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"Investments for the future" and industrial policy in Europe: how to target and select innovative projects?

Launched in 2010, the "Investments for the future" programme marks the return of industrial policy in France. The underlying government's purpose is to target sectors, fields, technologies or categories of companies likely to ensure the long-term competitiveness of the French economy.

This updating of industrial policy is not specific to France. All developed countries face the need to redirect their growth model in response to major new socio-economic challenges, such as climate change, scarcity of natural resources, ageing populations, etc. More or less limited resources – notably in the form of public budgets – mean that some choices must be made. So the debate is no longer about the very existence of industrial policy, but about the definition of its actual objectives and of the ways of achieving them.

The analysis in this paper shows that industrial policy has been profoundly transformed, in particular regarding where and how to target resources. International comparison shows that there is hardly any difference in the priority fields (biomedical, nanotechnologies, digital economy, etc.) that the main comparable countries have chosen to promote. There are greater differences in the ways in which, at a more specific level, they organise the selection of innovative projects, according to the characteristics and needs of their respective systems of innovation.

However, a review of the challenges and good practices of several European countries should make it possible to develop some broad principles that enhance the targeting of industrial policy and the selection of innovative projects.■

PROPOSALS

1. Promote disruptive innovation but with no technological or sectoral bias
2. Select projects not only based on criteria related to their profitability or their technological excellence but also on:
   - their potential spillover effects
   - the quality of related human resources (management capacity, creativity)
3. Design the next "investments for the future" mechanisms at the European level

THE CHALLENGES

After having been somewhat discredited, industrial policy has made a clear-cut comeback in recent years. Justified theoretically by the existence of market failures[1], it mostly appears as a way of enhancing growth potential by addressing major long-term structural challenges. Many countries, notably China, the United States, Japan and South Korea, have for example set up major investment programmes in "green" technologies[2]. The US, in particular, has just announced a new federal programme in favour of US-made products, with a focus on energy efficiency, robotics, manufacturing processes, advanced materials and defence industries[3]. Considerations of power obviously play a role here. Meanwhile, the European Union's new growth strategy, *Europe 2020*, presents support for the industrial base as a key factor for ensuring dynamic and sustainable competitiveness[4].

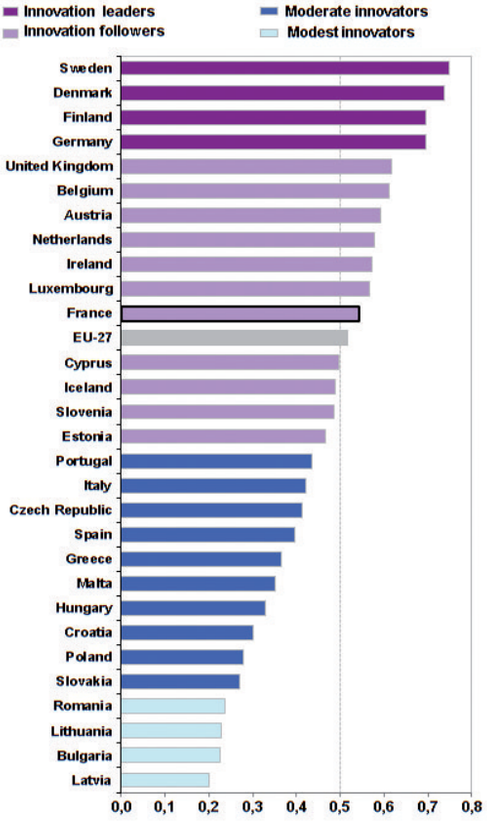
In developed economies, the recent return of industrial policy has occurred mostly in the form of innovation policies[5]. Indeed, the industrial competitiveness of these countries mainly relies on the ability of firms to position themselves on the tomorrow's markets by developing new goods, services, processes and technologies. What makes this challenging is that these future markets are not known. In a context of scarce budgetary resources, the key issue therefore relies on countries' ability to make the "right" choices in terms of investment fields, players, and project selection criteria.

Based on a survey of public-support mechanisms for research and innovation in several European countries, this paper discusses new trends in industrial policies.

MAIN CHALLENGES IN INNOVATION

With major emerging economies moving to the fore, innovation is more than ever a key factor to the competitiveness of advanced economies. Industrial policies are thus set on the basis of an identification of challenges that each country faces in the area of Research-Development-Innovation (RDI). In this respect, the European Innovation Union Scoreboard (IUS)[6] usefully sheds light on countries' relative RDI performance, both at an aggregate level and for the different dimensions of the innovation process.

Chart 1:
Average performance of EU member countries in innovation (2010)



Note : Average performance is measured using a composite indicator building on data for 24 indicators going from a lowest possible performance of 0 to a maximum possible performance of 1. Average performance in 2010 reflects performance in 2008/2009 due to a lag in data availability.
Source: Pro Inno Europe, Innovation Union scoreboard 2010.

(1) Such failures are mainly related to the incomplete nature of markets due to imperfect and asymmetric information, the existence of spillovers and the presence of economies of scale.
(2) See "The global revival of industrial policy – Picking winners, saving losers", *The Economist*, vol. 396, n° 8694, 7 August 2010, p. 54-56.
(3) See "President Obama Launches Advanced Manufacturing Partnership", White House press release, 24 June 2011.
(4) See European Commission, *An integrated industrial policy in the era of globalisation*, adopted on 28 October 2010, COM (2010) 614 final /2, Brussels, 17 November 2010.
(5) See Soete, L. (2007), "From industrial to innovation policy", *Journal of Industry, Competition and Trade*, vol. 7, p. 273-284.
(6) Available on the European Commission's Pro Inno Europe site: http://www.proinno-europe.eu/inno-metrics/page/innovation-union-scoreboard-2010

A comparison with Germany, the UK, Finland and Sweden highlights France's relative performance. Based on the synthetic indicator established in 2010 (*chart 1*), France, along with the UK, is classified as an "innovation follower", while the Nordic countries and Germany are among the "innovation leaders". The US performance is, on the whole, 50% higher than that of the EU-27.

