first argument for that change was simplification: the incremental system results in specific calculation difficulties that make it more impenetrable and force SMEs to hire costly specialist services to "optimise" their tax declarations. Additionally, an incremental credit does little to incentivise companies whose R&D expenditure is stable over time, for example after a previous spike. In 2006, the rate for the volume-based share rose, but the EUR 16 million ceiling still made it unattractive to large companies. In 2008, the CIR became wholly volume-based, and the ceiling was repealed and replaced by a reduced rate beyond a given threshold value. The 2008 changes resulted in the system that is still largely in place today.

Under the system, companies are entitled to a tax credit equivalent to 30% of their eligible R&D expenditure up to EUR 100 million annually, and 5% beyond that. Any surplus CIR not paid in a given year (because the company did not make enough profit) constitutes a claim on the State and can be set off against tax for the next three years; companies can apply for reimbursement of any remainder at the end of that period. Increased CIR rates (50% in the first year, 40% in the second) are offered to new entrants, defined as companies that have no declared R&D for the past 5 years: that measure was gradually reduced, then repealed as of 2011. JEIs and new companies, companies established in certain geographic areas and (since 2011) firms that meet the European Community definition of SMEs, are also eligible for immediate reimbursement of unclaimed CIR (because the company did not turn enough profit), making the CIR a type of subsidy. A double tax credit (i.e. 60% up to the EUR 100 million threshold and 10% above it) applies to research the company contracts out to PROs and to expenditure on recruiting a young PhD graduate. Moreover, business conglomerates also benefit from the "tax integration" scheme: they declare the R&D expenditure of their subsidiaries (even 100% owned) separately, enabling them to keep most of their spending below the EUR 100 million threshold, and thus to claim the 30% CIR rate on a higher portion of their R&D.

R&D is defined as in the Frascati Manual, with the addition of textiles collections and some expenditure related to patents, standardisation and technological monitoring. The expenditure covered includes staff costs, operating costs, depreciation of equipment used in R&D and R&D entrusted to outside experts and PROs. Government aid (subsidies) must be deducted from the base.

Since 2013, the CIR has been supplemented by an "innovation tax credit", which covers innovation expenditure other than R&D (prototypes, pilot installations, patents) and applies only to SMEs.

Following the 2008 reform, the cost to the State budget soared; it was even higher in 2009 because under the economic recovery plan, companies obtained reimbursement for CIR claims in the first year, thereby providing them with useful capital at the lowest point of the macroeconomic cycle. The "tax claim", in other words the rights to the tax credit accumulated each year, whether used that year or not, rose from EUR 1.8 billion in 2007 to EUR 4.5 billion in 2008; according to some forecasts, it could reach EUR 7 billion in

the future (French Court of Auditors, 2013b). BERD was EUR 23.4 billion in 2011 in France; the CIR is therefore likely to have funded close to 20% of French companies' R&D effort.

Tax treatment of R&D in OECD countries

Tax support for R&D can take various forms, and some countries use more than one. The first form consists in excluding R&D from the tax base ("tax allowance"). All OECD countries provide tax relief for R&D by allowing complete and immediate complete depreciation, i.e. full exclusion from the tax base. This is an advantage, since R&D is an investment and should therefore be subject to progressive partial depreciation, in the same way as physical investments. However, a number of countries (9 of the 34 OECD countries, including the United Kingdom, plus the BRICs – Brazil, Russian Federation, India, China, South Africa) go beyond this, allowing depreciation of over 100%, such that R&D results in a reduction of the non-R&D components of the tax base. A second form of fiscal support is the CIR, which consists in directly deducting from the corporation tax an amount related to the company's R&D expenditure. This amount may be proportional to the volume (as applied in eight OECD countries, including France since 2008), or at least partly based on the variation in R&D compared to a benchmark year, generally the preceding year) (six OECD countries have a hybrid system along these lines). The third type is where the tax support relates to the revenue (rather than the expenditure) generated by R&D, which is subject to corporation tax at a lower rate than the company's other revenue. As R&D revenue is difficult to isolate from other operating revenue, the definition is usually limited to revenue generated by patents, including royalties from licences (the "patent box", which concerns ten OECD countries, including France and the United Kingdom). Finally, some countries have systems to reduce social security costs for research jobs, sometimes subject to a time limit.

Fiscal measures are termed "horizontal" in that the State does not intervene in the type of R&D undertaken by the company, in contrast to subsidies, which are generally "targeted" (see Box 6.2). That said, the State can discriminate between the types of companies and expenditures eligible for aid. Some countries (ten in the OECD, including France) afford more favourable treatment to SMEs than to large companies, often in the form of a higher credit rate up to a certain expenditure amount or a threshold related to the size of the company.

The number of OECD countries that offer tax incentives for R&D rose from 12 at the end of the 1990s to 24 in 2012 (out of 34 member countries). Although 14 countries have recently introduced such mechanisms, two have abandoned them (Mexico and New Zealand). Several emerging countries also have these mechanisms (China, India, Brazil, Russia, Singapore, etc.). One reason for the growing spread of these mechanisms is that they are not subject to WTO and European Union limits on government aid (50% for research, 25% for experimental development). It should be noted that countries where BERD is highest, including Sweden, Switzerland and Germany, have no specific fiscal mechanism for research.

Thus, while France is part of a widespread trend, it is at the cutting edge, both as regards fiscal expenditure (the cost of the mechanism to public finances) and impact on the unit cost of R&D (Figures 6.1 and 6.2).

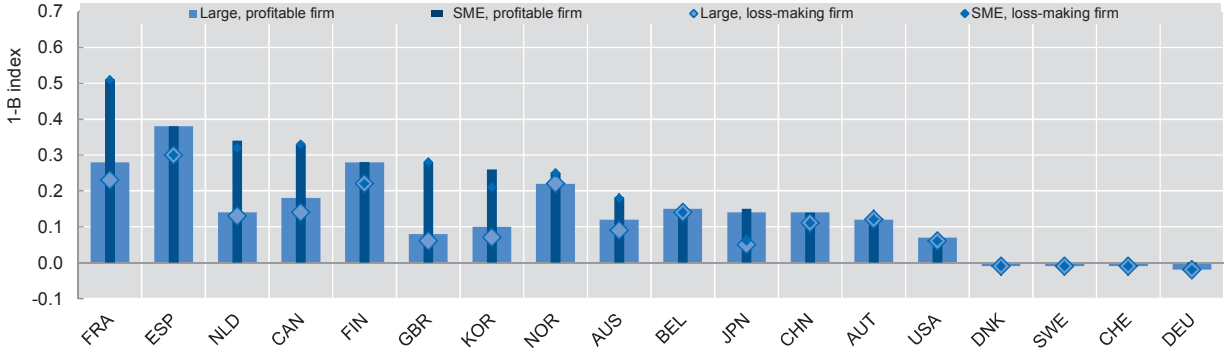
Box 6.2. The economics of tax assistance for research

Fiscal support for R&D consists in tax relief for companies based on the amount of their R&D expenditure. The government's aim is to reduce the cost (or "price" to the company) of R&D in order to motivate the benefiting companies to do more. The externalities and other market failings result in an R&D market price that exceeds its social value; the State seeks to remedy this by introducing an indirect subsidy. The aim is to increase thereby the overall amount of R&D by companies.

In comparison with direct aid (subsidies), tax assistance is notable for its "horizontal" nature, i.e. its principle of neutrality. Indeed, aid is independent of the company's R&D decisions, e.g. its thematic choices. When a company is more knowledgeable than the State on the best orientations for research – which is likely the case for competitive markets – then this neutrality is preferable to the State controlling the direction of research, as happens with targeted subsidies. Conversely, when the community has specific needs for technologies with limited profitability, a targeted subsidy is preferable. However, upon closer examination, tax assistance is not in fact wholly neutral: it promotes certain types of innovative efforts (founded on R&D) over others (resulting in non-technological innovation), and those that undertake them (R&D tends to be conducted by large companies – which are the chief beneficiaries of the measure). To remedy this bias, some countries have introduced special mechanisms for particular categories of companies (often SMEs or fledgling companies) or R&D (e.g. co-operative R&D). Although more neutral than targeted aid, the CIR can nevertheless be a targeted tool.

The chief potential drawback of this measure is the "deadweight loss effect" it can generate. When a tax credit is based on the total volume of R&D (which is currently the most widespread situation), the overall R&D efforts benefits from the price cut – even if the company would have conducted a significant share of it without the subsidy, making at least some of it redundant. Ideally, only "marginal R&D" should be subsidised – i.e. R&D that the company would not conduct without the subsidy – but it is impossible to isolate that share from the rest. The deadweight loss effect increases the cost of the measure to the State and dilutes its impact. One way of limiting its effect is to base the tax cut not on the volume of R&D, but on the change in R&D expenditure compared to a benchmark period – the idea being that without the subsidy, the company would simply repeat its previous R&D expenditure. This reduced base allows a higher rate of tax reduction while limiting the cost of the measure. However, it presents the disadvantage of making the measure more complex, hence less easy to navigate, and of introducing trajectory effects (a particular R&D effort will receive more or less aid depending on the company's previous efforts).

Figure 6.2. R&D tax subsidy (1-B-index), 2011



Source: OECD (2013), *OECD Science, Technology and Industry Scoreboard 2013: Innovation for Growth,* OECD Publishing, doi: 10.1787/sti_scoreboard-2013-en.

The reduction in the unit cost of R&D is measured by the "B-index", a kind of average effective taxation rate. The B-index indicates the proportion of each euro of R&D that is payable by the company out of its own equity after the tax concession. In 2011, it was set at 0.656 in France, meaning that the average subsidy obtained by a company for EUR 1 of (eligible) R&D is 34.6%, compared to a benchmark situation where R&D is treated as intermediate consumption in the production process and is neither taxed nor subsidised. The OECD average is 0.879; France ranks 3rd out of 27 for its generosity (Figure 6.2). Indeed, most OECD countries have a tax incentive mechanism for R&D.

Box 6.3. Tax incentives for tax assistance for R&D in the Netherlands

The current policy mix in the Netherlands places particularly high emphasis on indirect measures to promote R&D. The share of indirect funding compared to direct funding instruments is among the highest of all he OECD countries (only Canada and Australia have a higher share of indirect funding). Two instruments to support innovation – the Research and Development Promotion Act (WBSO) and the Research and Development Allowance (RDA) – are in place. A third instrument, the Innovation Box, applies to revenues from licensing and the commercialisation of intellectual property (IP).

