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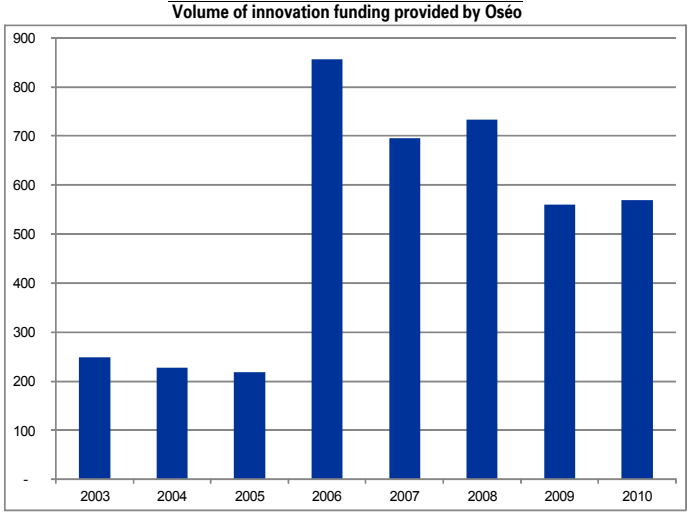
The role of Oséo in the financing of innovation

This study was prepared under the authority of the Directorate General of the Treasury (DG Trésor) and does not necessarily reflect the position of the Ministry for the Economy, Finance and Industry.

- Oséo plays a pivotal role in public policy regarding credit and credit guarantees. With €569 million in aid for innovation in 2011, Oséo is also a major provider of support for innovation. Thanks to its broad scope for action, it is able to support companies throughout their development. For example, Oséo can offer companies aid for innovation programmes in order to develop a new product or for scaling a product up for industrial production, as well as loan guarantees. This study focuses on aid for innovation.
- As a bank held by the State and public institutions, Oséo exists to remedy market imperfections in the provision of funding to companies. When the returns are highly uncertain or the investment lead time is long-as is particularly the case with innovative projects-entrepreneurs naturally have difficulty financing their projects, desirable as these may be for society in general, over and beyond considerations of private profitability for the company itself. Oséo provides repayable advances to these firms, combining funding with partial coverage of the risk involved.
- Oséo functions within France's wider system of innovation support mechanisms, including in particular the research tax credit (*Crédit d'impôt recherche*). All firms engaging in R&D qualify for the latter, whose justification lies in the positive externalities generated by the dissemination of knowledge that comes with R&D, benefitting society at large.
- Oséo grants funding for innovation after scrutinizing each project individually. This study finds that Oséo selects projects effectively: for a given amount of R&D spending, projects receiving 33% of their funding from Oséo generate three times more patents than projects not supported by Oséo.
- According to a study by Nicolas Serrano-Velarde (2009), it emerges that funding provided by Oséo has an impact on R&D spending by small and medium-sized businesses (SMEs). €1 of funding in the form of a repayable advance is reckoned to generate a €1 increase in R&D spending by SMEs. On the other hand, the risk of a windfall profit is greater among larger companies.
- As a result, Oséo appears to provide effective support for innovation. As far as possible, it ought to continue to target small and medium-size forms and promising projects that would otherwise not have seen light of day for lack of finance.

Volume of innovation funding provided by Oséo



Source: Budget Directorate, Oséo annual reports.
Note: For its 2006 and 2007 financial years, Oséo funding volumes include funding provided by the Industrial Innovation Agency (Agence de l'Innovation Industrielle - AII). Oséo's 2010 funding does not include funding provided under the Single Inter-Ministerial Fund (Fonds Unique Interministériel - FUI).

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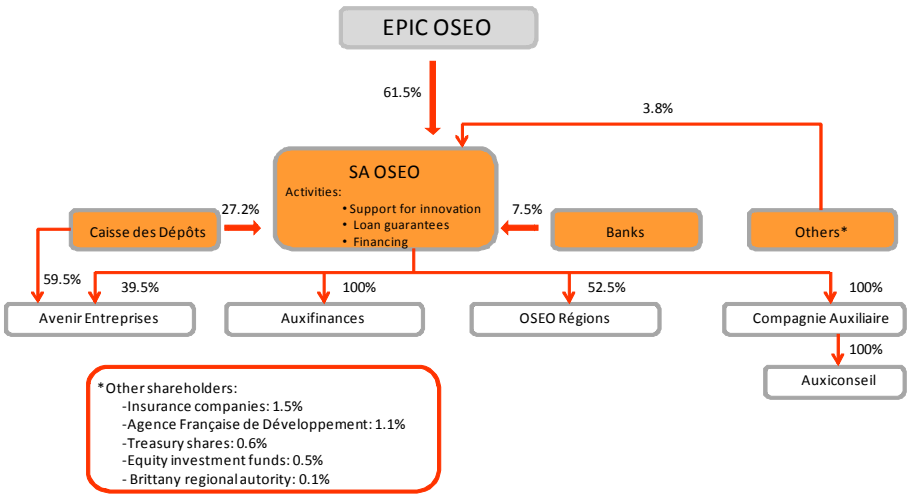
1. Oséo is a major source of funding for SMEs and for innovation