Breaking down this indicator based on eight major innovation dimensions (*chart 2*) highlights each country's main strengths and weaknesses.

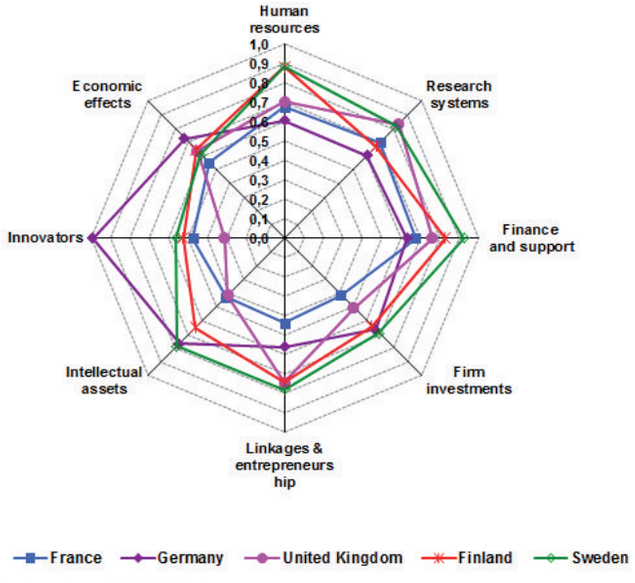
France and the UK, for example, have strong positions in terms of innovation determinants but their performance is undermined by weaker commitments from companies. In contrast, the overall good performance of Germany reflects companies' strong innovative capacity with significant economic benefits, but hides weaknesses in human resources and funding. Sweden and Finland have a relatively balanced profile, with good relative performances both in innovation enablers (notably regarding human resources and funding), firm activities (particularly in terms of partnerships) and the economic effects of innovation activities.

An analysis of these indicators, as well as national debates on innovation policies, highlights the three main challenges each country faces (table 1). In France, for example, the challenges are to raise private investment in R&D, to shore up links between science and industry, and to promote the growth of innovative SMEs. These challenges are related to the overall RDI performance of countries, but also depend on their structural characteristics. For example, a continued specialisation of Germany in medium/high-technology sectors (e.g., the automotive industry, specialised machines and chemicals) could ultimately lessen its performance. So a major challenge for Germany is to strengthen its position in high-technology or knowledge-intensive sectors.

To meet these challenges, public authorities are playing an increasingly active role in business support. This is a clear return to industrial policy, albeit in a highly transformed state.

Chart 2:

Comparison of five European countries' performances, based on innovation dimensions (2010)



Source: Pro Inno Europe, *Innovation Union Scoreboard 2010*, CAS chart.

Note : the eight innovation dimensions presented here relate to three main types of indicators:

1) Enablers:
– Human resources (availability of a high-skilled and educated workforce),
– Research systems (international competitiveness of the science base),
– Finance and support (availability of finance for innovation projects and support of governments for RDI activities).

2) Firm activities:
– Firm investissements (R&D and non-R&D investments that firms make in order to generate innovations),
– Linkages and entrepreneurship (entrepreneurial and collaboration efforts among innovating firms and with the public sector),
– Intellectual assets (different forms of Intellectual Property Rights generated as a throughput in the innovation process).

3) Outputs:
– Innovators (number of firms that have introduced innovation, covering both technological and non-technological innovations and the presence of high-growth firms),
– Economic effects (economic success of innovation in employment, exports and sales due to innovation activities).

Table 1:
Main challenges for research and innovation

	Challenge 1	Challenge 2	Challenge 3
France	Increase **business R&D investment**	Improve **transfer from public research to innovation**	Foster **innovative SMEs growth** through better funding
Germany	Reinforce **funding of innovation** for SMEs and young technology firms	Keep pace with **global technology trends**	Adjust the **education system** to changing requirements of technology and innovation
United Kingdom	Increase **business R&D investment**	Increase the **corporate intensity of innovation** (new products, patents, brands)	Reinforce the **education system** to meet the future skill needs
Finland	Bring out **new innovation models**	Increase and enforce **attractiveness for investments**	Broaden the **base of innovative growth-oriented enterprises**
Sweden	Restructure the **industrial base**	Reinforce the **impact of R&D investments** on economic growth	Develop **non-technological innovation**
United States	Advance the **pace of innovation**	Accelerate **commercialisation of research findings**	Strenghten **innovation finance**

Source: Inno-Policy Trandchart, *2009 Country Reports*, Centre d'analyse stratégique synthesis.

A DEEPLY RESHAPED INDUSTRIAL POLICY

According to Cohen and Lorenzi (2000)[7], industrial policy can be defined, strictly speaking, as a policy aiming "to promote sectors that, for reasons of national independence, technological autonomy, insufficient private initiative, decline in traditional activities, or territorial or political equilibrium, deserve intervention". In France, this conception of industrial policy used to be reflected mainly in the support for major technological programmes (in areas such as IT, aerospace, rail transport, energy or telecommunications), carried by a few large companies. It is based on a top-down, centralised model in which the State is supposed to be able, through direct R&D support and public procurement, to identify and develop technologies, sectors and players that are strategic for industrial competitiveness.