The WBSO is a tax measure applied to R&D staff salary costs. It was introduced in 1994. In 2009 and 2010, the tax reduction was temporarily increased to support R&D during the crisis. In 2012, the reduction amounted to 42% up to EUR 110 000 and 14% beyond that. For new companies, the tax reductions amounted to 60% up to EUR 110 000 for a total of three years. Self-employed entrepreneurs are also eligible for the measure. Of the total number of companies using the WBSO, 97% are SMEs (accounting for 73% of the budget for the measure). An evaluation of the WBSO over 2011/12 showed that the mechanism has positive effects on promoting business R&D. However, it also showed that the increase in aid did not translate into an equivalent increase in R&D. In the light of the evaluation, the Government decided to reduce the scope of the tax benefits.

The RDA is a tax reduction measure for BERD established in 2012. It allows companies to deduct a share (40%) of their R&D expenditure from income tax. The RDA supplements the WBSO: it applies to tangible and intangible R&D expenditure, whereas the WBSO applies to staff expenditure.

The Netherlands introduced the Innovation Box (a "patent box"-type measure that provides tax relief for a share of the revenue from patent exploitation) in 2007, after Ireland, France and Hungary. The effective rate of the Dutch Innovation Box is 5% (it is 15.5% in France and 10% in the United Kingdom) and, since 2009, the ceiling for tax reductions has been abolished (it had previously been equal to 4 times the cost of the IP associated with the invention). In the Netherlands, the Innovation Box applies to companies that develop patented inventions, as well as companies that receive an "R&D Statement" certifying that a share of the activities linked to the new IP was conducted in the Netherlands.

Source: OECD (2014), *OECD Economic Surveys: Netherlands 2014*, OECD Publishing, doi: 10.1787/eco_surveys-nld-2014-en.

Effectiveness

Tax assistance for R&D has undergone numerous evaluations in various countries, often using econometric techniques. One of the difficulties in this area lies in the lack of uniformity of the measures – which, leaving aside the "tax assistance for R&D" label, vary widely among countries, as well as over time. Hence, the results obtained for one country or one period do not necessarily apply to another. This is particularly true when assessing the system currently in place in France, which has no historic precedent or "twin" with comparable scope. It is risky to extrapolate the results obtained from much more modest support measures, such as the CIR in France prior to the 2008 reforms, to the current situation.

Generally speaking, most of the evaluations of tax assistance for R&D conclude that the measure is somewhat effective, in that it seems that where such assistance exists, companies spend more on R&D than they would do in its absence: there is "additionality". Moreover, a number of studies conclude that there is "net additionality", in that the supplement to BERD is probably higher than the tax cost of the measure.

An OECD analysis of a panel of 19 countries for the period 1982-2018 (Westmore, 2013) estimates that a reduction of 5% in the effective rate of R&D taxation generates a 6% increase in the stock of business R&D, all else being equal. This is a linear estimate, which holds for the average taxation rates observed in the OECD countries.

With regard to France, a study using econometric techniques was performed in 2012 as part of the compulsory evaluation of the CIR by the MESR (Mairesse and Mulkay, 2012). The study first estimates the price-elasticity of R&D capital at 0.4%, meaning that a 10% reduction in the cost of R&D (e.g. thanks to the CIR) leads to a 4% increase in R&D capital in the long term. Using this coefficient, estimated over the period preceding the reform (up to 2007), the authors calculate that an increase in the CIR rate will have a favourable effect on business R&D. The effect takes a while to emerge, but after five years it exceeds the increase in tax expenditure on R&D: there is therefore net additionality (lever effect).

It is, however, difficult to extrapolate an estimate based on a modest CIR to the very weighty CIR as it stands now, since for various reasons companies' reaction coefficients probably depend on the amount of assistance received: the CIR affects the price of R&D and price is only one of the factors that determine a company's R&D expenditure. The other determining factors, according to corporate analyses, are as follows: the industry to which the company belongs (a biotechnology company must spend much more on R&D than a textiles company); its market positioning (an up-market company by virtue of its image and investments in quality must generally innovate more than mid-market companies or companies at the lower end of the range); the environment provided by the country in terms of skilled labour, research, accessibility; and companies' incentives to grow (depending on the economic or fiscal environment, etc.). Lowering the price of R&D when the other determining factors are fixed is effective up until to the point where they become limiting factors. Even if R&D is very inexpensive, a company whose market no longer expects innovation or that is not intent on growth will have no real reason to invest in that area, all the more so as R&D is only a (sometimes small) part of the cost of innovation, which also includes production and marketing costs. A modest CIR serves to correct market-induced distortions – since the market generally does not remunerate investment in research sufficiently– and therefore provides incentives for companies to spend more; but the effect of a very high CIR is kept in check by all the other factors that affect R&D expenditure beyond its direct cost. The question is to identify the generosity threshold of the CIR beyond which these constraints come into play.

Business R&D did not really flag in France during the crisis, in contrast to several other countries, a fact possibly and partly to be attributed to the CIR. Indeed, the volume of business R&D rose (at constant prices) by 10.0% between 2007 and 2011, even as GDP fell and business investment in physical capital fell further. However, Germany – which does not have a CIR – registered an 13.8% rise in its corporate R&D, and the European Union a 9.6% increase, over the same period. It would therefore appear that although R&D remained relatively stable during the crisis, this phenomenon was not solely attributable to the CIR. At the macroeconomic level, the tax expenditure associated with the CIR rose from EUR 1.7 billion in 2007 to EUR 5.1 billion in 2011 – i.e. an increase of

EUR 3.4 billion (or: EUR 3.1 billion at constant price). At the same time BERD (including the CIR received) was growing by 13.8% at constant price between 2007 (when it was EUR 19.9 billion) and 2011 (plus 20.2% in nominal terms minus 5.6% of inflation), hence an increase of EUR 2.8 billion (at 2007 constant price). Overall, after controlling for inflation, business expenditure on R&D grew less between 2007 and 2011 than the CIR received (EUR 2.8 billion against EUR 3.1 billion). Some crowding out therefore occurred during that period, at least at the macroeconomic level, as public funding tended to substitute to companies own funding instead of boosting it. This does not necessarily mean that R&D would have remained at that level in the absence of the CIR, because French industry was in crisis at the time, and it is likely the CIR acted somewhat as a shock absorber, avoiding to many companies bankruptcy or a reduction in their expenditure on R&D.

At the microeconomic level, the number of claiming companies rose by 80% between 2008 and 2010, to almost 18 000 in 2010. Of the new entrants, 70% are small, independent companies, which received 75% of the CIR for new entrants. This increase denotes success in one of the aims of the 2008 reform – to make the CIR more accessible through administrative streamlining and enhanced economic attractiveness. More companies than previously, especially small companies, now find participating in the mechanism useful. Does this entail actual growth in the number of companies conducting research? Against the economic background of recent years, and in light of weak global R&D expenditure by French companies, it is likely that only a small proportion of new *claimants* are in fact new *performers* of R&D.

What is the amount of the CIR by company size? The CIR is degressive, since above the EUR 100 million threshold for R&D, its rate falls from 30% to 5%. However, corporations are able to circumvent this threshold by spreading their financial statements across subsidiaries. The outcome is a real rate of assistance more or less along a "U' curve: the companies receiving the greatest assistance in proportion to their R&D expenditure are the smallest and the largest. Table 6.3 illustrates the fall in the assistance rate for companies with up to 2 000 employees. Beyond that level, an MESR study (cited by the French Court of Auditors, 2012) gives the subsidy rate for the 50 largest claimants as 21% in 2010. This can also be explained by the greater involvement of very large companies in co-operative research with publicly funded bodies and universities, which receive a double CIR rate (60% or 10% depending on the amount). The CIR was designed as a more egalitarian measure than direct aid, whose asymmetrical nature (favouring large companies) has long been recognised. It has partially achieved that objective, in that it benefited very small companies more than medium-sized or large companies. The CIR does not register as deep a "dip" as direct aid in its distribution by company size. While it reaches medium-sized companies better than direct aid, they still benefit relatively less from the measure as a category – which therefore serves only to lessen, rather than reverse, the inegalitarian nature of the distribution of public aid. It should be noted that when companies are consolidated within the conglomerates to which they belong, intermediate-size enterprises (ISEs) appear to receive relatively better treatment, since several of the less subsidised ones probably belong to a conglomerate.

Table 6.3. Rate of public funding for business R&D in 2009

Staff	BERD, EUR billion	Direct funding/BERD, %	CIR/BERD, %	Public funding/BERD, %
<50	2.5	13.3	32.5	45.8
50 to 250	3.2	5.7	19.2	24.9
250 to 499	2.1	7.6	17.8	25.4
500 to 1 999	5.1	4.7	14.3	19.0
>= 2 000	13.5	12.0	15.6	27.6
Total	26.4	9.6	17.8	27.4

Source: Draft Budget Bill 2013.

The CIR also affords preferential treatment to JEIs, thereby supplementing the JEI mechanism. Introduced in 2004, the mechanism supports eligible companies (companies in the first eight years of their existence whose R&D intensity is greater than a given amount) in the following ways: *i)* exemption from social security contributions for all employees involved in research; *ii)* exemption from corporation tax for the first three years and 50% reduction in the following 2 years, up to a ceiling of EUR 200 000 over three years; *iii)* exemption from property taxes for 8 years. Since the introduction of the JEI mechanism (2004), it seems that the number of companies in this category has risen sharply, illustrating a certain amount of success for the measure (which is only one component of the broader policy to encourage innovative entrepreneurship, also involving OSEO, the Deposits and Consignments Fund, etc.). As noted in the chapter of this report on innovative entrepreneurship, advances in the establishment and longevity of these companies have not been matched by growth: very few start-ups have experienced significant growth propelling them above the size thresholds of 50 or 250 employees. Although the CIR and the JEI mechanism foster the establishment and survival of these companies, they may also inhibit their growth. A growing company will see both the direct aid and tax assistance it receives fall fairly quickly, which will not motivate entrepreneurs to pursue a path that increases the risks and decreases the advantages. It is obviously difficult to identify each company's capacity for growth with precision, and the State cannot be expected to do so. By contrast, it is reasonable to assume that companies that essentially survive on aid over many years do not have much capacity for growth, and that aid should therefore be redirected to companies with greater potential. The JEI mechanism is limited to eight years, which is already a considerable length of time, but there is no such restriction on the CIR. The non-discriminatory nature of the CIR, which helps companies with no growth potential to survive, could therefore have negative effects in terms of fostering the growth of JEIs.

