Main findings:

• Level-based R&D tax credits are subject to a serious deadweight loss.
• Increment-based R&D tax credits are not subject to that deadweight loss, but have their own deficiencies.
• The bulk of the empirical evidence concludes that there is no crowding-out but also little additionality.
• R&D tax incentives have the advantage of being neutral, less costly to administer, and more acceptable for the general block exemption regulation in state aid than R&D subsidies.
• R&D tax incentives benefit more large firms than SMEs.

Recommendations:

• Tax incentives need to be stable, reliable and refundable.
• Deductibility of the R&D tax credits from the employer’s social security contributions, as done in the Netherlands, is a good practice to follow.
• Provide special provisions for first-time R&D performers.
In order to encourage private firms to invest in R&D, governments provide them with tax incentives. Those tax incentives can take different forms: R&D tax allowances, R&D tax credits, accelerated depreciation, refundability, carry back or carry forward provisions, special tax credits for R&D done in cooperation with universities or for certain R&D functions like health or environmental R&D. But in one way or another they intend to lower the price of doing R&D.¹

Is there an economic justification for R&D tax credits?

The rationale for introducing these tax incentives rests on the existence of market failures: spillovers, asymmetric information, inappropriability of R&D benefits, uncertainty and incomplete capital markets, indivisibility of large projects and coordination problems.

R&D spillovers can be of two kinds: pecuniary spillovers and knowledge spillovers. The former exist when firms benefit from R&D conducted by other firms because of backward or forward linkages or because of complementarity of goods or services provided by the two firms. Knowledge spillovers refer to benefits in the form of knowledge due to applicability of knowledge acquired in one field of science to other fields (cross-fertilization) or simply from the experience gained by other researchers as to the promising or unpromising avenue of certain research directions. Private firms do not necessarily take these spillovers into account when deciding on the amount they spend on R&D. Society as a whole does therefore not reach by itself the level of R&D that would be optimal from a societal point of view. Spillovers can be positive or negative. When speaking of tax incentives one has of course positive spillovers in mind, and indeed most of the numerous empirical studies on R&D spillovers have concluded to the existence of positive spillovers.

Asymmetric information is a problem when an R&D firm needs external financing but has no collateral and the external fund provider needs some guarantee that the research project is worth funding. The outside funder does not possess the knowledge of the project that the researcher has, and the researcher is not ready to share that knowledge because the funder could get away with the brilliant idea or share it with somebody else. Therefore especially SMEs and start-ups that lack sufficient internal funding will find it difficult to finance their projects.

Because of its rival and only partially excludable nature, knowledge is sometimes hard to hide and will sooner or later leak out and become public. The R&D performer does therefore not reap the full benefit from his investments and may not spend as much as would be optimal for society.

Some other market failures worth mentioning actually call for public R&D instead of private R&D and are not really solvable for handing out R&D tax credits. First, R&D is in essence a risky and even uncertain investment and capital markets for risky events are incomplete. Because of the lack of insurable risk, some projects will not be

¹ See http://www.oecd.org/sti/rd-tax-stats.htm
undertaken by private firms. Second, certain R&D projects are indivisible and require too large an investment to be undertaken by private firms. And, third, there can be coordination problems in the sense that certain projects require specific skills that might not be available just when they are needed.

The choice between two major types of R&D tax credits: level-based and increment-based?

Level-based R&D tax credits are proportional to the amount of R&D undertaken. Increment-based R&D tax credits are proportional to the increment in R&D expenditure with respect to a base level (which is for instance the average R&D amount of the last three years).

Increment-based R&D tax credits are more efficient than level-based R&D tax credits in the sense that there is a higher bang for the buck. By its very nature, incremental the R&D tax credit scheme leads to a ratio of incremental R&D over tax expenditure that is higher than 1. In level-based R&D tax credit there is a high deadweight loss. Suppose a firm was doing for 100 000 Euro of R&D even without R&D tax credits. Then, suppose a 20% level-based R&D tax credit is introduced. The firm suddenly receives 20 000 Euro even without doing any extra R&D. The firm needs to invest at least an additional 20 000 in R&D for there not to be a partial crowding-out. The larger the initial R&D size, the higher the deadweight loss. And even if the firm invests exactly the amount it gets from government, hence there is no crowding-out but also no multiplier effect, the bang for the buck will be just equal to one.

There is a limit though to the efficiency of increment-based R&D tax credits. For one, the base goes up as firms invest more in R&D with as a consequence less of a chance to receive tax credits in the future. This incentive scheme may even encourage firms to adopt a strategic behavior of a zigzag expenditure outlay scheme to maximize the income from R&D tax credits, an expenditure scheme which is probably not in line with a smooth and sustained scheme typical of R&D projects that call for gradual adjustments to save on adjustment costs. Secondly, the increment-based R&D tax credit calls for an accelerated investment to continue receiving funds in support of R&D, while there is a limit as to how much firms are willing and able to invest in R&D. This tax scheme may even be such that it penalizes firms that decrease their R&D level and makes the management of R&D both for the firms and for the public authorities rather complicated. It is worth noting that France and England have respectively switched to and adopted level-based R&D tax credits.

Are there alternatives to R&D tax credits?

There are alternative ways to solve the market failures: subsidies, intellectual property rights, allowing for research joint ventures, public labs, venture capital markets.
Do tax incentives solve the financing problem? For occasional R&D performers and start-ups, no, because the money is received ex post, hence they may still have financial difficulties in initiating their R&D projects. For continuous R&D performers, who continuously can rely on R&D tax credits, financial support from tax incentives will ease but not entirely remove the financial constraint. R&D subsidies, collaborations with universities or public labs, and venture capital markets are complementary means to solve the financing problem. The power of R&D tax incentives in solving the financing problem is reduced if tax incentives are unstable, unpredictable, non-refundable or if there is a time lag between the R&D expenditure and the collection of R&D tax credits. There is room for efficiency in managing tax credits. Whereas in some countries firms without corporate income taxes cannot claim any R&D tax credit, in other countries, like the Netherlands, firms can deduct the tax credits directly from the employer’s social security contributions.