1.1 The creation of Oséo established a single body offering a continuum of assistance to innovative firms

Oséo SA grew out of a reorganisation of institutions providing support to SMEs that was launched in 2005, and that merged a series of innovation, funding and export assistance mechanisms into a single body[1] (see Box 1). This concentration of activities gave rise to a major provider of business funding. The resulting continuity in the range of assistance available usefully addresses the needs inherent in the different phases of a project and in the life of companies. Early-stage assistance to innovation fosters the emergence of new ideas, which can then qualify for easier access to funding via co-financing and bank guarantees in order to scale up these ideas for industrial production and bring them to market.

Oséo SA is a bank whose capital is 90% held by public institutions, i.e. the French Government via the Epic* Oséo, the Caisse des Dépôts (CDC), and the Agence Française du Développement (AFD), and more than 60% held by the Government (see Chart 1). Other banks also hold a 7.5% stake in Oséo SA, and it is therefore expected to behave like a French bank tasked with responding to gaps in the market where these failings hamper the activity and development of SMEs.

Chart 1: Activities and ownership of Oséo SA



Source: Oséo, 2011.

Box 1: **Oséo's three businesses**

Since 2005, Oséo has deployed a very wide array of instruments to support SMEs. These fall into three lines of business, namely: lending, loan guarantees, and support for innovation.

Innovation: Oséo's remit where innovation is concerned entails providing support for risky collaborative innovative projects being promoted by information technology companies or SMEs, involving distinct technological breakthroughs, with major international market potential, and generating positive externalities. Since 2010, it has also been in charge of managing the Single Inter-Ministerial Fund that serves to finance invitations to tender for competitive clusters, alongside the National Research Agency (ANR) and local and regional authorities. Oséo is also responsible for the accreditation of innovative companies eligible for investment by innovation-focused mutual funds (*fonds communs de placement dans l'innovation*-FCPI)[a].

Loan guarantees: Oséo helps SMEs to borrow from banks by guaranteeing between 40% and 70% of the amount borrowed. These guarantees are focused on lending to SMEs with limited collateral, i.e. whose assets are mainly intangibles (e.g. patents), business startups and LBOs, and for international expansion purposes.

Financing: Oséo acts as a co-financer, in conjunction with banks, to augment the volume of financing available and address the sizeable funding needs of business startups and development. Oséo also provides cash facilities against companies' trade and other receivables, etc.

Bolstering this continuous spectrum of financing formulas, new instruments have been introduced such as mezzanine finance (through *contrats de développement participatifs* or "participating development contracts"), and through "participating seed loans", which consist in a deferred-repayment long-term (8-year) loan to enable a company to finance its activities pending the arrival of an investor in the shape of a seed fund, venture capital fund or an industrial investor.

Other countries have brought together support for the funding, innovation, development and international expansion of SMEs within a single agency. In Sweden, for example, ALMI Företagspartner is a public company responsible for advising SMEs on their development and for stimulating business startups and innovative activities. Types of funding provided range from business loans to microcredit instruments, innovation loans, and export finance. Also worth citing is Germany's public bank, KfW, which specialises in support for SMEs and information technology companies (corresponding to the German concept of Mittelstand). KfW provides loans, subordinated loans (mezzanine finance) and equity investment support via specific programmes.

a. A company does not need to be accredited by Oséo if its R&D accounted for more than 15% of its expenses in the previous accounting period.