A further argument in favour of the current mechanism is the attractiveness it gives France in the international competition to attract or retain multinational companies' research laboratories. The CIR has a significant impact on the cost of research. The direct costs of research in France are arguably high, particularly given the social security contributions owed on researchers' salaries (French National Research and Technology Association, 2013). The impact of the CIR on the unit cost of research (excluding immovables) can be assessed at 30%. Some operations to establish foreign companies' laboratories in France after 2008 have been largely attributed to the CIR. Studies of multinational companies show that while cost plays a role in their choice of where to establish R&D facilities, it is not the chief criterion (see the section above on attractiveness). The chief criteri-

on is the quality of the environment, including the availability of qualified researchers, respected universities and companies in the same line of work, and its central role in global knowledge networks. The second criterion is demand for the company's products, since it seeks proximity to its markets in order to better determine their characteristics and adapt its product offer. For new projects, multinational companies initially select several possible locations based on the quality and demand criteria outlined above. It is only at the second stage that they consider cost-based criteria, and that measures such as the CIR can play a role. A country's attractiveness as a locus for research depends first on the quality-based criteria provided for the activity, and second on the dynamics of its internal market. Although the effect of the CIR at that level could be considerable, it would probably be limited in the absence of additional changes, e.g. related to opening publicly funded research to industry (in fact, the number of new facilities owned by foreign companies registered during the reference period remains low).

Another aspect of the CIR worthy of consideration is the management costs it entails for the receiving company: one of the reasons for the change to a volume-based CIR was to simplify the mechanism in order to reduce companies' management costs, especially for SMEs. These costs include the measurement of eligible expenditure, identifying the perimeter and estimating the expenditure within the perimeter. This is not necessarily a trivial undertaking for SMEs, who fear *ex post* tax adjustments should they commit an error in analysing the perimeter. The previous growth-led mechanism was more costly to manage because it involved retrospective estimates of R&D expenditure and more complex calculations in relation to the anticipated tax credit. This component was withdrawn, greatly simplifying the procedure. However, it would appear that companies' management costs are still high. This is evident in the fact that a number of consultancies specialising in provide CIR assistance to SMEs still exist in the market, and that they seem to charge a significant commission, in the order of 15% to 20% of the credit obtained (source: information obtained during one of the interviews).

Conclusions on the CIR

The recorded or estimated effects of the CIR, particularly since its reform, are as follows:

- The number of claimants has increased significantly, from around 10 000 in 2007 to 18 000 in 2010.
- Spending on R&D by companies in France increased during the crisis (by EUR 1.6 billion between 2008 and 2010), whereas in many countries it stagnated or fell. By contrast, non-CIR expenditure funded by companies themselves fell (even taking into account the slight reduction in direct public funding).
- The credit supplement is directed at large or very large companies. Companies with over 2 000 employees received EUR 2.1 billion in CIR in 2009 out of a total of EUR 4.7 billion. Thus, they received 45% of the CIR, while undertaking 51% of business R&D (Table 6.2; the consolidation of companies into the conglomerates to which they ultimately belong, effectively subordinating ISEs and SMEs to larger entities, qualifies this finding, although it remains valid [MESR, 2013]). Moreover, the CIR is paid in addition to direct aid, which tends to be even more biased towards large companies, so that all in all the aid they receive is disproportionate to their share of R&D. This bias is even greater if we focus on very large companies, e.g. the largest 50 (French Court of Auditors, 2011).

The stated goal of the CIR is to encourage companies to increase their research expenditure. However, several arguments suggest that this objective has only partially been attained: companies have indeed increased their expenditure, but not to a degree matching the aid received. The CIR can however be given a second, broader function – to boost the competitiveness of companies that do R&D by reducing their tax burden. This second objective is completely different from the first in that it targets not R&D, but the company itself and its survival. Thus, in the context of the 2009 economic crisis, the CIR probably contributed to the survival of R&D-intensive companies that would otherwise have disappeared. This broader objective can be understood in the light of the falling competitiveness of a large segment of French industry, to which the government reacted in 2008 by favouring a specific category of companies: those that engage in research.

As the analysis in chapter 2 of this study shows, France's deteriorating competitive strength is not due chiefly to a lack of research; it stems from ill-suited framework conditions (see the chapter on macroeconomics and framework conditions). Hence, the CIR can only be a partial solution to the problem at best. It can, indeed, limit immediate losses of price competitiveness through its effect on the costs of the beneficiary companies and improve non-price competitiveness over the longer term thanks to the supplementary research it provides. But it is not enough to focus on research companies a remedy for a problem that affects all companies, especially in a country where the most competitive sectors (agri-food, luxury) are not research-intensive. Indeed, the CIR will not help save companies whose growth does not depend on research, and it risks allowing companies without much growth potential to survive solely because they conduct research (as exemplified by some JEIs). In this light, it is probably preferable to reduce the rate of corporation tax and at the same time reduce the generosity of the CIR, since both measures have a neutral effect on public finances. This could be achieved by reducing the rate offered above EUR 100 million in R&D, or introducing a ceiling (as in the pre-2008 reform days), which would ensure that small companies and ISEs are less affected by the cut.

Direct instruments of public support for innovation in business

This section will consider the chief direct instruments of public support for innovation in France: competitiveness clusters, the Business Competitiveness Fund (FCE), *Bpifrance (OSEO) programmes, France's* involvement in the European Framework Programme on Research and Technological Development (FPRTD), and innovative procurement

Competitive clusters

Objective

The competitiveness clusters policy was introduced in 2004 with the aim of promoting the emergence of "innovation clusters" along the lines of Silicon Valley (see Box 6.4). A competitiveness cluster brings together, in a particular area and on a particular theme, companies of all sizes, public laboratories and training establishments. Its purpose is to support innovation, by promoting for example collaborative R&D projects between stakeholders.

Box 6.4. Rationale and international experience behind cluster policies

Clusters are geographical concentrations of interconnected companies, higher education establishments and other privately or publicly funded research organisations engaged in joint or complementary economic activities. The geographical concentration is assumed to have effects that benefit all parties involved ("spillovers"), e.g. the opportunity to fund shared infrastructure (scientific equipment), an active labour market in highly specialised areas, and shared knowledge and know-how. Clusters are often defined on the basis of their sector(s) of activity and research topics: typical examples are the ICT clusters in Silicon Valley (United States) and Bangalore (India), or the Öresund region (Denmark/Sweden) in life sciences. Most OECD countries have cluster promotion policies that seek to achieve a critical mass capable of generating more innovation and making companies and organisations more competitive globally.

Policies to support clusters can vary depending on their objectives (develop interaction between business and universities or interaction between SMEs and large companies, stimulate competitiveness in more traditional sectors, etc.) and the characteristics of the specific clusters (e.g. how mature they are). In many OECD countries, recent trends have been to combine local cluster policies and national specialisation strategies by selecting and promoting a number of sectors associated with existing assets concentrated in specific regions. The instruments adopted to support clusters include *(i)* the establishment of collaborative networks and platforms among the clusters' member organisations; *(ii)* the formulation of internationalisation strategies; *(iii)* specialisation and profiling in generic technologies and emerging industries.

Examples of recent cluster policies in OECD countries can be found in the Netherlands, the United Kingdom, Germany, Norway, Austria, Sweden and Belgium.

In 2001, the Swedish innovation agency VINNOVA launched the VINNÄXT programme, which seeks to support sustainable economic growth in the regions by developing internationally recognised research and innovation clusters in specific thematic fields. The programme provides long-term funding (ten years) to selected regional consortiums. It emphasises a cross-sectoral, interdisciplinary and collaborative approach, together with research focusing on the economic or societal needs, along with planning and forecasting efforts.

The United Kingdom's Technology Strategy Board set up "Launchpads", through which it funds the development of innovative SME clusters in specific fields and selected locations. In 2011, the first Launchpad was launched in East London, with an emphasis on digital product applications. Since then, 13 additional projects have been funded in various fields and locations (e.g. space in Oxfordshire, digital and creative industries in Glasgow, materials and manufacturing in the North West, and the motorsport industry in Oxfordshire and Northamptonshire). The Launchpad programme places particular emphasis on innovative SMEs and their ability to attract private sector investment.

Several initiatives have been introduced in Germany to promote clustering and concentration of innovative capabilities both at the national and subnational levels. A competition for "specialist clusters" was launched in 2007 by the Federal Ministry of Education and Research (BMBF) and led to 15 clusters being selected and supported (there were three calls for applications – in 2008, 2010 and 2012). The programme is not aimed at specific sectors, but selects the clusters with the best strategies to develop new technologies or new markets and requires significant private sector co-funding. The "skills networks" bring together the most innovative technological networks. The networks selected are compared to those in the "European Cluster Excellence Initiative". The "Clusters of Excellence" programme promotes university clusters focused on cutting-edge science and research activities for a period of five years. Other support measures have been introduced through the German states (*Länder*), generally in the selected technologies or fields and with an emphasis on inter-*Länder* co-ordination.

Implementation and funding

Following a national call for applications in 2004/05, 71 clusters were selected bringing together 7 500 companies. Some 15 clusters are "global" or "globally focused" and receive around 80% of the funding, while the other clusters are essentially national or regional. The main programme providing funding for the clusters is the FUI, financed by several ministries, including the ministry in charge of industry, and by OSEO (Bpifrance in 2013). The FUI contributed some EUR 1 billion between 2007 and 2011 (Table 6.3). The clusters are also associated with other programmes, – since the label effect can result in bonuses for the projects – but as part of separate procedures – OSEO innovation programmes, ANR thematic programmes for collaborative projects, ADEME aid for green projects, European Regional Development Fund aid and assistance from local authorities. Total public funding for companies as a result of the clusters amounted to around EUR 700 million in 2009, out of a total of EUR 2.5 billion in direct public funding for innovation. The funding procedure is as follows: each project must involve at least one company that is a member of the cluster. The procedure for applying for funding is in two phases: the cluster "labels" the project; it is then submitted to the FUI for funding at national level (ANR funding consists chiefly of a bonus awarded to projects labelled by the clusters and selected by the ANR under its own procedures). As well as funding, the clusters provide a number of services: project identification and implementation assistance, technological and commercial monitoring, activities at the international level and to promote the cluster. Activities are led by a permanent team (on average, 12 full-time equivalent (FTE) employees per cluster). The cluster is managed by a "co-ordination committee" comprising cluster member representatives, local authorities and government. Nationally, the programme is administered by a committee comprising representatives from the various ministries involved.