A need to rethink the traditional approach

Since the 1990s, this approach has appeared to be broadly outdated, due mainly to the shift in the competitive and technological context. First of all, given the growing role of transnational companies and the restrictions imposed by the EU competition policy, the promotion of "national champions" has become largely obsolete. Second, as sector boundaries are vague and porous (along with the diversification of company activities and outsourcing of business services), it is no longer possible to clearly define the scope of State intervention. Third, the process of business innovation is now strongly market-driven and is based more on non-technological factors, such as design, marketing, payment modes, etc. Finally and most important, the position of France at the technological frontier, i.e., at the most advanced stage of technological development relative to other countries, means that the markets and the technologies which will be sources of growth are not known a priori.

Vertical approaches targeting technologies, sectors or companies are therefore hard to implement[8]. Moreover, they may end up being especially ineffective, as they tend to favour incumbents leaders (*cherry picking*), carry certain perverse risks or effects, including the "capture" of public support by special business interests, the waste of public funds on choices that lead to a dead ends, the creation of artificial overcapacities in certain fields, the distortion of venture capital markets, and so on.

(7) Cohen E. and Lorenzi J.-H. (2000), "Des politiques industrielles aux politiques de compétitivité in Europe", in *Politiques industrielles pour l'Europe*, CAE Report n° 26, Paris, La Documentation française.

(8) See Le Blanc G. (2010), "Les politiques d'innovation à l'épreuve de la variété", in: J. Lesourne and D. Randet (dir.), *La Recherche et l'Innovation en France - FutuRIS 2010*, Odile Jacob, p. 251-271

Table 2:

Industrial policy between two paradigms: the main divides

	Traditional industrial policy and/or in a strict meaning	More recent industrial policy and/or in a broad meaning
Overall context	A framework mainly national	EU framework (competition policy) and role of transnational companies
Positioning in relation to other policies	Head-on opposition with competition policy	Systemic, integrated approach, generating synergies with other policies
Positioning facing changes in market structure	An often defensive stance (restructuring measures)	A more proactive stance (acceleration, renewal and anticipation)
Main targets	Technological competitiveness of firms and attractiveness of territories, in some fields	Innovation in a broad meaning and societal aspects: sustainable development challenges, etc.
Positioning regarding the "technological frontier"	Technological catch-up (based on pre-set objectives) through major programmes	Exploration of multiple and unpredictable technological trajectories
Orientation towards supply or demand	Primacy of supply-side policies, especially through the creation of new technologies	Greater attention to the use of new technologies (emphasis put on adoption and dissemination)
Prevailing orientation of economic development	Top-down and hierarchical	Bottom-up and decentralised/regionalised
Preferred target in terms of actors	Large groups ("national champions")	SMEs, intermediate-sized companies, "ecosystems" (competitiveness clusters, etc.)
Sectoral orientation	Only the manufacturing sector	All areas of activity, even non-manufacturing ones
Vertical or horizontal dimension	Primacy of sector-based measures or measures targeted on certain companies	Combination of transverse or thematic elements
More or less systematic intervention	Discretionary intervention, with *ad hoc* content	Strategic dimension, with an objective of overall prosperity
Role of the State	Presumed to be omniscient and infaillible, acting as a substitute or a guide for private actors	Partner, cooperating pragmatically with the private sector (shared learning)
Favourite instruments	Physical infrastructure, public-sector companies, direct public support	Intangible infrastructure, indirect measures (tax or regulatory incentives)
Type of governance	Relatively opacity and relative scarcity of competitive procedures, tight national borders	Concern of transparency; importance of public bidding processes and of international cooperation

Source: Centre d'analyse stratégique synthesis.

A broader approach

The recognition of this new environment has first led to the increased use of horizontal policies, aiming to create a climate favourable to the development of all firms (through technical standards, intellectual property rights, etc.). Such policies, which have been carried out mainly on a European scale under the Lisbon strategy, have failed to revive the industrial base but have led to a more systemic approach of public interventions. The former head-on opposition between industrial policy and competition policy has thus given way to a more integrated approach[9], striving to create synergies between industrial policy and other public policies (territorial planning, education policy, trade policy, healthcare policy, etc.). Industrial policy is thus more and more akin to a targeted innovation policy (*table 2*).

Moreover, the often defensive approach taken in public intervention (e.g., protection of established companies or of sectors undergoing restructuring) has shifted towards a more pro-active vision focusing on the renewal of the economic base (entry of new firms, emergence of new areas of specialisation). Industrial policies have thus acquired a strategic dimension, with the objective of strengthening the productive system in the fields meant to provide long-term prosperity.

Lastly, industrial policies no longer seek to merely enhance firms' competitiveness and the attractiveness of a given territory. Their ambition, broader and more diffuse, consists in meeting the challenges of societal changes, linked to globalisation, climate change and scarcer resources.

(9) See Aghion P., Boulanger J. and Cohen E. (2011), "Rethinking industrial policy", *Bruegel policy brief*, n° 4, June. See also Lallement R. and Wisnia-Weill V. (2007), "Concurrence et innovation: quelles politiques pour favoriser le développement des entreprises?", Centre d'analyse stratégique, *Horizons Stratégiques*, n° 4, p. 156-175.

An in-depth change of the instruments and in the governance

This broader and less circumscribed vision of industrial policy reflects the new challenges of innovation policy. Given the uncertainty surrounding demand, the search for new opportunities requires to explore various technological trajectories and to test out several economic models[10]. In this context, industrial policy cannot merely orient private and public R&D activities but must help build new markets. In other words, the current challenges are on the scale of "ecosystems" (clusters, etc.) bringing together heterogeneous players, notably according to their status (public or private), their sector or their size (SMEs or large companies).