(1) Until 2005, the National Agency for the Promotion of Research (Agence Nationale pour la Valorisation de la Recherche-ANVAR) was responsible for providing support to innovative SMEs, for industrial innovation by SMEs (PROBLEM WITH FRENCH?), and for the promotion of research results. The institutional framework for the provision of this support has evolved considerably since that date. The ANVAR was replaced by Oséo ANVAR, a company (CHECK), which became Oséo Innovation at the end of 2007 following a merger with the Agency for Industrial Innovation (Agence pour l'Innovation Industrielle-AII). Oséo's three components-Oséo Innovation (ex-ANVAR), Oséo Garantie (ex-SOFARIS) and Oséo Financement (ex-BDPME) were merged into a single entity, Oséo SA, in 2011.
* *Etablissement public industriel et commercial*-Public establishment of an industrial and commercial nature.

1.2 Oséo accounts for 22% of public funding for private R&D. It is thus a major provider of support for innovative companies

Oséo granted €569 million in aids to innovation in 2010 (not including loans, loan guarantees and FUI funding), versus €560 million in 2009 and €733 million in 2008. The drop was due to the bolstering of the research tax credit mechanism in 2008, which gave rise to claims of €4.7 billion in 2009, compared with €1.7 billion in 2007. Despite this, Oséo remains a major provider of direct support for research by businesses. By way of comparison, the Single Inter-Ministerial Fund, which Oséo manages on the State's behalf, had a budget of €500 million for 2009-2011 (an average of €165 million per year) to finance projects accredited by the competitive clusters. Similarly, in 2009 the National Research Agency (ANR) granted €79 million in funding (more than 55% of which went to SMEs) to companies collaborating on projects with a public laboratory (of which €47 million concerned projects within the framework of competitive clusters).

Public support for private research can take other forms than direct funding for nationally selected projects. Private sector research is also supported by research contracts, in the defence sector especially, and via the European Framework Programme for Research and Technological Development, as well as via the competitive clusters, for example, at the regional level. Consequently, in order to form an overall picture of the public financing directly available to companies, it is worth referring to the French Ministry for Research's annual survey of companies concerning their R&D resources[2].

Companies responding to this survey reported having received €260 million in public funding for R&D from Oséo in 2007. Consequently, excluding tax spending and defence-related spending, Oséo is still the main provider of funding for private R&D (see Table 1). Even so, Oséo accounts for only around 30%, roughly, of public funding, which illustrates the diversity of public funding available for R&D. For example, the Directorate General for Civil Aviation provided 20% of funding for civilian projects, mainly via repayable advances. The Ministry for Research also plays a role, for example, via loans for the creation of innovative startups. Finally, the Ministry of Industry also provides substantial support for private research, in particular through its Department of Information Technologies and the Information Society.

Table 1: Breakdown of public funding for R&D in 2007 and 2008 as reported by companies, by source of funding, excluding defence and European Union

Public funding received by companies	2007		2008	
	in €M	in%	in €M	in%
Major technology programmes	*426*	*40%*	*305*	*29%*
of which:				
- Civil aviation programme directorates	214	20%	81	8%
- Ministry for Industry: STSI (1)	86	8%	100	10%
- CNES	119	11%	100	9%
Civil funding (ministries, funding agencies and other bodies)	*519*	*49%*	*631*	*60%*
of which:				
- Ministry for Research	54	5%	88	8%
- Ministry for Industry (excluding STSI) and Oséo-ANVAR	293	28%	331	31%
- Ministry of the Environment and ADEME	18	2%	14	1%
Other sources of funding (local and regional authorities, and non-profit bodies)	*110*	*10%*	*117*	*11%*
Total public civil funding	**1 055**	**100%**	**1 054**	**100%**

Source: MESR DGESIP-DGRI SIES; (1) The STSI is the Department of Information Technologies and the Information Society at the Ministry for Industry.

1.3 Oséo supports innovation through refundable advances and, to a lesser extent, through subsidies

Oséo deploys an array of instruments adapted to the precise point in the life cycle of a company's project. These include:

- Subsidies, which target the phase farthest upstream (and the riskiest) in the innovation process. Examples include the *appui à la création et à la faisabilité des projets* (project startup and feasibility assistance grants) and *concours d'aide à la création d'entreprises de technologies innovantes* (innovative business startup assistance grants) programmes.
- Repayable advances: these are primarily intended to promote the development of near market-ready projects. They combine an interest-free loan with coverage of the risk. The principal is repayable only if the project is technically or commercially successful. Repayment depends on the project's success, but a flat-rate repayment is due even in the event of failure.