Table 6.4. Sources of funding for competitiveness clusters

Amounts in EUR millions

	2006	2007	2008	2009	2010	2011
FUI	189	239	256	220	157	149
Local government	99	125	227	167	164	167
OSEO	163	242	219	159	172	144
ANR	175	194	118	192	213	182
European Funds	n/a	n/a	92	117	114	72
ADEME	n/a	n/a	n/a	n/a	n/a	170

Source: Scoreboard of competitiveness clusters of the Directorate General for Competitiveness, Industry and Services (DGCIS)[1]

Between 2008 and 2011, the allocation of funding by type of recipient and funding body was as follows (Table 6.5):

Table 6.5. Recipients of funding for competitiveness clusters

Funding body	FUI	ANR	ISI	OSEO	Total
Public and community funding	43%	76.8%	12%		44%
Private sector:	57%	23.1%	88%	100%	56%
– SMEs and ISEs	39.1%	11.6%	85%	100%	43.7%
– large companies	15.2%	9%	3%		10.3%

Source: Erdyn et al. (2012), http://competitivite.gouv.fr/documents/commun/Politique_des_poles/2eme_phase_2009-2011/evaluation/rapport-evaluation-2012-%20complet.pdf (in French).

Companies attracted 56% of total funding, including 36.4% for SMEs and 7.1% for ISEs. Large companies accounted for around 10% of the funding, although in 2010 they received 44% of total direct public funding (both civilian and military); 65% of cluster members are SMEs and ISEs, 7% are large companies and 17% are research and/or training bodies.

Impact

The competitiveness clusters have undergone several assessments, some of which have had an impact on public policy. Thus, the assessments conducted at the request of the ministry in charge of industry at the end of the first phase (2008) and then the second phase (2012) led to significant revisions of certain aspects of the cluster policy, especially a greater focus on the downstream aspects of the innovation process, through commercialisation.

The performance of the clusters in terms of co-operation and innovation was assessed by a team of consultants on behalf of their managing authority (Erdyn et al., 2012). Between 2008 and 2012, 58% of companies belonging to clusters collaborated with new non-industrial partners and 59% with new industrial partners. By contrast, impact was limited in terms of turnover. Between 2008 and 2011, the cluster projects generated just under 1 000 patents, chiefly in ICTs, biotechnology, health and energy. The global clusters lodged on average three times more patents per cluster than the national clusters. Between 2008 and 2011, the clusters generated 2 500 innovations (new products or procedures). Three-quarters of these innovations were generated by national clusters. The most active sectors were agri-food, ICTs and energy. Around 6 500 articles were published between 2008 and 2011, chiefly in the fields of ICTs, biotechnology, health, agri-food and energy. Global clusters performed twice as well than national clusters in terms of the average number of articles per cluster. Finally, 93 start-ups were launched, chiefly within national clusters (61 start-ups). Where patents are concerned, just as with publications or business creation, clusters played a very small role in the French landscape (between 1% and 4%) and their ultimate success did not denote a change in the French research and innovation system.

An econometric assessment of the impact of clusters on SMEs was conducted by INSEE researchers for the period 2007-11 (Bellégo and Dortet-Bernadet, 2013; Bellégo, 2013). However, it is difficult to assess the impact of clusters on large companies, which are typically members of several clusters through various establishments. The assessment shows additionality in the public funding received: companies that are members of the clusters, and even more so those that received FUI funding, increased their annual research expenditure more than similar companies outside the scheme, by EUR 76 000

(cluster members) for EUR 30 000 in extra direct aid received and EUR 100 000 (FUI beneficiaries) for EUR 45 000 in extra direct public aid received. However, participating companies also received more CIR than the others (EUR 33 000 for cluster members and EUR 41 000 for FUI beneficiaries). This shows complementarity between the various measures, but also makes it difficult to perform a separate assessment of their individual effects All in all, the extra private funding for R&D generated by the clusters is positive, but limited (EUR 12 000 for cluster members and EUR 14 000 for FUI beneficiaries). However, the impact in terms of R&D effectiveness (measured by patents) or volume of economic activity (measured by turnover) is not particularly significant. Finally, another purpose of the clusters is to increase co-operation on research between companies, and between companies and public laboratories. The growing number of co-operative projects initiated by the clusters indicates some success on this score, although the multiple measures taken under the various frameworks to increase co-operation makes it difficult to assess their individual contributions.

Questions raised

Several issues have been raised by stakeholders and observers concerning the clusters and could be the object of further assessments, as follows:

- The steering mechanism is very complex due to its interministerial composition and the resulting differences in strategic goals (competitiveness vs. regional attractiveness).
- A number of stakeholders criticised the complex procedure for applying for aid, deeming the two phases both redundant and lengthy. The funding procedures are very complex for companies – especially for SMEs, which are often awarded funding from several sources, each with its own specific rules.
- There is no training in most clusters, even though many companies state that access to a workforce with specific skills is a priority.
- Professionals from the risk capital industry, including venture capital, were barely consulted in the first two phases, so that the clusters' impact on innovative entrepreneurship has been limited.
- In terms of governance, small companies appear to be very under-represented in the management structures, where public research institutions and large companies have the greatest weight.
- Where location is concerned, geography and research themes do not always coincide. Indeed, companies often find partners, whether public or private, far removed from their own base. Moreover, large companies manage their research on a national (or even global) scale and thus end up being involved in a number of clusters working on similar or complementary activities, thus complicating internal project planning. Fixing the clusters geographically thus seems questionable, even if the geographical criteria have been significantly relaxed, including many instances of clusters co-labelling their projects.
- While the clusters cover all the key technologies identified by the ministry in charge of industry over several successive financial years (the most recent being 2011), they are generally too dispersed across the technologies, with the result that overall, co-ordination between the two approaches seems fairly poor.

- Management costs are considerable: over 800 FTE posts are directly assigned to managing the clusters, not to mention managing the FUI, etc. (Erdyn et al., 2012).

Conclusions

Overall, the competitiveness clusters policy plays a positive and significant role in the technical fields and geographical areas concerned. In particular, it links the regions – with their drive and own resources – to a national policy. Care must be taken, however, to ensure that the clusters do not generate excessive operating costs (themselves a reflection of onerous procedures) and are open to new players (entrepreneurs). Clearer expression of the various sectoral priorities of the ministry in charge of industry would permit greater synergy with the other innovation policies.

Business Competitiveness Fund (FCE)

The FCE supports three instruments: *i)* the competitiveness clusters; *ii)* EUREKA and the Joint Technological Initiatives; *iii)* support for strategic R&D. In 2009, the FCE funded 337 R&D projects, including 200 competitiveness clusters and 36 EUREKA clusters to the tune of EUR 401.6 million. The average number of partners funded per project was 4.2, with companies receiving 67% of the total aid (PLF, 2011).

EUREKA

EUREKA was established in 1985 to support the downstream phases of innovation at the European level through a programme with simple and lean administrative procedures. It is a bottom-up programme, geared towards the needs of industry. Projects must meet the minimal requirement of comprising at least two participants, from two different member countries – a rule that was modified in 2012 in order to increase participation from newly associated countries. EUREKA is not a source of research and innovation funding, but it awards a label to projects that meet the evaluation criteria jointly established within the programme, thereby facilitating their access to national funding. Thus, each country funds its own actions. EUREKA also provides services such as assistance with partner searches and networking, access to contacts at the national level and disseminating news about the innovations achieved under the programme.

In 2012, EUREKA awarded labels to 297 projects at the European level representing EUR 1.1 billion in total costs (public and private funding). The strategic initiatives known as "Clusters" account for 69%, the Eurostars Programme 18% and individual projects 13% of the total. France funds all three initiatives.

EUREKA clusters are long-term industrial projects (for SMEs and large companies) aiming to develop key technologies for European competitiveness. Funding is directed at a small number of strategic sectors: micro-nanotechnologies, electronics, energy, the environment and water. In France, the clusters are managed and funded by the DGCIS, which labelled 45 projects (77% of all labelled clusters) in 2012 with a total cost of EUR 245 million (of which EUREKA funded 31.3%). Support for co-operative projects often involves SMEs (60% of partners) in distant downstream projects. In 2012, 12 projects were funded in France at a cost of EUR 15 million. The Eurostars Programme is designed to support high-tech SMEs. In 2012, 34 projects (24%) were selected in France with a total cost of EUR 21 million.

Support for "strategic local" R&D: Nanotechnology

Support of this type mainly consists in supporting the excellence of the French nano-electronics industry. Nano-electronics is a key generic technology, which has been a key priority of France's industrial and innovation policy since the launch of the "Crolles 1" programme in 1992. The Nano 2012 ("Crolles III") programme signed in 2009 for five years is a public/private programme co-ordinated by STMicroelectronics. It brings together industrialists and research bodies (notably the Alternative Energies and Atomic Energy Commission [CEA]-LETI) with the aim of strengthening French industry's place in the development of technologies to manufacture electronic components for the most advanced semiconductors used in communications, consumer electronics, etc. It represents an expenditure of EUR 2.3 billion, including EUR 457 million provided by the State and local government and EUR 340 million by STMicroelectronics. In 2010, the programme received EUR 113 million (including EUREKA/ Cluster for Application and Technology Research in Europe on NanoElectronics [CATRENE] credits), EUR 50 million to support EUREKA projects not related to CATRENE, EUR 10 million for a new call for projects in the field of ecotechnology and EUR 10 million for strategic R&D projects. Nano 2012 has been renewed under the Nano 2017 programme (2013-17) endowed with a total budget of EUR 1.8 billion.

Bpifrance-OSEO

Bpifrance is a key player in policy to support innovation in France. This public institution was created in 2013 from the merger of OSEO (the French Agency for innovation and SME development), CDC-Entreprises (a branch of the Deposits and Consignments Fund, a State bank, which funds companies and is heavily involved in innovation and SMEs) and the Strategic Investment Fund (which provides capital to companies selected by the State). Agencies with a fairly similar purview exist in other countries (Box 6.5). Because Bpifrance was established so recently, this review will focus on analysing the activities of its predecessors, specifically OSEO and CDC-Entreprises (see also the chapter on entrepreneurship).

Activities

OSEO (Bpifrance) is an important player in *i)* aid for innovation; *ii)* credit guarantees; and *iii)* SME and ISE financing. In 2011, OSEO awarded (excluding FUI) EUR 547 million in aid to innovation (Table 6.6), compared with EUR 733 million in 2008. This fall coincided with the enhancement of the CIR since 2008 and probably reflected the State's intention to limit direct aid as indirect aid rocketed (Masquin et al., 2012). OSEO is a major player in direct aid to companies. Direct aid to innovation is distributed through various programmes.

The aid provided by OSEO has different aims, as follows:

- support competitiveness clusters: OSEO manages the FUI
- support innovation in SMEs for projects deemed eligible by OSEO experts in accordance with technical and economic criteria
- support large projects (aid between EUR 3 million and EUR 10 million): the ISI programme, the successor to the Industrial Innovation Agency, was integrated into OSEO in 2007

- encourage co-operation between SMEs and ISEs: with each other, with large groups ("Passerelle" programme), with PROs, internationally (Aid for Innovation Development through International Co-operation), etc.
- support innovation in specific industries (aeronautics, etc.).