The State thus acts as a partner and coordinator for the actors of the innovation process. Industrial policy is now largely based on a pragmatic and interactive process of shared learning and strategic cooperation between public authorities and the private sector, aiming to revitalise the productive base. To implement this bottom-up approach, the public authorities most often rely on indirect channels and mechanisms (taxes or regulatory incentives, etc.) and experimentations at the level of the various territories. Industrial policy thus acquires a strong regional component[11].

The type of governance required has also been greatly modified with the development of more transparent practices, often involving calls for tenders and striving to increase international cooperation. This has two major consequences. First, a greater role is now given to evaluating these policies. Second, policy makers are increasingly aware of the need to halt the tendency to the unnecessary duplication of research efforts, by having different countries pool some action plans or programmes.

A NEW WAY OF TARGETING INDUSTRIAL POLICY

The decline of the top-down and sector-based approach to industrial policy does not necessarily mean that public authorities are no longer targeting their initiatives. Recent initiatives most often combine a vertical approach with transversal elements, which corresponds to a "matrix" approach to industrial policy[12]. A well designed industrial policy cannot reject targeting outright, on the pretext that public authorities may make wrong choices. Such choices, in fact, are part of an experimental process of discovery, which necessarily involves trial and error. What matters the most is being sufficiently well organised to correct failures at an early stage[13].

Hence, even if it is reasonable to assume that choices of sectors and technological specialisation come mainly within firms – according to a sort of subsidiarity principle[14] – public authorities do have several roles to play here.

According to Foray (2009), such roles consist in providing the entrepreneurs with an appropriate framework of incentives, assessing the potential of emerging technologies in a given territory – country or region – (potential for innovation, size of sectors concerned, etc.) and in identifying and promoting the additional investments needed to develop innovation in a given field and to set up networks between stakeholders[15]. In other words, for the public authorities it is less a matter of guiding and assisting the main actors in the field concerned (manufacturers, researchers, trainers, etc.) as to play a role of catalyst and thus enhance their ability to create wealth.

Given these overall guidelines, some groups of criteria can be used to orient industrial policies.

The major societal needs

While it is not possible today to identify the major products, technologies or applications of tomorrow, we do know the needs that they will have to address: climate change, ageing of the population, energy transition, urban planning, etc.

Identifying these major socio-economic needs makes it possible to steer industrial policy into various fields (healthcare, citizen safety, defence, space, energy, environment, food, transports, etc.), while avoiding the traps of an approach that focuses too much on pre-determined activity sectors or on technologies that are clearly identified and too narrowly circumscribed. Even so, this ultimately leads to steering choices towards certain families of technologies (e.g., "eco-technologies") or certain sectors (e.g., construction and civil engineering, linked to the issue of energy savings).

(10) See Le Blanc G. (2010), *op. cit.*

(11) Aiginger, K. (2007), "Industrial policy: A dying breed or a re-emerging phoenix", *Journal of Industry, Competition and Trade*, vol. 7, n° 3-4, p. 297–323.

(12) Aiginger, K. and S. Sieber (2006), "The matrix approach to industrial policy", *International Review of Applied Economics*, vol. 20, n° 5, p. 573-601.

(13) Rodrik D. (2004), "Industrial policy for the twenty-first century", *CEPR Discussion Paper*, n° 4767, November.

(14) "Markets whenever possible, complemented by State action whenever necessary", as the previous UK government put it; see HM Government (2009), *New Industry, New Jobs: Building Britain's Future*, Department of Business, Enterprise and Regulatory Reform.

(15) Foray D. (2009), "Understanding 'smart' Specialisation", *in* Pontikakis D., Kyriakou D. et Van Bavel R. (dir.), *The Question of R & D Specialisation: Perspectives and Policy Implications,* JRC Scientific and Technical Report n° 1665, Luxembourg, p. 19-27.

The potential for radical or diffusing innovation

Given that France is no longer in a logic of technological catch-up[16] but stands basically on the "technological frontier", the real issue of targeting is that of radical innovation, rather than incremental innovation, which occurs per degree within established sectors. But disruptive innovation involves taking significant risks, considering low-probability events and accepting the possibility of failure within a highly uncertain framework. This makes industrial policy all the more necessary, as private investments tend to fall below socially desirable levels; in any case, experience has confirmed that radical technological changes seldom occur without public intervention[17].

Another important criterion concerns the ability of technologies to spread and to have positive spillovers on a rather wide range of users. In this regard, the European commission refers to "key enabling technologies"[18], which include, notably, nanotechnologies, micro- and nanoelectronics (semiconductors in particular), photonics, advanced materials, biotechnologies, as well as advanced manufacturing systems (e.g., robotics)[19]. For this type of technologies, the challenges mostly arise in terms of deployment and adoption, i.e., in terms of usage, notably through demonstration effects.

The organisation in production chains and the role of SMEs

Taking into account the dissemination potential of technologies tends also to favour an approach in terms of production chains and to give up a purely sector-based vision of industrial policy. Indeed, in many sectors of activity, the innovation potential is largely based on the quality of industrial linkages (notably with suppliers and customers) and of the links between the various segments of the value-added chain.

For example, in nanotechnologies, where the fields of application are potentially numerous (automotive, healthcare, energy, electronics, cosmetics, the environment, etc.), a wide variety of actors, often unaccustomed to cooperate, must be brought together in order to promote inter-disciplinarity, training, staff mobility, etc[20]. Such interactions are also decisive for the most mature sectors, which can be disrupted by the arrival of new technologies. This is notably the case of the automotive sector, with the development of new types of batteries such as fuel cells[21].

The focus on the role played by production chains highlights the need to involve all actors in the industrial base, which, in turn, requires reinforcing the weight of SMEs. This is especially necessary in France, the UK and Sweden, where, according to OECD data, public aid for R&D in recent years has mostly benefited large firms[22].