The repayable advance takes the form of an interest-free loan, which is granted to the company after its application has been scrutinised and after negotiation of the loan terms (amount, triggers for the different tranches of the loan, grace period before repayment falls due). This is a cash advance allowing the firm to finance part of its innovation project as it progresses. Insofar as companies repay 55% of the sums advanced by Oséo, on average, this instrument serves to leverage private sources of funding, contrary to subsidies.

What distinguishes a repayable advance from a loan is the linkage between repayment of the capital and the project's technical or market success. All or part of the capital is repayable, depending on the degree to which the objectives

(2) In this survey, companies engaged in R&D gave information regarding the source of funds to the best of their knowledge. Consequently, it does not take account of tax breaks, indirect subsidies (e.g. infrastructure, public research, etc.), and assistance transiting via other actors is less well reported.

are fulfilled, since this represents a technological gain for the company. The exact share repayable depends on the size of the firm, the riskiness of the project, and how collaborative the project is. These criteria also affect what share of the project the repayable advance can cover. Altogether, the repayable advance can cover between 10% and 50% of the project's costs, which represents a high proportion of protection against the risk incurred.

The risk of opportunistic behaviour is limited by the portion of the cost borne by the company, and by Oséo's capacity to select projects (through *ex-ante* evaluation) aimed at ensuring the entrepreneur respects its obligations. Where appropriate, companies can be sanctioned for behaving opportunistically by being required to repay the outstanding portion of the advance in full. The point of a repayable advance, in that sense, is that it allows the firm to bounce back readily in the event of a project's failure without unduly jeopardising its financial health and hence its borrowing and investment capacity.

Box 2: **Interest-free loans for innovation: an experimental instrument**

In July 2010, Oséo introduced an "interest-free innovation loan" (French acronym PTZI). Unlike Oséo's conventional repayable advances, these loans are repayable regardless of the project's outcome. In case of failure, therefore, the company would bear the loss in full, with Oséo assuming only the risk of default by the company. While this mechanism answers the company's funding needs, it does not cover its risk.

During the experimental phase, applications undergo a single examination and at the end of the process the company is offered the choice of opting either for the "PTZI" or for a repayable advance. By comparison with the repayable advance, which is paid in a series of intermediate tranches subject to verification of the project's progress, and whose amounts are deductible from the R&D expenditure base qualifying for the research tax credit, the PTZI offers companies a cash facility available immediately and easier to use. The PTZI currently represents a third of all innovation aids (repayable advances and interest-free loans combined).

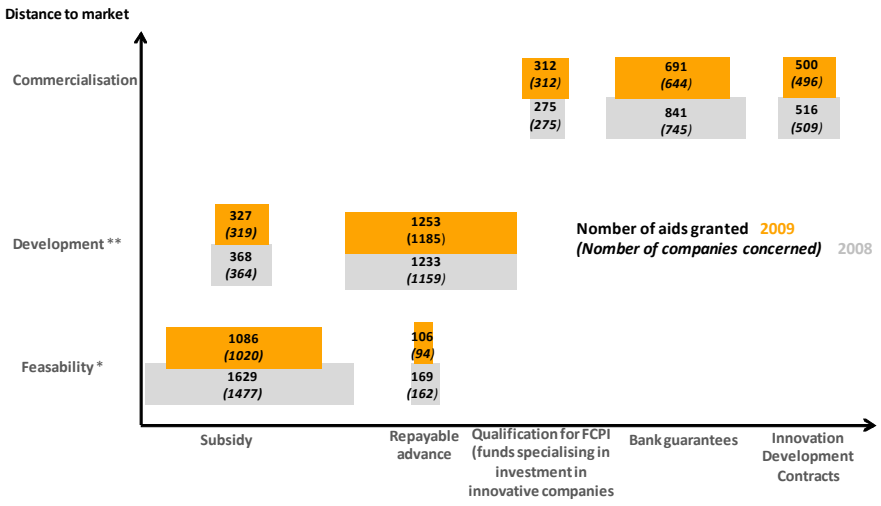
Subsidies and repayable advances are provided under two distinct programmes, namely: the "AI" innovation grants, which correspond to the former ANVAR's activity, and the "ISI" programme (aid for strategic industrial innovation), which supports collaborative projects open to companies with fewer than 5,000 employees.

The AI programme comprises around ten different types of assistance, offering a continuum of support for companies (see Chart 2). Grant volumes fell from €460 million in 2008 to €411 million in 2009, 28% of this volume taking the form of subsidies in 2009.