Box 6.5. Aid for innovation agencies in Finland and the United Kingdom

Foundation for Finnish Inventions – Finland

This organisation provides risk financing to private individuals and entrepreneurs so that they may develop and exploit their inventions. Financing can take the form of grants or loans, generally ranging between EUR 2 000 and EUR 200 000. The grants cover the early costs of developing an invention. Funding decisions are made on the basis of the innovativeness, technical functionality and economic evaluation of the invention proposal. The funds serve to cover the costs of patenting, product development and commercialisation. The financing incorporates a refund to the foundation, contingent on the success of the project and on the revenue received by the entrepreneur. If the inventor starts a company to commercialise an invention, the foundation can provide a loan on human working capital. The loan is generally granted only if no other adequate sources of funding are available.

Innovation, Research and Development Grants – United Kingdom

This is a grant for individuals and SMEs based in England whose goal is to undertake R&D on technologically innovative products and processes. The grant is administered by the regional development agencies. There are five different types of aid. Proof of market grants test the commercial potential of an innovative idea (USD 31 000 [dollars] are distributed to SMEs). Micro-projects are development projects lasting no longer than 12 months (USD 31 000 available to companies with fewer than 10 employees). Research projects investigate the technical and commercial feasibility of innovative technology and last between 6 and 18 months (up to USD 155 000 available to SMEs with fewer than 50 employees). Development projects focus on the pre-production of a new product or process involving a significant technological advance and last between 6 and 36 months (up to USD 389 000 available to SMEs with fewer than 250 employees). Exceptional development projects entail a significant technological advance and are strategically important for a particular technology or industry: they last between 6 and 36 months, funded by a negotiable grant of up to USD 779 000.

Table 6.6. Activity by OSEO 2010-11

EUR millions

	2010	2011
State funding – AI Programme	308	315
Partnership funding	121	89
State funding – ISI Programme	140	107
FUI	81	112
Investments for the Future Programme (PIA)	0	36
Total aid	650	659

Source: OSEO activity report (2011).

Aid is awarded either in the form of a subsidy (preferably for upstream research projects), or as a repayable advance in case the project is successful (usually for downstream projects, close to market). On average, companies repay 55% of the funds advanced to them by OSEO (Masquin et al., 2012). OSEO also guarantees bank funding. Guarantees are provided to promote creation, transmission, development, innovation and international expansion.

OSEO offers 12 guarantees in all. Innovation guarantees facilitate the access of innovative SMEs to bank funding while Biotech guarantees are specific to biotechnology companies. Guarantees for innovative projects enable banks to issue market guarantees, on order and behalf of SMEs, to the benefit of their customers. The amounts involved in 2010 were around EUR 300 million.

In partnership with banking and finance establishments, OSEO contributes to funding certain investments, funding the operating cycle and bolstering the equity of SMEs. This includes various innovation-related mechanisms. Chief among them are the following: innovation loans finances the industrial and commercial launch of an innovation by an SME. CIR pre-financing provides cash to cover R&D expenses in the year they are incurred. R&D project industrialisation loans for competitiveness clusters fund downstream expenditure for an R&D project with the goal of industrialising or commercialising an innovative product, process or service. Equity seed loans strengthen a company's financial structure to facilitate and prepare for initial fundraising. Innovation development contracts are loans to fund non-tangible investment and working capital requirements associated with an innovation or modernisation programme. Participatory development contracts strengthen the equity capital base to implement development projects. Finally, re-industrialisation assistance is a repayable advance to fund a share of investment expenditure.

Finally, OSEO (now Bpifrance) has been one of the main operators of the PIA since 2010 with regard to aid for innovation and SMEs, including re-industrialisation assistance and the calls for R&D proposals issues by competitiveness clusters. OSEO and Bpifrance also contributed to establishing the Digital Ambition Fund. The Ecotechnology Fund supports equity and quasi-equity transactions for acquisitions of minority stakes in innovative SMEs in the field of renewable energy and green chemistry, sorting and commercialisation of waste, pollution remediation, eco-design products, smart grid and vehicles of the future. The aim of the Rare Diseases Innovative Biotherapies Fund is to invest in the equity of new companies. The National Seed Fund manages equity investments for Bpifrance.

Impact

It is difficult to assess the impact of OSEO, since the companies it supports it also receive other forms of aid and it is not easy to identify the actual effect of each one. It is clear from the econometric study by Masquin et al. (2012) that a project that receives 33% of its funding from OSEO (the average rate of aid in 2009) produces 4 times more patents for an SME and twice as many patents for a large company than a project that receives no aid. Moreover, according to Serrano-Velarde (2008), for each EUR 1 in repayable advances disbursed by OSEO between 1995 and 2004, companies spending less than EUR 300 000 spent EUR 1 more on R&D. This effect diminishes with the recipient company's amount of R&D expenditure and is cancelled out when the budget exceeds EUR 9 million. The OSEO mechanism is therefore more effective for small companies

than for large ones. It would also appear that the effect of loan guarantees on moral hazard is significant and merits more systematic assessment (Lelarge et al., 2013).

The adoption in 2014 by Bpifrance of an "open data" policy enabling independent researchers to access its data (stored in a secure warehouse) is an extremely positive decision, which should allow assessing its operations in accordance with the prevailing scientific criteria.

French participation in the Framework Programme for Technological Research and Development (FP)

French participation in European research programmes is low and falling (French Court of Auditors, 2013). Its share of credits distributed under the Seventh Framework Programme was 10.5% at end 2013 (Table 6.7), compared to its 17.5% contribution to the European Union budget. This low level of participation is due to a relatively low number of submissions from French applicants and is not offset by an especially high success rate. Various explanations for this phenomenon have been suggested: the downstream approach of FP topics (in contrast to the upstream approach of French research); the failure to take project management into account (an important component of any work for the FP) in assessments of public sector researchers, who consequently have little incentive to become involved; finally, the increased ease of access to French public funding – especially through the ANR – making European aid, with its more complex procedures, less attractive. These explanations naturally apply more readily to public research than to company-led research, although business participation in FP has also fallen. The fact that France's share of European Union R&D fell significantly in the 2000s may be another factor, since it lowered its capacity to draw up projects from 17.9% in 2000 to 16.4% in 2010 (measured as BERD). The fall in France's share in business R&D (from 17.5% to 17.0%), however, was less significant.

Overall, there has been relatively low FP funding for French companies, since it amounted to EUR 1.3 billion between 2007 and 2013, i.e. less than EUR 200 million per year.

Table 6.7. Participation of the various French stakeholders in FP7, 2007-13

	Participation	Participation (%)	Contributions received (EUR thousands)	Contributions (%)
Higher education establishments	1 900	16.65%	639 554.6	13.97%
Research bodies	4 558	39.94%	2 254 018.4	49.22%
Public sector bodies	395	3.46%	72 161.3	1.58%
Private sector bodies	4 130	36.19%	1 281 116.9	27.97%
Other	430	3.77%	332 754.7	7.27%
Total selection	11 413	100.00%	4 579 606.0	100.00%

Source: European Commission, E-Corda-FP7 projects and participants database (25 October 2013), MESR-DGESIP/DGRI-SIES.

Innovative public procurement

Public procurement can play an important role in innovation (OECD, 2010). This has long been recognised in fields such as defence or infrastructure and, more recently, in areas related to sustainable development (low-carbon energy, etc.). The interviews conducted for this review show that the role of public procurement could be especially important for JEIs, which as a result obtain not only income (for example through subsidies) but receive a kind of implicit "certification" that they can use as a commercial lever with other potential clients.

Market size

Public procurement in France rose from EUR 52.5 billion in 2005 to EUR 87.8 billion in 2005 (according to the Public Procurement Economic Observatory [OEAP] at the Ministry of Economy and Finance). This trend is a reflection of the "major contracts" for equipment and supplies.

What is the share of innovative public procurement in total public procurement? In France, as in other countries, the lack of data on public procurement of R&D and innovation does not allow a precise assessment. The OECD Working Party of National Experts on Science and Technology Indicators uses the input-output tables of the national accounts to measure the volume of intermediate consumption of highly knowledge-intensive products by the public administration and defence. In France, that volume represented 16% of gross sectoral output, but 61% of total intermediate consumption in 2007, compared with gross sectoral output of 36% in the United Kingdom and 17% in Germany and total intermediate consumption of 69% in the United Kingdom and 54% in Germany (OECD, 2013b).

The 2013 report by the Commission of Experts for Research and Innovation (EFI, 2013) analyses public procurement in Germany and France using data from TED (the supplement to the Official Journal of the European Union on European public procurement). The first hypothesis put forward by the EFI is that the public contracts that are most likely to have innovative content have undergone a process of "competitive dialogue". Although these accounted for less than 1% of all public procurement in Germany between 2006 and 2010, they accounted for close to 4% in France. The second hypothesis is that public procurement is more likely to be innovative when it involves certain high technology sectors, as well as defence, the environment and R&D. The EFI estimates that over 2006-10, public procurement in France in these sectors represented 13.5% (high technology), 2% (defence), 6.1% (environment) and less than 0.1% (R&D) of the total volume of public procurement. The figures for Germany were 7.3% (high technology), 2.4% (defence), 4.2% (environment) and 0.5% (R&D).

An OECD study (2010) notes that France is one of the countries that attach the lowest level of priority to demand-side policies (p. 86, it is written that Finland and Spain attach the highest level of priority and Germany a medium level of priority). A report by the European Commission (2011) notes that France has not identified any demand-side measures as full-fledged instruments of innovation policy. France's response to the policy questionnaire for the 2012 edition of the *OECD Science, Technology and Industry Outlook* mentions two programmes: the Passerelle programme managed by OSEO and the measures included in Article 26 of the Economic Modernisation Act 2008 (Law No. 2008-776 of 4 August 2008 on economic modernisation [LME]).

The Passerelle programme and the Small Business Act

The Passerelle programme (managed by OSEO) was launched in 2007 to encourage innovative SMEs to become involved in calls for tender made by public bodies or large companies and to facilitate the creation of new products and services by the same SMEs. The projects are funded in equal thirds by the SME, the public sector or private sector organisation purchasing the product or service offered by the SME and OSEO. The SME retains the intellectual property (IP) rights associated with the innovations. This programme appears to have a very low take-up.

The "French-style" Small Business Act (Article 26 of the 2008 LME) gives innovative SMEs preferential access to public procurement. This temporary experimental mechanism earmarks a maximum of 15% of the average amount of public procurement contracts involving high technology, R&D and technological studies below the threshold for formalised procedures over the past three years, or preferential treatment in the event that equivalent tenders are submitted.