The development potential

While the needs of a territory (country or region) may form the basis for the major outlines of industrial policy, the thematic targeting must also take into account the potential development of various fields of activity. Industrial policy must therefore be defined according to the skills and assets that each territory possesses. This requires identifying beforehand the major blocks of knowledge on which the growth strategy may be based[23].

The case of the digital economy provides a good illustration. The different trends at work (standardisation, ultra broadband, spread of usage, etc.) indicate that the many possible applications will require a huge change in scale, with a high number and variety of users, in diverse fields (manufacturing, energy, healthcare, culture, risk prevention, urban planning, climate, etc.). It follows that the future in this area will mainly depend on the design of innovative systems (for example, assisted-autonomy systems for elderly persons), rather than the manufacture of components. This is favourable to European countries that possess skills for creating systems and networks and for training personnel with integration capabilities. The development potential thus looks promising in Europe, especially since it represents a considerable pool of jobs[24]. Indeed, the job-content criterion remains obviously of primary importance in choosing a production chain or a thematic area.

(16) Miotti L. and Sachwald F. (2004), *La croissance française 1950-2030: le défi de l'innovation*, Institut français des relations internationales (IFRI), Paris.

(17) Edquist C. and Chaminade C. (2006), "Industrial policy from a systems-of-innovation perspective", *EIB Papers*, vol. 11, n° 1/2006, June, p. 108-132.

(18) In France, the public authorities can rely, among other things, on the prospective *key technologies* exercise done every five years since 1995 by the Ministry of Industry on a five to 10-year timeframe. The fourth edition (*Technologies clés 2015*) was published in March 2011.

(19) European Commission (2009a), *Preparing our future: developing a common strategy for key enabling technologies in the EU*, COM(2009) 512 final, Brussels, 30 September 2009.

(20) See Le Blanc G. (2010), *op. cit.*

(21) This point shows that, in a given sector, the phase of decline is not inevitable and can be delayed or countered by the emergence of new technologies. See, among others, Livesey F. (2010), "Rationales for industrial policy based on industry maturity", CIG *Working Paper*, 2010/1.

(22) Uppenberg K. (2009), "R&D in Europe: Expenditures across sectors, regions and firm sizes", *CEPS Paperbacks*.

(23) Foray, 2009, *op. cit.*

(24) See the presentation of Gérard Roucairol (Vice-president of the Académie des Technologies) at the CAS seminar on 18 January 2011. http://www.strategie.gouv.fr/content/seminaire-depenses-d'avenir-en-france-et-l'etranger

The degree of specialisation

Besides the issue of sectoral or thematic targeting, there is also the difficult matter of the degree of specialisation. On the one hand, too little specialisation is suboptimal, as it does not achieve the critical mass that is necessary to be competitive. On the other hand, too much specialisation is also to be avoided, as a minimum degree of variety and redundancy is necessary for producing scientific results and for sustaining long-term innovation potential, in a world where innovation trajectories are increasingly numerous and intertwined[25]. In this regard, all this probably depends on the size of the territory in question, as a small region is much more urged to specialise, whereas it is the interest of large countries to preserve a relatively diversified structure.

THE FRENCH AND GERMAN EXAMPLES

In France, the "Investments for the future" programme is a good illustration of this new way of designing and targeting industrial policy, both in terms of the objectives put forward and concerning the modalities of support (*Box 1*).

Box 1:

The "Investments for the future" programme: an illustration of this new type of industrial policy

The objectives

In France, the approach underlying the "Investments for the future" programme has been motivated by the wish to accelerate the transition towards a more sustainable development model based on a knowledge-based and "green" economy. Under this approach, investments are assessed on the basis of their societal impact, in a long-term prospect and with a renewal-based approach. The resources are invested (€35bn) on four priority channels: (*i*) higher education, research and training (€18.9bn); (*ii*) industrial production chains and SMEs (€6.5bn), (*iii*) sustainable development (€5.1bn); (*iv*) the digital economy (€4.5bn). These strategic priorities include both an horizontal approach to investment in education and research, but also thematic dimensions (digital economy, clean energies and less-polluting transports, healthcare, and biotechnologies) where innovation should ensure the competitiveness of the French industrial base over the long term*. This targeting also reflects the will to strengthen the links between the various actors of the innovation process (notably the links between public and private research, and between SMEs and large groups), in order to bring out true "eco-systems".

Modalities of support

Regarding the nature of public intervention, the "Investments for the future" programme makes a real qualitative change in the design of industrial policy. First of all, it is based on the logic of continuous learning. There is no pre-set schedule but, rather, a gradual commitment of resources based on the findings of intermediate project assessments. Another innovative feature is the bottom-up and selective approach based on a call for national projects. In the selection process, attention is paid not only to the intrinsic quality of the projects but also to the existence of spillover effects. Hence, funding procedures aim to favour the creation of assets** (logic of co-investment) and leverage*** (vis-à-vis private funding as well as local government funding).

The "Investments for the future" programme is also original in its governance method. The 35 "actions" taken are governed by conventions signed between the *Commissariat Général à l'Investissement* (CGI) and the 10 public operators in charge of leading the selection process. These conventions, which specify, action by action, the objectives pursued, the project valuation criteria, and the processes of selection, follow-up and ex-post assessment, allow the CGI to play a real role as an integrator.

* When including thematic actions, €22.2bn has been invested in research and higher education. This comes in addition to the actions previously taken under the law on freedoms and responsibilities of universities (LRU) and to the Opération Campus.

** Consumable endowments and subsidies make up only 40% of funding and most often include financial "claw back" clauses or profit-sharing clauses in case of the success of the subsidised technology.