The ISI programme, which was deployed in the wake of the merger of Oséo with the *Agence pour l'Innovation Industrielle* (Industrial Innovation Agency) concerns strategic collaborative projects with industrial ramifications, embodying a high degree of innovation, involving at least two companies and a laboratory, on breakthrough projects with commercial aims. Oséo distributed €140 million through this programme in 2010, 41% of it in the form of subsidies, versus €150 million in 2009, 43% in the form of subsidies.

A small portion of innovation aids (8% of the amounts distributed in 2009) goes to companies with upwards of 250 employees. Oséo also covers the different categories of SME, the "ticket" rising with the size of the firm. The average ticket for companies with fewer than 10 employees was €73,000 in 2009; it was €119,000 for companies with between 10 and 15 employees; and €165,000 for SMEs employing more than 50. In terms of the age of the companies aided, 26% of funding went to companies less than 3 years old, 21% to companies aged between 3 and 8, and 53% to older companies.

Chart 2: Typology of Oséo financial assistance in 2008 and 2009, by degree of market-readiness



* Aid for projects in their feasibility phase, aid for partnerships, aid for recruitment, and aid for transfers
** Aid for projects in their development phase, for projects in their pre-launch phase, "Passerelle" (bridge) projects, contributions to "SRC" (research finance companies).

Source: Oséo 2010 annual report.

NB: This chart does not show aid for the development of research results, which is aimed at public research laboratories, or aid for young people.

2. Oséo supports private sector innovation through assistance in overcoming market failures and in hedging against risk

As a public operator, Oséo can address clearly identified market imperfections. For example, it can remedy difficulties experienced raising finance in the marketplace, or guarantee innovative projects for which financial institutions lack adequate visibility.

2.1 Oséo provides a response to imperfections in the credit and insurance market that could otherwise lead some firms to drop plans to innovate or invest less in innovation

For companies, the question is often less whether it wants to innovate than whether it can muster sufficient funds to embark on an innovative project. Ideally, funding ought to be forthcoming if the project holds out the prospect of sufficient returns relative to the risk of failure. However, shortcomings in the insurance and credit markets may curb the project's development, or even prove prohibitive, thereby justifying public action.

For these markets to function, financial institutions need to be in possession of the necessary information in order to price their services to companies (lending or insurance) fairly accurately. They also need to be able to ensure that the borrower respects its obligations. The problem here is that, given that the company knows more about the riskiness its project than the financial institution-a case of asymmetric information-the company enjoys an advantage enabling it to behave opportunistically.

For example, it may conceal some information before signing a contract, leading to under-estimation of the risk and thereby lowering the risk premium used to calculate its interest rate. The inability to adjust the price of their supply of credit to the quality of the demand means that financial players will respond by limiting their supply to certain types of agent. Consequently, loans will be made available on tough conditions in order to limit the financial institution's risk exposure. This makes it harder for companies to raise finance or obtain insurance cover if they are unable to satisfy these conditions, in terms of sureties, notably, or if their projects are too risky.

Similarly, once the contract is signed, the financial institution is ill-placed to assess whether the borrower is respecting its obligations. Unlike a car insurance policy, where the loss adjustor can frequently ascertain whether or not damage to the car was caused deliberately or accidentally, it is hard to assess how far an entrepreneur can be held responsible if his project fails. Given the impossibility of writing a policy to cover possible opportunistic behaviour, an insurance company will refuse to insure the project.

These imperfections powerfully affect innovative companies. On top of the commercial risk inherent in any project there is a technological risk, whose assessment demands specific technical expertise that financial institutions may lack. Moreover, in the event that the project fails, since most of the value added is intangible and since most of the costs consist of wages, the financial institution can recoup only a small portion of the loss from the company's liquidation. Similarly, technical considerations together with uncertainty over the project's outcome make it extremely difficult to verify whether the entrepreneur is respecting his obligations.

Consequently, the market failures caused by ex ante and ex post information asymmetries have a major impact on innovative companies, restricting their capacity to both innovate and grow, giving grounds for public intervention in this sphere. Repayable advances provided by Oséo play an invaluable role in this respect. Especially since the fact that Oséo simultaneously provides a cash advance and insurance against the risk reduces the complexity of the system of aids to innovation for companies. The resulting simplicity also obviates the need for Oséo to assess funding and risk-coverage applications separately.