To promote this mechanism, the DGCIS helped ten voluntary public bodies to implement the new measure and published two practical guides – one directed at innovative SMEs and the other at purchasers. A report on the LME (2010)[2] states that the regulatory mechanism was adopted in its entirety and that monitoring mechanisms (survey of public procurement by the OEAP) were still too recent to provide statistics. In 2013, no information on innovative public procurement appears in the survey data available on the Observatory's website. It is therefore difficult to provide a quantitative assessment of the "French-style" Small Business Act. It can, however, be compared to its equivalents in other countries, which seem more successful, at least in the United Kingdom and the Netherlands (Boxes 6.6 and 6.7).

Box 6.6. Small Business Research Initiatives in the United Kingdom and the Netherlands

Small Business Research Initiative **(SBRI) – United Kingdom (OECD, 2010)**

Introduced in 2001, the SBRI earmarks a share of the Government's procurement budget (11% of the budget in financial year 2007/08) to be assigned to SMEs through competitive R&D contracts. The SBRI has been reformed several times to increase its performance and impact. Since 2009, it has operated in two phases: a feasibility phase (USD 156 000) and a development phase (USD 390 000 to USD 1.6 million). In 2010, 370 contracts in the areas of defence, health and construction were financed at a total value of USD 39 million. It would appear that awards are skewed towards a large number of very small projects still in the feasibility phase.

Small Business Innovation Research (SBIR) – Netherlands

The government launched an SBIR on several different themes: agriculture, energy, transport, water management and defence. Based on the SBIR of the United States, the programme provides funds to SMEs through public procurement to develop innovations that help solve societal challenges. Like the programme described above, it covers two phases (with USD 69 000 for the feasibility phase and USD 625 000 for the development phase). A 2007 evaluation of the SBIR pilot programme showed that it attracts companies that are new to the public procurement market and co-operate more than firms that did not receive a contract.

Box 6.7. Innovative public procurement in Sweden

Historically, public procurement has played an important role in the development of a large number of innovative companies in Sweden. The scope of the related policies has been reduced since Sweden joined the European Union and assumed the obligation to comply with the directives on European-wide public procurement and the Treaty of Rome principles. Nonetheless, a number of initiatives are under way in Sweden to promote innovative public procurement. To date, they are still being prepared rather than implemented. The main initiatives are as follows:

- Three inquiries related to public procurement and innovation have been conducted by the Ministry of Enterprise, Energy and Communications for public procurement innovation, the Ministry of Health and Social Affairs, and the Ministry of Communication to assess the rules governing public procurement from the perspective of economic and social policy, including innovation. The principal conclusions are that:
  - Public procurement innovation can have significant effects in the public and private sectors.
  - Very few contracts incorporating innovation are being issued and there is considerable potential, especially in the areas of infrastructure, health and the environment.
  - Public procurement bodies need better information and direction.
  - The legislation in force does not preclude procurement markets focusing on innovation, even though it entails certain restrictions.
- VINNOVA (the public agency for innovation) has worked to develop innovative procurement. Between 2009 and 2010, VINNOVA conducted a number of pilot activities. In a call for tenders launched in May 2011, the "innovation" aspect was highlighted with regard to supplying meals for the elderly.
- In the draft budget for 2012, VINNOVA was allocated SEK 24 million (kronor) to develop a competency and support initiative for the procurement of innovation. Initially, the initiative will cover preparing concepts for innovation procurement (e.g. public procurement before commercialisation by the company), subsidies, development of templates and guidelines, operational assistance (including legal advice), publicising information (websites, visits, conferences, brochures, etc.) and co-operation with other agencies and organisations, both nationally and internationally.
- Recent changes in procurement legislation also pave the way for establishing procurement centres and using competitive dialogue in procurement. Centralising procurement enables companies to amortise the fixed costs of innovation more easily, whereas competitive dialogue can facilitate the flows of information between purchasers and vendors that are useful when developing and purchasing new products and services.

Source: OECD (2013), *OECD Reviews of Innovation Policy: Sweden,* OECD Publishing, doi: 10.1787/9789264184893-en.

France Brevets

In 2011, France established a patents fund, "France Brevets", which was allocated EUR 100 million – half each from the Deposits and Consignments Fund and the PIA. The role assigned to France Brevets is to create an "infrastructure" for the patent market – which is necessary to the secure, open and transparent development of the IP economy – and to facilitate access to the IP market by entities for which it is generally less easy – PROs, universities or SMEs. Specifically, the role of France Brevets is to acquire patent rights (preferably in the form of a licence), group them in clusters and license them out (sub-licensing). It can acquire patents from PROs or French SMEs and help commercialise them (obtain licences); conversely, it acquires them on the market and makes them accessible to French SMEs on terms that the SMEs would not have been able to negotiate by themselves. Thus, France Brevets provides a brokerage service in a highly complex market. The fund was created for the following reasons: recognition of the need to bring together patents from various sources and fields to act as a basis for innovation (or ensure operational freedom); recognition of some players' weaknesses when it comes to the complexity of commercialising and acquiring IP rights; the view that developing IP markets is beneficial and should be encouraged by the State; finally, the idea that France is currently lagging behind in this area. France is not the only country to have embraced this route and other countries are also doing so, including Korea ("Intellectual Discovery" and "IP Cube Partners" funds) and Japan ("Life Sciences IP Platform" fund). Since its inception, France Brevets has started to build up a portfolio in ICTs, life sciences and space. In 2013, France Brevets initiated legal proceedings for counterfeiting against a company accused of patent infringement. Two comments must be made in that regard. First, financial gain as an aim of commercialising patents, such as that pursued by private operators, does not appear to fall within the scope of public action – the risk being that France Brevets might engage in the "trolling" that pollutes the American patents system, whereby specialist bodies often take abusive legal action against productive companies in order to extort payments. This is neither within the purview nor the powers of France Brevets. Additionally, the ambitions of France Brevets must remain commensurate with its relatively modest size – which matches its level of experience with a view to establishing a genuine patents market. With an operating fund of EUR 100 million, it would not be able to make the financial commitments necessary to play an effective role in monetising patents, a field rife with giant players such as Intellectual Ventures (United States), endowed with USD 5 billion.

Targeted and sectoral policies

This section will focus on the various sectoral innovation policies implemented in France in the following areas: services, the military, civil aeronautics, space, the automotive industry and the environment.

Policies supporting innovation in companies

Modern economies are marked by a concentration of the service sectors in production activities, and increasingly in innovation (Box 6.8) – hence the growing importance of innovation policies related to those sectors. This raises, however, specific questions regarding policies related to the manufacturing sectors.

To be eligible for public funding in France, innovative service projects must have a technological foundation. The French approach is narrower than the European Community (EC) approach, which does not outright exclude non-technological R&D from public

aid. The bodies and programmes concerned include OSEO, the FCE, support for platforms, ANR and ADEME. Intervention by local government is more in line with the EC regime and aid may be used for service-based innovative projects. Thus, national support mechanisms for innovation in France partially take into account innovative services. For example, OSEO will fund service innovations as soon as they employ an innovative technology or group of technologies (principally ICTs). ANR aid is directed at technological programmes, but some programmes in the fields of health and innovative energy storage, as well as the "*Émergence"* and "sustainable cities" programmes seek to support the development of technologies and services. The FUI funds technological platforms in competitiveness clusters and thereby supports a service offered to companies to verify feasibility and test a technological development. It also supports projects in the humanities and social sciences. Similarly, Article 26 of the LME (2008) enhancing SME access to public procurement and the CIR remains focused on technology-based innovation in services.

Box 6.8. Industry and services: Partners, not competitors

The OECD economies are increasingly based on services and less and less on industry. In France, the share of manufacturing in the value-added fell from 22% in 1970 to 10% in 2011, while its share of employment dropped from 23% to 11%. The trend is the same in all the OECD countries, including Germany and Japan, where the importance of the manufacturing industry is higher than elsewhere. Some observers see this as a negative trend and hold it partly responsible for the weak growth since the crisis broke in 2008 and the balance of payments deficits in some countries. Several countries now have policies that seek to restore the manufacturing industry. The two main arguments for this approach are as follows:

- The manufacturing sectors are more innovative, e.g. they spend much more on R&D than service sectors do.
- There is more international trade in manufactured goods, which therefore contribute more to the trade balance.

Both arguments are, however, fragile. The first argument ignores the development of "modern" services (e.g. computers, health, financial services) that are often focused on ICTs and extremely innovative. The second ignores the fact that manufactured goods that move from one place to another incorporate some of the value created in the service sectors, which supply the manufacturers. OECD analyses using input-output matrices show that the share of services in exports reckoned in terms of value-added is 50% for France (compared to 25% in gross terms). Other countries present similar orders of magnitude (OECD, 2013c). The importance of services to competitiveness is illustrated by the fact that the decline in France's competitiveness during the 2000s was not due to a rise in unit labour costs in manufacturing proper, but in services, which in turn increased the total manufacturing costs.

Moreover, as part of global value chains, where production processes are segmented across countries, service industries (e.g. R&D or marketing) are separate from manufacturing, but they are all mutually dependent in that the competitiveness of the one ensures the competitiveness of the others, and vice versa. Establishing competitive manufacturing in a low-cost country ensures the sustainability of the high value-added employment that remained in the most advanced country. Thus, it is not appropriate to view manufacturing and services as incompatible; they are, on the contrary, highly compatible.

Current industrial policies must therefore provide service activities a place that matches their actual economic importance and their role in innovation and competitiveness, which is at least as important as that of the manufacturing sectors, and certainly complements it.

More than other programmes, the PIA emphasises innovation in services by targeting technology-based innovations, although not exclusively. The calls for tenders in the first waves of the PIA related to establishing shared innovation platforms; biology and health-related research infrastructures; innovative digital services for e-education; self-building and co-operative housing; health and social services; sustainable mobility; and the digital field. The PIA also launched a call for tenders on funding the social economy, an important area for human services and non-technological innovations.In 2011, the DGCIS announced an action plan for innovation in services. The plan contained several priorities and resulted in the publication of a guide to service innovation for SMEs and the establishment of a National Service Innovation Prize. The plan seeks to "deploy financial resources for innovation in services", including through OSEO, which in 2012 launched a call for proposals on innovation in services with a EUR 7 million budget. The DGCIS launched a call for "multiservice platform" proposals with a budget of EUR 1 million. This initiative provides a subsidy that encourages companies (especially very small enterprises) to form multiservice platforms offering a set of services tailored to client demand. It also encourages the platforms to be innovative in the services they supply to companies by collaborating with training and research establishments. The DGCIS selected five projects from the 2010 call for proposals and four projects in 2012.