*** According to the CGI, the total investment is expected to be between €60bn and €70bn for €35bn in public-sector credit.

This programme is all the more appropriate to strengthen the public dimension of targeting, given the relatively selective technological policy now practiced by countries like Germany, particularly since the federal government in 1992 stopped offering R&D tax incentives and, even more perhaps, since the 2006 launch of the High-tech Strategie (*see Box 2*). In this latter case, the overall orientation is taken less on the basis of traditional sectoral breakdowns than on major societal needs and, since 2010, based on priority fields of action, if not precise objectives.

(25) Kyriakou D. (2009), "Introduction", in Pontikakis *et al.* (dir.), *op. cit.* p. 11-18.

Box 2:

High-tech Strategie, or the implementation of a truly integrated policy of research and innovation in Germany

A major challenge in terms of technological leadership

From the German point of view, the challenge for research and innovation policy is twofold. On the one hand, it must maintain the investment in innovation in order to preserve the leadership in mid/high-technology sectors such as automotive, chemicals, electrical engineering and machine construction. On the other hand, it should make up ground lost both in knowledge-intensive services, in which Germany has clear weaknesses, and in cutting-edge technologies, where it has caught up only partly in the past decade and is in the EU-15 average. In this sense, it is at least as much a matter of promoting the technologies of the future as ensuring the strength of existing structures.

Implementation of the overall mechanism: the first phase of the strategy (2006-2009)

With this in mind and through its *High-tech Strategie (HTS)*, Germany, for the first time, set up a comprehensive national strategy bringing together the main players of the German innovation system. Indeed, this initiative amounts to setting the research and innovation policy drawn up by the German federal government in a multi-year framework, in cooperation with the federal states (*Länder*), public research organisations, and the corporate world. It has established a set of objectives and priorities and set up a series of ad hoc instruments. As designed from the start, over a period of four years, corresponding to the duration of the previous legislative term (2006-2009), the *HTS* planned to provide public funding of €41.6bn in 17 priority fields[26]. As an inter-ministerial strategy, the *HTS* takes an integrated approach that addresses both framework conditions and public support schemes, and also takes into account shifts in science and technology, as well as societal and economic needs. However, in this first phase, inter-ministerial coordination encountered difficulties in implementation and the HTS was deemed insufficiently targeted.

A second phase, redefined and more targeted: the High-tech-Strategie 2020

In mid-2010, the federal government extended this strategy along the lines of the first phase but while seeking to add some other features to enhance societal dialogue and to focus resources more intensely. As a result, the strategy has been reoriented towards specific missions, this time with *fields of action that are priority for the public authorities*, and no longer with technological fields or research programmes, as it was previously the case. Called the *High-tech-Strategie 2020*, this second phase also focuses on the targeted development of the German system of research and innovation. Indeed, the *HTS 2020* focuses on five cross-cutting areas: food and healthcare, energy and climate protection, security, mobility, and communication, which form sectoral innovation systems, in which participants in research, business and political areas define and implement together the key measures, programmes and projects. In short, the *HTS 2020* takes a mission-based approach, with five priority fields conceived as "global challenges".

A strategic process that still remains complex and relatively unclear

The strategic process is structured on three levels: cross-cutting areas ("global challenges"), framework programmes, and support programmes. The level of the framework programmes is used as the basis for formalising the priorities schedules and the support programmes. However, the 38 specific lines of action that have been planned to express the five major cross-cutting areas are regarded as too numerous by the federally-mandated commission of experts in research and innovation (EFI). According to its last annual report, it is hard to assess which of these lines of action are of high strategic importance and which are more operational in nature. In a context of scarce budgetary resources, it is doubtful that these 38 lines of action can all be successfully carried out. The report calls for clarifying the responsibilities of the various ministries concerned, given that for each major field involved, there are several strategies, some focusing on key technologies, some on cross-cutting projects and framework conditions, and some, at times, on "projects for the future" (*Zukunftsprojekte*). The experts also recommend to further clarify certain terms used, including those of "lines of action" "projects for the future", and "key technologies", as well as their links with the major challenges being addressed. For all these reasons and despite its overall targeting on just five fields, the report concludes that the *HTS 2020* is too fuzzy and complex, which makes it difficult to implement the concepts chosen and their required assessment.

Main sources: BMBF (2010), *Ideen Innovation Wachstum – Hightech-Strategie 2020 für Deutschland*, Bonn/Berlin; EFI (2011 and 2010): Expertenkommission Forschung und Innovation, *Gutachten zu Forschung, Innovation und technologischer Leistungsfähigkeit Deutschlands 2010*, Berlin

(26) Aerospace, healthcare research and medical technology, astronautics, security, biotechnologies, services, energy, information and communication technologies, micro-systems, maritime technologies, nanotechnologies, material technologies, optical technologies, production technologies, plants, automotive and traffic technologies, climate research/environmental technologies.

THE SELECTION OF INNOVATIVE PROJECTS

Once the broad outlines have been set, the design of the industrial policy implies to carefully select the "right" projects, i.e., those that help develop long-lasting competitive advantages and that would not have been possible without public support. This task is all the more difficult, as such projects are particularly risky and rather long-term in nature.

While all countries make public funds available specifically for innovative projects, the role of the State in the selection process is far from being uniform. It depends notably on the nature of public funding (i.e., direct aid, tax incentives, or equity investments) and of beneficiaries (companies or venture capital operators).

In the US and UK, where the venture capital industry is well developed, the investments for the future are mainly managed by private equity funds specialising in innovation funding. The government gets involved by co-funding investments but plays no direct role in selecting the project owners[27].

In Finland, innovation is also funded to a large extent by venture capital, but public authorities also play a direct role in selecting and funding project owners[28] at the earliest stages.