2.2 Oséo's action complements the other components of French innovation policy

Oséo is only one among several actors involved in French policy in support of innovation, but it is distinguished by its positioning, since it is meant to complement or substitute for the banks when these do not play their part. Its place within the system lies between equity financing[3] and subsidies or tax credits.

Subsidies and equivalent measures (tax credits) represent a key policy instrument in support of private innovation. They are justified by the "knowledge externalities" generated by R&D.

For the company, innovation helps to generate a profit through lower production costs and/or bringing a new product to market. The resulting profit will shape its investment choice. However, the company underestimates the real return on R&D for society as a whole by ignoring the impact of its work on other actors via dissemination of the resulting knowledge, for example[4]. This dissemination is a positive externality, enabling other companies to use this knowledge without contributing to its cost.

The aim of public innovation policy is to enable companies to earn larger profits from innovation, through subsidies or a tax credit aimed at bringing their R&D spending closer to the desired collective level. The French research tax credit serves to subsidise knowledge externalities, in the form of a tax credit for 30% of reported R&D spending[5] below €100 million and 5% above that figure. This is supplemented by

(3) This type of funding too is a response to a gap in the credit market, but the amounts involved are smaller, and it is suitable only for companies with substantial growth prospects. Public support for equity investment takes the form of tax incentives and direct intervention via the Caisse des Dépôts et des Consignations. On this subject, see "Business angels et capital-risque en France: les enjeux fiscaux" (Business angels and venture capital in France: tax issues", note by the *Centre d'analyse stratégique* no. 237, September (2011).

(4) Complementarities between technologies is another source of externalities: a company that improves the efficiency of photovoltaic cells will make this technology more attractive to consumers, thereby expanding the market for producers of complementary technologies (concerning the structure of panels, for example, or the batteries equipping them), enabling the latter to improve the return on their innovations also.

(5) Which rises to 40% for the first year in the mechanism and to 35% for the second year.

other mechanisms. For example, assistance provided within the framework of the competitive clusters subsidise externalities relating to location, i.e. arising from the advantages a company gains from being located close to other companies. Meanwhile, the ADEME (French Environment and Energy Management Agency) subsidises environmental externalities[6].

R&D externalities too receive very favourable treatment via a range of mechanisms. Oséo's legitimacy stems from its distinctive positioning in this set up, with a series of leveraged instruments such as repayable advances and interest-free loans that increase the funding available to companies at relatively low cost to the budget.

Box 3: **Innovation and market failures**

Funding for innovation by companies suffers from two major gaps in the market. the resulting lack of investment in innovative projects gives grounds for State intervention:

1. Externalities connected with the dissemination of knowledge

It is generally easier to spread knowledge than to create it. For example, it does not cost much to imitate a technology as compared with the costs incurred by the person who first invented it. Patents afford the legal protection without which there would be no incentive to invest in innovation. Yet patents do not preclude, indeed they facilitate, the divulging of knowledge, which can then be used by other actors. Despite the royalties due on the use of a patented invention, a patent allows the innovator to appropriate only some of the value of the knowledge he created, the remainder being an externality of the innovation process (for example, if the invention is transposed outside its initial field of application). If he cannot profit in full from his ideas, the innovator may decide not to develop certain projects that might nevertheless be useful to society, or he may prefer to devote fewer resources to it than might be socially optimal.

2. Asymmetries of information

In a contractual relationship between an entrepreneur and his finance providers, the two parties may not be in possession of the same information regarding the matter dealt with by the contract. This leaves the way open for opportunistic behaviour and can undermine market relationships in general. Akerlofa[a] cites an emblematic example of information asymmetry with the market in secondhand cars. The vendor knows the condition of the car on sale, but not the buyer, who needs to beware of hidden defects. The latter will therefore offer a lower price than what he would have paid for a car with no risk of defect. Yet that price will not satisfy the vendor of a good quality vehicle, giving him an incentive to drop out of the market. Fewer and fewer decent vehicles will be put on the market, as a result, further reinforcing buyers' mistrust. The market could even collapse in the absence of a certificate attesting to the vehicle's quality, thereby reducing this information asymmetry (which implies dealing with a reputable dealer) or the possibility of recourse by the consumer after the purchase.