Over the past several years, measures have been taken to co-ordinate all the public institutions supporting innovation (MESR, ANR, OSEO, Strategic Investment Fund [which became Bpifrance Investissement in 2014], French National Institute of Industrial Property, etc.) so that they may work together on improving IP in service innovation, adapting the existing mechanisms that support service innovations mainly based on technological advances and adapting public financial institutions' project assessment processes. This review has not been able to identify any progress achieved in this respect.

The two sectoral plans announced in 2013 by the Ministry of Industrial Recovery (MRP) include "services" components. Of the 34 stated key sectors, several relate to services, with a heavy technological component (ICTs). The "six key priorities" of the Lauvergeon Commission include the "silver economy" (addressing the changes in the economy stemming from the ageing population) and feature measures to support the creation of innovative services that meet the needs of the elderly.

French policy increasingly recognises the importance of innovation in services. The trial-and-error approach taken in implementing the various measures is a normal thing given that this is a new field. However, there is still no set of principles that can guide public action, especially for non-technological innovations. The existence and nature of any market failures with regard to these innovations – failures that are not necessarily of the same nature as those affecting technological innovations – should be examined. Consideration should also be given to the complementarity between technological innovations and service innovations, which mean that the absence of the one can sometimes hinder the development of the other, and vice versa; this is particularly the case in areas where public action is crucial, such as health or the environment.

The military

In 2013, the Ministry of Defence allocated around EUR 3.3 billion to R&D, including EUR 1.2 billion to business. In comparison to OECD countries, the share of defence-related R&D budgets as a proportion of all public R&D budget credits (as an average from 1999 to 2010) was 21% for France, 55% for the United States, 27% for the United Kingdom, 14% for Sweden and 6% for Germany. France's industrial performance reflects

this approach to public defence finance: in terms of patents, the specialisation coefficient for defence for the period 1999-2008[3] is 1.6 for France, compared to 1.4 for the United States, 0.7 for the United Kingdom, 2.2 for Sweden and 1.2 for Germany (Moura, 2012). As in other OECD countries, public defence expenditure fell considerably in France, especially during the 1990s following the end of the Cold War. The reduction in France's overall R&D intensity from 2.5% at the beginning of the 1990s to 2.2% at the end of the 2000s is entirely due to the fall in defence credits. Defence had been a driving force in the advancement of a number of cutting-edge scientific and technical fields in the post-war period (see, for example, the role of the Defense Advanced Research Projects Agency in the United States) and the fall in defence expenditure adversely affected a number of the areas concerned.

The "Defence research and technology" component (EUR 902 million in 2013) is managed by the French Defence Procurement Agency (DGA). It comprises upstream studies (research to underpin the launch of arms programmes, EUR 752 million) and subsidies (studies allocated to PROs, including ONERA [the French Aerospace Lab], French-German Institute of Saint-Louis, the French Space Agency [CNES], schools and SMEs). Financial commitments are planned in the form of upstream study programmes covering core research and technology (15%, including training through research), technological studies (50%) and demonstrators (35%). To complement the upstream studies, the DGA supports innovation through mechanisms including RAPID (support regime for dual innovation), ASTRID (specific support for defence research and innovation) and ASTRID-Maturation.

The RAPID programme is an aid to SMEs and ISEs with fewer than 2 000 employees to develop dual innovation. Established in 2009, it received EUR 30 million in from funding from the DGA in 2010 and has received EUR 40 million since 2011. It awards subsidies to companies that spontaneously present dual (and possibly collaborative) innovation projects.

*The ASTRID programme, launched in 2010, is conducted in partnership with the ANR. I*t supports highly exploratory and innovative dual research lasting between 18 and 36 months with maximum subsidies of EUR 300 000. Industrial concerns must have ties to a research laboratory or institute. The ASTRID programme received funding of EUR 12 million in 2011. The ASTRID-Maturation programme, launched in 2013, is funded by the DGA and managed by the ANR. Its aim is to commercialise the results of dual research produced under ASTRID.

Civil aeronautics

With Concorde and then Airbus, France has gradually accumulated world-class aeronautical skills. Airbus and its many subcontractors are a vital component of French industry and a significant contributor to the trade balance. A sophisticated system of public support paved the way for the emergence of Airbus; technological innovation is still at the heart of that support.

Total public aid for civil aeronautical R&D awarded to companies by DGAC amounted to EUR 271 million in 2010 (French Court of Auditors, 2011). Including OSEO aid to the aeronautical industry, direct aid to aeronautics amount to approximately EUR 300 million – nearly one-quarter of direct public aid to industry.

The objectives in this field are to support the aeronautical industry's competitiveness by encouraging the development of breakthrough technologies leading to sustainable and "green" air transport.

The main types of activities financed are as follows:

1. *Aid for upstream aeronautical research.* Transfers to business totalled EUR 120 million in 2010 (EUR 60 million in 2011 and 2012) and are carried out by DGAC. Around 50 (often collaborative) projects are proposed to DGAC each year. Since 2010, around 20 projects are supported every year, benefiting over 20 companies (large conglomerates, component manufacturers and SMEs) and research bodies. The individual project amount ranges from EUR 0.5 million to EUR 8 million for a period of 1 to 3 years.
2. *Support for development of aeronautic programmes.* These repayable advances amounted to EUR 175 million (including OSEO aid to the aeronautics industry) in 2010. The funds are earmarked for the development of new airplanes, engines, helicopters, avionics equipment and systems. Repayments are made in line with product sales.
3. *PIA support.* The amount committed under the PIA to the aeronautics industry is EUR 1.5 billion. It is managed by ONERA and benefits companies in the aeronautics sector by way of subsidies (minimum EUR 500 million) and repayable advances (minimum EUR 800 million). This support makes it possible to co-finance technological demonstrators, develop future aircraft and improve the operational profitability of manufacturers in the sector.

Space

France tops the space industry rankings in Europe[4] with a consolidated turnover of around EUR 2.7 billion in 2009. The French civil and military space budgets (EUR 2 billion per year in total) represent one-third of European space budgets. Moreover, France is the leading contributor to the European Space Agency (ESA) budget, with contributions of EUR 770 million in 2012.

The French Space Agency (CNES) is the body responsible for implementing French space policy, which obviously has a strong technological component. With a budget of around EUR 1.36 billion in 2011 (excluding French participation in the ESA), CNES funnels EUR 800 million to industry to conduct national civil and military programmes. According to the assessment report of the Evaluation Agency for Research and Higher Education (AERES, 2010), the research and technology budget for space systems is a strategic resource for SMEs, but the uncertainties inherent to the programme (budget constraints, programming changes, delays in decision-making) tend to destabilise participating SMEs. Large companies are more resilient because CNES funding accounts for only a small share of their turnover.

Moreover, research and innovation in space are also funded by other channels, such as ANR, the competitiveness clusters, OSEO grants for innovation and the PIA. There are three competitiveness clusters in the aeronautics/space field: Astech, Aerospace Valley and Pégase.

Some of the PIA measures are earmarked for space (EUR 500 million). The CNES is the operator and the beneficiaries are companies in the sector. The aim of the PIA is to contribute to the major technical choices made by the ESA as part of its future launch programme and to accelerate the development of new generations of satellites.

Automotive industry

Introduced at the beginning of the 1980s, the Land Transport Research and Innovation Programme (PREDIT) is a tool for co-ordinating research and innovation. It is run by the ministries in charge of research, industry, transport and the environment, and by three agencies: ANR, ADEME and OSEO. ADEME is involved through contracts or subsidies and is in charge of the Demonstration Fund (support for hybrid and electric vehicle projects). ANR contributes through the Vehicles for Land Transport or Sustainable Cities programmes. OSEO is involved in technological and innovative services incorporating ICTs. PREDIT 4 (2008-12) had EUR 400 million in public funds and was supposed to generate a total research effort of EUR 1 billion. PREDIT 4 has six priorities: energy and the environment, quality of transport systems, mobility in urban regions, logistics and goods transport, competitiveness of the transport industry and transport policies.

Environmental protection and energy management: French Environment and Energy Management Agency (ADEME)

Environmental protection and energy management are research priorities in many countries, for both economic and welfare reasons. They were also championed as priorities in France in the SNRI of the MESR in 2009 and in the Juppé-Rocard report that led to the creation of the PIA, also in 2009. They are one of the missions of the CEA and other PROs and one of the themes selected to feature among the 34 key industries in 2013. The Grenelle Environment Forum (2008) also highlighted innovation. Indeed, this area brings together several strategies embodied by various stakeholders. Here we will focus on the agency that most clearly incorporates these objectives into its mission: ADEME.

ADEME is an objective-led agency that supports research performed by public or private operators and funds phases from pre-industrialisation through research demonstrators. Its annual R&D budget is around EUR 40 million, two-thirds of which go to companies, and one-third to public laboratories. In 2011, over 50% of aid contracts involved ecotechnologies in the fields of energy, waste, air and noise. The Agency calculates that the public/private leverage effect, including demonstrator funding, was 1.68 in 2010 and 2.1 in 2011.

ADEME awards aid for projects conducted by an organisation independently or in co-operation. "Co-operative research" refers to calls for proposals and covers co-operation between at least two independent companies, including an SME, or co-operation between a company and a research organisation. It also supports R&D projects, which can be submitted to ADEME at any time on any of the priority topics. In 2011, ADEME funded 54 new theses, 46% of which were co-funded by a company, a local authority or a public institution.

In 2008, at the close of the Grenelle Environment Forum, ADEME established the Research Demonstrator Fund for New Energy Technologies. The purpose of research demonstrators is to optimise technologies just prior to the industrialisation stage and to enable them to move from the laboratory stage to a size where the technologies can be tested in real use conditions. In 2009, a EUR 151 million envelope was committed to pro-

jects as part of the Demonstrator Fund; EUR 600 million will be committed by manufacturers and research bodies to R&D.

In 2010, four PIA programmes were entrusted to ADEME: technological platforms and demonstrators in renewable energy, low-carbon energy and green chemistry; smart electricity grids; the circular economy; and vehicles of the future. In 2013, 115 projects were selected (of the 541 proposed) for a total funding of EUR 940 million.