In France and Germany, where venture capital is less well developed[29], public authorities play a greater role in selecting innovative projects. These include the KfW banking group, the federal government and states (*Länder*) in Germany; and agencies such as Oséo in France.

In practice, these public entities, which are often specialized, must set their own selection criteria, based on their specific missions. In this regard, there is no universal method for doing so. This is especially true for the French "Investments for the future" programme, where the selection process is defined action by action under the conventions signed between the CGI and public operators. However, judging from the practices adopted in various European countries (*see Boxes 1 and 2 and the appendix*), three main principles can be put forward to guide the project-selection process. They may be useful for the CGI in its current missions but are also meant to inform the debate on the future evolution of the scheme.

PROPOSAL 1

Promote disruptive innovation but without technological or sectoral bias

Innovation does not require sweeping away what already exists, but the reference to established situations implies itself a conservative bias. Radical innovations are essential for maintaining or creating sustainable competitive advantages and require systematically promoting the most innovative approaches and a spirit of creativity, so that routine schemas can be left aside[30]. However, industrial policy is not just a matter of cutting-edge technologies and high-end manufacturing. It can *a priori* be applied to any sector, regardless of its stage of maturity, including services. The experience shows that much of disruptive innovations (such low-cost automobile, airline or hotel chain, such online social network) is based on an understanding of innovative uses and, basically, on a non-technological dimension (business model, design, etc.).

PROPOSAL 2

Select projects not only based on criteria related to their profitability or their technological excellence but also on :

- **their potential spillover effectfs;**
- **the quality of related human resources (management capacity, creativity).**

The financial viability of a project should surely be one of the first selection criteria. However, its internal rate of return is generally difficult to assess, especially given the uncertainty surrounding the technologies and markets of tomorrow. Therefore, public authorities should incorporate from the outset the possibility of failure and, when that happens, suspend their funding without delay. That said, another mistake would be to underestimate *a priori* the potential outcomes, by assessing a project's value solely on the basis of its internal rate of return. Indeed potential economic impact of a project depends heavily on its position in the chain of value and on the spillover effects that it can have on the scale of a territory. With this in mind, the "collaborative" projects deserve a special attention, as they allow the networking and the opening up of the innovation actors.

(27) In the US, the Small Business Investment Companies (SBIC), venture capital funds with a mix of public and private investment (2/3 and 1/3) and benefiting from special tax breaks, play an essential role in funding innovative projects. In the UK, the *UK Investment Fund Investment*, which was set up in 2009 to fund long-term, high-potential projects is managed by two funds of funds (*Hermes Private Equity* for clean-tech and low-carbon technologies and the European Investment Fund for ICT and biotechnology sectors).

(28) Sitra, a national research and development fund, is directly involved in the funding of the equity capital of firms, while Tekes, the national technology agency, offers direct funding for business innovative projects (mainly via subsidies and loans).

(29) Another policy brief of the Centre d'analyse statégique, published in September 2011, deals specifically with the issue of the development of seed capital in France, *La Note d'analyse*, n° 237.

(30) This requires taking risks and accepting the failures that inevitably result. So success of the "investments for the future" programme must not be judged on the sole basis of an individual project.

Moreover, the risks incurred must be assessed on the basis of all available information. Hence, while often essential, the criteria of technological or scientific excellence are not a sufficient basis on which to judge a project's quality. The skills of the teams concerned must also be taken into account, particularly from the point of view of collective creativity and management ability. This project-selection phase, which involves an exchange of information with public authorities, confirms that industrial policy is now a mutual learning process.

PROPOSAL 3

Design the next "investments for the future" mechanisms at the European level

If the governance device set up to steer the investments for the future proves itself, it should be extended but also adjusted, particularly by reinforcing its European dimension. Indeed, the subsidiarity principle should not only be used to advocate for "neighbourhood" solutions. Guarantee of efficiency, it also means that the European scale is better suited to projects whose scope – in terms of human and financial resources and potential economic outcomes – goes beyond the horizon of regions or countries. In concrete terms, this means, for example, allowing project bids from candidates residing in other EU countries, either in a community framework or through temporary and ad hoc consortiums, which would help ensure reciprocity. Such a flexible method looks more realistic than creating new "national champions" like EADS. It could be sponsored by public institutional investors, such as the European Investment Bank (EIB), the Caisse des Dépôts (CDC) or Oséo in France, the Cassa Depositi e Prestiti (CDP) in Italy, the KfW banking group in Germany or Tekes in Finland. By providing direct aid, such a mechanism would supplement the European Investment Fund (EIF), which was set up in 1994 and which focuses more on funding equity.

In the absence of an agreement on community funding, a common reflection on the "investments for the future" programmes should at least be initiated within an intergovernmental framework. In this prospect, pioneering bilateral initiatives should at least make it possible, through successive stages, to enhance mutual knowledge of the various European mechanisms, to exchange good practices and, beyond that, to coordinate the public programmes concerned, then to bring them closer together and even merge them in part. A revival of the Franco-German partnership could make a useful contribution.

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LA NOTE D'ANALYSE

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APPENDIX

SOME EUROPEAN EXAMPLES ABOUT SELECTING INNOVATIVE PROJECTS

A.1. The selection criteria for Oséo-managed direct support to "Investments for the future"

As the main agency for financing RDI in France, Oséo in 2010 supported about 4,000 innovative projects for a total amount of €650m, including €430m in grants or repayable advance payments for direct support to business innovation, €140m for cooperative projects carried out by intermediate-sized companies (e.g. *Innovation Stratégique Industrielle* programme), and €80m in grants under the single inter-ministerial funding (*Fonds unique interministériel*) to finance collaborative projects of clusters. Direct assistance to innovation is supplemented by bank loan guarantees and co-funding alongside banking and financial establishments. Oséo plays a fundamental role in the implementation of the "investments for the future" programme and manages €2.44bn under "Industrial production chains and SMEs".