While information asymmetry is not confined to innovation, certain features of innovative companies make it particularly sensitive in their case:

- Innovation in particular is subject to information asymmetry given the uncertainty surrounding its commercial value, especially as seen through the eyes of people outside the company. However, an entrepreneur will be reluctant to disclose too much information to outsiders for fear of imitations, thereby reinforcing information asymmetry.
- For an investor or bank, information asymmetry connected with innovation is all the more problematic in that it can prove hard to bail out of an investment if the project fails, especially if the innovation is specific to the company or product, or if its implementation depends on the skills of its employees.

a. Akerlof, George A, (1970), "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism," *The Quarterly Journal of Economics*, MIT Press, vol. 84(3), pages 488-500, August.

3. All in all, Oséo's activities appear to be well-suited for productive projects and the financing of SME's

Theoretical justifications aside, one can assess Oséo's work from two angles. First of all, Oséo needs to select projects carefully, so as to focus on the best of them. Yet it would be wrong for public funding simply to replace the private funding that a company with a good project and solid guarantees could have obtained without State intervention.

On both of these aspects, available quantitative figures are positive, since Oséo's activities appear to be targeted at the more productive of available projects and do serve to boost R&D spending, by SMEs especially.

3.1 On average, when Oséo supports 33% of a project's cost, this generates three times more patents than an unaided project

An econometric study has been carried out to find evidence of the effectiveness of Oséo's project-selection process and hence of the quality of projects aided by it. This compared R&D productivity between aided and unaided companies by the number of patents filed, while eliminating the impact of other factors such as sector, size, etc.

Estimates have been made for all companies combined, and for sub-sets of SMEs and large companies. Results are presented in Table 2.

(6) For example, green innovations reduce CO2 emissions and climate warming, in addition to savings resulting from the reduction in the company's own carbon consumption.

Box 4: **Methodology used to study the productivity of projects funded by Oséo**

This study is based on the theoretical framework of a "knowledge production function", introduced by Griliches (1979) plus, as additional explanatory factors, the share of domestic expenditure on R&D provided by: Oséo; the European Union (European Framework Programme for Research and Technological Development and structural funds); as well as by regional authorities, the Defence Ministry and other national sources (e.g. the f*onds de compétitivité des entreprises*-business competitiveness fund, ANR-national research agency, ADEME, aid provided by the *Conventions Industrielles de Formation par la Recherche*-Industrial research-training contracts-for the employment of doctoral students, and repayable advances to the aerospace industry, etc.).

The output associated with R&D is measured in the customary manner by the number of patents filed[a]. The variable used here is the sum of patents filed with the INPI in France, with the European Patent Office, the US Patent Office, and with those of other countries (including internationally via the Patent Cooperation Treaty). There are certain limitations to this indicator[b]. In order to overcome these, a number of variables affecting the propensity to file patents have been included, such as the company's sector and size, and how far upstream or downstream the R&D is, based on the respective shares of basic, applied and experimental research. It should be noted, moreover, that while measurement errors concerning the dependent variable have the disadvantage of diminishing the estimates' accuracy, they do not skew them, in general, unlike measurement errors relating to the explanatory variables[c].

The estimate is based on a negative binomial model, adapted to counting variables such as the number of patents. This has been preferred to the Poisson model, which is more constrained. Since the Poisson distribution depends on a single parameter only, one of its characteristics is that variance and expectation are equal. It so happens that the findings are "overdispersed" by comparison with the Poisson model[d]. The negative binomial law, with a variance greater than expectation, offers a solution to this problem.

By writing y_i the number of patents filed by company i in 2007, X_i the vector of the explanatory variables for company i, which are estimated, the conditional expectation and variance of y_i are written:

$$E(y_i|X_i) = e^{x_i'\beta}$$

$$V(y_i|X_i) = e^{x_i'\beta}(1 + \alpha e^{x_i'\beta})$$

The vector X_i combines the aforementioned variables. To verify R&D spending, we have used the log of the company's domestic expenditure on R&D between 2005 and 2007[e].

a. Other, less common metrics include the share of revenue generated by products less than five years old, or the product turnover rate (Crépon et al. 2000). We have tested a regression with this metric, which is available in the INSEE innovation survey, but because of the sample's small size (around 500 observations), few variables were significant, although this does not invalidate our findings.
b. In the first place, patents are not necessarily the best way to protect innovations, and some innovative companies prefer to keep their innovation a trade secret. In addition, the value of a patent can vary greatly. Finally, a single invention can give rise to patent filings in more than one country, which is reflected in the indicator chosen here. Nevertheless, given the cost of filing, we may consider that the quality of a patent rises with the number of filings, so that it would not necessarily be preferable to limit ourselves to the number of inventions patented.
c. In general, these skew the parameters towards zero (see for example Griliches and Mairesse 1995).
d. An overdispersion test was carried out, which rejects the hypothesis of equalisation of the variance and expectation of the distribution with a 95% probability.
e. We therefore assume a maximum lead time of three years between performance of the R&D and the resulting patent filing. To extend this period to five years would considerably restrict the size of the sample and hence the precision of the estimators, but it would not alter the outcome qualitatively.