Box 6.9. The "Top Sectors" policy in the Netherlands

Motivated by concerns over the international competitiveness of the Netherlands and emerging social challenges, the Dutch Government announced the "Top Sectors" approach in February 2011. The "Top Sectors" is a new form of industrial policy, entailing *i)* focusing of public resources in a small number of areas and *ii)* extensive co-ordination of activities within these areas among companies, government, universities and PROs. Nine sectors (which do not exactly match industrial sectors in established classifications) were initially singled out: agri-food, horticulture and high-tech propagation materials, energy, logistics, the creative industry, life sciences, chemicals and water. A tenth horizontal theme, "headquarters", was subsequently added, highlighting the importance attributed to retaining and attracting major multinational companies. In 2011, the nine sectors accounted for over 80% of business R&D and under 30% of value-added and employment. Whereas traditional approaches to industrial policy are too government-centred, industry representatives are at the centre of the co-ordination process in the sectors. The Government, for its part, commits to developing sector-specific policies across ministerial portfolios, including education, innovation and foreign policy, as well as reducing the regulatory burden. The "Top Sectors" policy also aims to reduce the administrative burden for companies, combining the hitherto disparate channels of public support to companies into a single window for service delivery (*Ondernemersplein*). The approach introduces new forms of governance. "Top Teams" comprising senior representatives from industry, research and government in each sector draft innovation agendas, which they submit to the Government for consideration. The Government then evaluates each top team's proposed agenda, which includes a strategic plan and instruments for the sector. The Government's evaluation takes into account the level of ambition, the degree of stakeholder commitment, the degree of openness, the balance between social and economic objectives and the extent to which the set objectives can be monitored and evaluated. The relationships and sectoral plans are then formalised in the top consortiums for knowledge and innovation (TKIs) – in some cases, there are several per top sector. The public budget allocated to the Top Sectors is difficult to calculate with accuracy because it includes funds allocated to other programmes and hence re-labelled, as well as other funds that are also co-financed by industry or the European Union. It also incorporates R&D funding dispensed by thematic ministries (e.g. of health and sports, infrastructure and the environment, and defence) and the regional and local authorities. The Dutch Government estimates that (excluding regional and EU funding), between EUR 1 billion and EUR 1.1 billion will be made available to the "Top Sectors" every year over 2013-16. Of this total, the TKI funding allocation (between EUR 50 million and EUR 130 million) can be identified clearly as additional funding. Between EUR 30 million and EUR 50 million per year are earmarked for education and labour market measures, while EUR 700 million to EUR 900 million per year are earmarked for research and innovation.

Source: OECD (2014), *OECD Reviews of Innovation Policy: Netherlands*, OECD Publishing, doi: 10.1787/9789264213159-en.

Developments in 2013 and 2014: the "34 key industries" and the "7 sectors of the future"

In September 2013, the MRP announced a plan entitled "the new industrial France" aiming to support innovation in "34 key industries". With funding of over EUR 3 billion, the scope of the plan was significant. Following a National Council for Industry study conducted by McKinsey, 34 key industries were selected on the basis of 3 criteria: *(i)* growing world markets; *(ii)* positioning as a French leader in the related technologies; and *(iii)* existence of a sound academic, technological, economic and industrial ecosystem. The chosen technologies also contribute to meeting the social challenges of the future. The 34 industries include renewable energies, new cars and digital hospitals. The deadline for marketing the planned innovations is 2020. Each sectoral plan is managed by a group of stakeholders chaired by a manufacturer, which will have to prepare a plan and submit it to the Government. The governance model is fairly similar to that of the "Top Sectors" in the Netherlands (see Box 6.9). In September 2013, the "Horizon 2030" plan was also released in the wake of the report drafted by a committee chaired by Anne Lauvergeon. The committee initially identified the challenges French industry would face by 2020 and singled out on that basis the following seven areas: energy storage; materials (rare metals) recycling; economic exploitation of marine resources; phytoproteins and vegetal-based chemistry; personalised medicine; the silver economy (for the elderly); and the commercialisation of mass computer data. In the second phase, the State commits funds to implement the stated priorities. The procedure followed is similar to that implemented for risk capital, with several rounds of investment in projects which are reassessed at each stage. Innovation competitions are launched in the seven chosen fields. With a total budget of EUR 300 million, EUR 200 000 in aid will be paid at the end of the first round to selected innovative companies, provided that the developmental work and jobs are located in France. Following a second selection round, much larger budgets of up to EUR 2 million will be made available to the companies.

Conclusion: Assessment of French policies supporting research and innovation

The gradual refocusing of French State intervention in industry over recent decades has tended to refer to the discourse on "new industrial policies" because it takes into account the prevailing environment in which global industry operates. The question is, to what extent do the decisions that are actually implemented tally with requirements of those policies, and hence the requirement that French industry be competitive? From that point of view, the response is mixed: in fact, the genuine progress made over that period must be extended further to fully realise the desired paradigm shift. This chapter concludes with an assessment of the main aspects listed above – the framework conditions, strategic cohesiveness, interventions on linkages and upstream activities, opening up to stakeholders and entrepreneurship, consistency of between the instruments used, and assessment and transparency.

Framework conditions

As shown in the chapter on macroeconomics, France is from this standpoint not very well placed, due to its fragmented labour market, high labour costs, insufficiently reactive continuing education, financially cumbersome State, complex and onerous tax system, and many regulations. The efforts made by the Government to improve this situation are welcome.

Strategy

Despite abundant and in-depth strategy for industry, innovation and innovation policy, decisions ultimately lack strategic cohesiveness. This chapter has reviewed a plethora of plans and horizontal or thematic measures. Systematic mechanisms do not seem to have been introduced so as to ensure that these various strategies and the decisions to which they lead are in alignment: co-ordination, where it exists, occurs ad hoc and is not always effective. The "new industrial France", for example, deserves to be more expressly anchored in the analyses of new demand or globalisation (which can be found in the "Horizon 2030 Committee" report), and even more so in the various analyses that place entrepreneurship (rather than increased support for large companies) at the heart of government objectives. In a context where public resources are scarce, this results in efficiency loss throughout the public support system and in "blind spots" that are obscured by a surfeit of measures.

Despite the absence of a clear single strategy, French policy is clearly focused on supporting R&D, with the result that entire swathes of the most competitive sectors of French industry (agri-food, luxury products, services, etc.) benefit little from innovation policies. This is incompatible with the requirements of the new industrial policies to promote "entrepreneurial discovery" which insist on the necessary connection between the structure of the current or anticipated economy and the orientations of innovation and emphasises the importance of non-technological innovation. The latter has appeared in recent industrial plans, but still in a marginal position.

Political emphasis on the linkages between stakeholders and upstream activities

Since 2004, France has used competitiveness clusters to emphasise linkages between companies, and between companies and public research.

A number of programmes announced as part of the PIA or more recently (e.g. the "34 key industries") target technologies rather than specific companies. However, the dividing line between technologies and companies is not always watertight: some technologies have a very narrow business base, and the support offered to some technologies can be channelled towards specific companies.

Openness towards "non-client" companies

A third feature of the "new industrial policies" is their insistence on the need to open up government mechanisms to a variety of companies beyond the State's traditional "clients" (chiefly large companies). This aspect has also received much attention in France.

Entrepreneurship has been given pride of place in French innovation policy and has been the subject of a large number of measures over the last 15 years (see the next chapter). As a result, France is very much in line with the trend of new industrial policies.

It should also be noted that a growing share of public funds earmarked for companies are allocated on the basis of open calls for tenders (as with the PIA since 2010, ANR grants and funds stemming from the "Horizon 2030" operation), thereby favouring those companies that prepare the best projects – which are not necessarily those that are most accustomed to public financing, especially since often international panels are involved in the selection process. Here again, France is in line with the principles of the new industrial policies.

Nevertheless, it bears noting that large companies continue to be the chief beneficiaries of public support in both absolute and relative terms (rates of assistance). ISEs benefit the least from public aid, despite having become a policy focus since 2008.

Instruments

Recent debates in France demonstrate high awareness of the need to streamline the list of stakeholders and instruments involved in innovation policy, whose excessive complexity has earned it the label of administrative "millefeuille" (this complexity is not specific to innovation, but seems particularly high in this area). However, few actions have been taken to that end.

The fact that each instrument ties up with several objectives, and vice versa, is not a problem in itself and is even desirable in order to ensure system coherence. But it should be recognised that the new instruments were created over time without systematic discussion on which instruments already in place should be withdrawn or amended to provide optimum conditions for the new instruments. The plethora and overlapping of instruments reduces both their effectiveness and effective State oversight of each one.

The instruments can also be considered from the point of view of the balance of the overall package. Here, France stands distinguishes itself internationally by its very high proportion of tax assistance compared to direct aid. The high level of generosity it has now reached means that tax assistance probably has limited effectiveness. At the same time, direct aid often comes in the guise of small lump sums (especially since there are so many measures, leading to a degree of dispersion or even "sprinkling"). Restoring the balance in favour of direct aid would allow increasing the sums allocated to individual measures. It would also give the various strategies' thematic priorities the necessary emphasis so that resources are properly allocated to ensure their effective implementation.

Assessment

Assessments that are both effective (with an impact on policies) and in line with international standards are a central component of the new industrial policies and should enable better management of public funds by identifying and then adjusting or cancelling programmes that do not meet the stated objectives.

France has made significant efforts in this field, especially in the context of the PIA, all of whose projects undergo continuous quantitative monitoring by the authorities involved. A number of important measures, such as the CIR or the competitiveness clusters, were the subject of repeated in-depth – and generally quality – studies commissioned by the supervisory authorities and conducted by academics or consultancies. It should, however, be noted that no independent assessment of these measures has taken place. Moreover, the systemic nature of innovation policies (each measure has several objectives, and vice versa) also calls for systemic, comprehensive assessments that match objectives to results; no such studies have been conducted. The new assessment group for innovation policies established within the General Commission for Strategy and Policy Planning could be the appropriate forum for steering this type of analysis.

Overall assessment

Overall, it appears that France has come a long way since the era when innovation policies focused on major State programmes, State needs, State means, etc. Some significant changes still need to be made for France to take full ownership of its new industrial

policies. Although with these new policies government action complements – rather than replaces – the market, France still has a number of programmes that replace the market altogether. A more economical approach would both reduce management costs for the State and increase the coherence and strategic focus of State interventions, making them a more effective tool for developing innovation in France.

Notes

1. http://competitivite.gouv.fr/documents/commun/Les_Poles_en_mouvement/tableaux-bord-stats-communs/2011/Touslespoles_2011.pdf.
2. Ministry of Economy and Finance (2010), Bilan de la loi de modernisation de l'économie, www.economie.gouv.fr/files/finances/lois/pdf/lme/100519bilanlme.pdf.
3. The specialisation index is the ratio between the proportion of space-related and arms-related patent applications in one country and the proportion of such applications throughout the OECD. A value higher than 1 indicates specialisation.
4. http://cache.media.enseignementsup-recherche.gouv.fr/file/Politique_spatiale_francaise/09/8/Strategie_spatiale_francaise-mars-BD_211098.pdf.

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