The targeting of direct support

Direct funding is provided to projects meeting the following criteria:

- Projects that cannot be supported by other financial instruments;
- Projects carried out by SMEs or intermediate-sized companies;
- Projects with a high return on investment, financially as well as societally and territorially;
- Projects likely to structure industrial production chains;
- Collaborative projects (open innovation approach or public-private partnerships).

The selection process

There are two major selection criteria:

- An analysis of project-related risks in five main areas: scientific and technological, financial, market, legal and managerial;
- A listing of the potential outcomes, based on the position of the project in terms of technology, as well as in terms of the impacts on the production chains and of societal benefits.

Main source: Oséo (http://www.oseo.fr/) and presentation by Laure Reinhart (deputy managing director of Oséo) at the CAS seminar on 18 January 2011 (http://www.strategie.gouv.fr/content/seminaire-depenses-d'avenir-en-france-et-l'etranger).

A.2. The competitive selection of "leading-edge clusters" in Germany

Launched in 2007 by the federal research ministry (BMBF), as part of the High-tech Strategie discussed above (box 2), the *Spitzencluster* competition aims to place in the narrow circle of global leaders the best-performing German innovation "ecosystems"' – meaning those that are most able to transform their regional innovation potential into a long-term ability to create value-added and jobs. To this end, three successive competitions are scheduled at intervals of a year and a half, each with a €200 million budget to be distributed among five winners, in each case for no more than five years[31].

The selection criteria used by the BMBF are mainly focused on the presence of value chains and on the involvement of key players in the regional innovation system. They concern the following points:

- significant financial involvement of firms and private investors;
- projects planned on the basis of existing strengths and leading to lasting changes;
- an increase in innovative capacity and in specific assets that enhances competitiveness and international leadership;
- measures to develop and experiment innovative forms of cooperation (including in matter of professionalised management of the cluster);
- measures specific to the cluster in terms of training, qualification and promotion of young talents.

No thematic targeting is imposed from the outset; the premium goes to the most compelling competitors, in their respective fields.

Main source: BMBF (2010), Deutschlands Spitzencluster / Germany's Leading-Edge Clusters, Berlin.

A.3. Tekes innovation funding strategy in Finland

Tekes is the main public RDI funding agency in Finland. In 2010 it funded almost 1900 projects for a total of €633m, including 70% for companies.

The strategy implemented by Tekes is based on a broad vision of innovation. For example, in 2010 52% of its fun-

(31) The first 10 winners were selected by an independent international jury at the first two competitions, which were held in mid-2008 and early 2010. They were in the areas of biotechnologies (personalised medicine in oncology) in the Rhine-Neckar region (BioRN), logistics in the Ruhr (EffizienzCluster LogistikRuhr), organic electronics in the Rhine-Neckar region (Forum Organic electronics), aerospace in the Hamburg region (Luftfahrtcluster Metropolregion Hamburg), medical technology near Nuremberg (Medical Valley EMN), micro-system technology in Baden-Württemberg (MicroTEC Südwest), biotechnologies in Munich (Munich Biotech Cluster m4), software in the Darmstadt, Walldorf, Kaiserslautern, Karlsruhe and Saarbrucken regions (Software-Cluster), photovoltaics in Saxony, Saxony-Anhalt and Thüringen (Solarvalley Mitteldeutschland) and micro/nanoelectronics (for energy efficiency) in Saxony (Cool Silicon).

ding was devoted to service firms and 42% was linked to non-technical aspects of business development (branding, staff management and work organisation, design, consumer behaviour, etc.). Tekes supports innovative and high-risk projects and also advises companies on how to implement their innovation processes and promotes networking among research actors in Finland. In addition to these funds, since 2006 Tekes has set up cooperative platforms between innovative companies and academic research. The goal of these "strategic centres for science, technology and innovation" (SHOKs) is to use radical innovations to address the socioeconomic transformations likely to occur within the next five to ten years. In 2010, SHOKs were funded to an amount of €99m in six broad strategic fields: information and communication (€36.5m), metal products and mechanical engineering (€28.4m), healthcare and well-being (€13.0m), energy and the environment (€10.7m), forestry (€8.5m) and sustainable building (€5.4m€).

The new "Growth and Well Being for Renewal" strategy launched in March 2011 is based on six broad principles:

- Give priority to SMEs seeking to expand (about one third of business funding will go to projects led by young SMEs);
- Strengthen the targeting of funding on highly innovative, high-risk projects;
- Assign the same importance to services as to manufacturing, and to intangible investments as to technological developments;
- Promote international cooperation in RDI;
- Adopt more flexible funding processes that strengthen the role of users and accelerates the appropriation of research results;
- Give Tekes a stronger role in the networking of innovation actors.

This is a resolutely bottom-up strategy, in which strategic fields are chosen in cooperation with all innovation actors (firms, professional organisations, associations, universities, research institutes, etc.). Almost half of Tekes' total budget will be devoted to multidisciplinary research in three thematic areas (natural resources and sustainable economy, individual vitality and intelligent environments) and three dimensions in the innovation process (the insertion of companies in the international value chains, the creation of value based on services and intangible assets, and the role of ICT in renewing services and production).

Projects presented by companies are subject to a competitive process based on an assessment of the viability of the project, the technology used, the potential commercial value, and other expected benefits, as well as the quality of the project leader.

Main source: Tekes
(http://www.tekes.fi/en/community/Home/351/Home/473/)