Table 2: The impact of public aid on the number of patents[a]

	All companies	Non-SMEs	SMEs
Log of R&D spending	0.991***	1.037***	0.785***
Share of Oséo funding	3.696***	2.553**	4.194**
Share of EU funding	−1.292	−2.602*	0.043
Share of funding by regional authorities	0.174	4.945	−2.925
Share of defence funding	−2.772***	−2.664***	−7.284***
Share of other funding sources	0.103	0.568	−0.817
Number of observations	1 887	1 546	341

a. Control variables have been eliminated for the sake of comprehensibility. While sector is an important factor in the number of patents filed, this does not apply in the case of either a company's total number of employees nor of the R&D stage (basic, applied, or experimental).

Key: * significant to a 10% threshold, **significant to a 5% threshold *** significant to a 1% threshold.

Source: DG Trésor.

The parameter associated with R&D spending appears to be very close to (and non-significantly different from) 1, which signals constant returns: a rise in R&D spending would increase the number of a company's patents in the same proportion.

R&D spending aided by Oséo appears to be more productive than the average: a project that is 33%-funded (the average percentage of aid provided in 2009) by Oséo would produce around three times more[7] patents than for an unaided project. This suggests that Oséo picks technically good quality projects. The multiplier is even reckoned to rise to 4 for SMEs alone, compared with 2 for large companies. However, this difference between SMEs and large companies need to be treated with caution, as it is not statistically significant.

(7) = exp (3.7 x 0.33).

There is no similar effect for the other types of public aid: the productivity of R&D spending funded by ministries other than the Ministry of Defence[8], agencies other than Oséo, and regional authorities, is similar to that of R&D not in receipt of public aid.

Those funded by the European Union are even reckoned to be less productive than the average when the beneficiary is a large company. For each euro spent, R&D carried out under contract with the Ministry of Defence results in fewer patents than unaided R&D. This need not be understood in terms of productivity, however: it simply reflects the fact that military R&D is more frequently protected through secrecy rather than patent filings.

3.2 Projects supported by Oséo produce an additive effect for SMEs, but this effect tapers off for companies that already invest heavily in R&D

This analysis of the quality of directly aided R&D projects is not in itself sufficient to form a judgment regarding the effectiveness of aid provided by Oséo. This effectiveness also needs to be assessed in terms of its incentive effect, i.e. its capacity to stimulate R&D spending that would not have occurred in its absence. Aid that merely produces windfall effects, for instance, would be of little value to society, even if the quality of projects aided were very good.

According to a European University Institute working paper (Serrano-Velarde N. 2009), the aid provided by Oséo aid could generate greater leverage if it was concentrated more on SMEs (without prejudice to-or actually improving-the average quality of projects aided, as argued in the aforementioned analysis). According to the authors of this study, repayable advances provided by the ANVAR (ex-Osée Innovation) between 1995 and 2004 are thought to have produced what is close to an additive effect, with €1 of repayable advance stimulating €1 of additional R&D in companies that spend little on R&D (less than €300,000, typically the amount spent by an SME). The impact then tapers off as total R&D spending by the company rises, being cancelled out when this spending exceeds €9 million.

The mechanism therefore appears to be effective as a means to support small companies engaged in innovation, but not necessarily for larger ones with more substantial R&D expenditures. A reasonable explanation for this finding is that these companies' longer history reduces information asymmetries, which means they are less affected by credit rationing. In that case, repayable advances could be seen merely as one useful funding mechanism among others, and not as "the" funding solution giving the green light for a project.

Innovation aids supplement the research tax credit when, in keeping with their intended purpose, they aim to address the funding difficulties some innovative companies encounter. This assumes a capacity to select not only good projects-as is the case according to the results produced-but also projects that would not have seen light of day because of funding difficulties. The targeting process this entails is therefore both demanding and tricky, being required to reconcile project quality with an inability to attract funding.

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(8) The results are robust if we exclude observations in receipt of defence funding.

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