Intellectual property right protection is certainly a more appropriate policy to solve the market failure related to the appropriability problem. And, as mentioned earlier, R&D entirely financed and generally executed in public labs or public procurement is the most straightforward way to solve the most risky, large and indivisible research projects. The main argument in favour of R&D tax credits is thus the presence of positive externalities and the ensuing lack of privately executed R&D from a social point of view.

If the additional R&D per Euro of tax expenditure, what is equivalently called the cost effectiveness ratio, the incrementality ratio or the tax sensitivity ratio, is close to 1, then the amount spent on tax incentives could as well be spent on public R&D or handed out as R&D grants. The bulk of the empirical evidence points to ratios that are not far away from 1 (see Hall and van Reenen, 1990, Parsons and Phillips, 2007, Lentile and Mairesse, 2009).

What are the pros and cons of R&D tax credits?

1) One of the main advantages of the R&D tax credit is that they are neutral, in the sense that they let the firms decide on which projects to spend the money. Firms know the needs of the market better than pure researchers, and because of their own involvement and investment in the game they will be more cautious in choosing feasible projects. The flip side of the argument is that tax-based support fails to focus on projects with a high social rate of return, precisely the market failure that the policy tries to correct. Two remarks, however, are in order. On the one hand, tax incentives can to some extent be geared to certain scientific fields and societal needs such as biotechnology, health or defence. On the other hand, firms might not be fully aware of all externalities, especially knowledge externalities, and therefore underperform compared to public decision making.

2) The second advantage of tax incentives is that they are less costly to administer and
involve less red tape. This argument holds especially for small firms. Even for R&D tax incentives the compliance costs are much higher for small than for large firms, explaining in part why the participation to the tax incentives programs are lower for small firms than for large firms. Small firms may be less informed of the existence of such kind of support and more reluctant than large firms to deal with the tax authorities. This problem has been found to be especially important in Spain (Corchuelo and Martínez Ros, 2008). Both the administration and the compliance costs are likely to be bigger for grant applications. Submitting a grant application and having it evaluated by experts is more costly and time-consuming than just verifying that R&D declared in indeed R&D.

3) The third advantage is that from a competition policy perspective R&D tax incentives are more easily acceptable for passing the general block exemption regulation for state aid in the European Community, especially if they are not focused on certain areas of specialization and if they are equal across countries. Direct grants and subsidies, by being more focused by definition, will be more likely to favour some firms and harm competition within the Community. But this also means removing tax competition, as is presently the case in Europe. Tax competition is counterproductive (see the study by Wilson, 2005). The aim here is not to correct market failures but to compete like in a prisoner’s dilemma for attracting R&D firms. Now competition can also be seen, not in the strict sense of having a level playing field, but as a game situation where firms and countries make their own choices regarding how to spend a fixed budget on science and technology and how much to devote to science and technology.

4) On the negative side, tax incentives favour large R&D spenders. Even if the R&D tax credits are higher for SMEs, it remains that the main beneficiaries of R&D tax credits are the large firms that generate most of the deadweight loss. Unless tax credit rates are much more generous for SMEs or that there are caps on the tax credits that large firms can claim, there is a blatant inequality in the tax credit scheme in favour of large firms. It can be argued that while small firms are the most dynamic and creative, it is the large firms that have the means to conduct large projects and to achieve breakthroughs after years of laborious research and development.

Has the literature done a good job in assessing the effectiveness of R&D tax credits?

It is actually not enough to look at the additionality of tax money spent on R&D support in terms of R&D expenditure. A full cost-benefit analysis would also call for including in the calculation of the return to tax incentives externalities, administration and compliance costs, the marginal excess burden of taxation, the deadweight loss. Parsons and Phillips (2007) show that, on the basis of reasonable estimates of these various effects, the net outcome is positive, but once standard errors of these estimates are included, it could easily turn out to be negative. Lokshin and Mohnen (2013) show that part of the R&D tax incentives can go into higher wages for R&D labour instead of going fully into higher real R&D expenditures. All these effects may take time to
materialize and therefore it is certainly sounder to estimate long-run effects. The empirical literature has put too much emphasis on the additionality and failed to do a proper cost-benefit calculation. The magnitude of the externalities is the major sensitive building block that could justify or not the effectiveness of R&D tax incentives. Unfortunately those estimates are far from being robust and estimated with great precision.

Beyond this full cost-benefit calculation, second- and third-order effects should also be examined, i.e. does the additional research have a high rate of return in terms of innovation and ultimately productivity or welfare? After all R&D is just a means to an end. If tax support is occasional, it is likely to be devoted to marginal projects that would not have been economically viable otherwise. If tax incentives are stable and reliable, then they will be incorporated in the financing of the whole gamut of research projects.

**In conclusion**

Since tax incentives have their pros and cons it is probably wise to consider direct and indirect R&D support as complementary policies. As argued by Busom et al (2012), start-ups and financially constrained firms will not get much help from R&D tax credits. Large firms prefer R&D subsidies whereas SMEs prefer tax incentives. Maybe the most useful role tax credits play is to encourage firms to devote some budget to R&D so as to keep and develop some absorption capacity. Special provisions could be made for firms that start doing R&D so as to get them into the R&D game with the hope that they will keep on investing in R&D afterwards, but maybe grants are a more useful tool for doing that (see Arqué-Castells and Mohnen, 2012, for a discussion of the extensive margin).

**References**

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