B 7 Options for funding R&D through tax credits

B 7-1 Economic justification for the state funding of private R&D expenditure

State funding of private R&D activities is economically well justified.[368] R&D activity often generates more returns among consumers and companies than what the research companies receive.[369] The consumers of new or improved products receive benefits which are not completely absorbed by the price of these products. R&D activities also lead to positive externalities: other actors can build on the new knowledge created by R&D efforts and use it to (further) develop products and processes of their own. As a consequence, private returns from R&D activities are lower than the macroeconomic returns. The incentives to engage in private research efforts are therefore too low, resulting in under-investment in R&D. State funding measures aim to correct this market failure.

Not only knowledge externalities, but also information asymmetries cause the market for new ideas to fail.[370] The term 'asymmetric information' is used when one side of the market is better informed than the other. This applies in particular to the funding of R&D activities. It is far more difficult for external investors to estimate the chances of success than it is for the companies that are active in R&D. The information asymmetry leads to a smaller number of R&D projects being financed than macroeconomically reasonable. This form of financing constraints is especially problematic for relatively young and small companies, because they do not generally have the reserves needed to finance R&D.[371]

By taking funding measures, the state can make a contribution towards partially offsetting these forms of market failure accompanying private R&D activities. Both direct and indirect funding instruments can be used for this purpose. Direct funding instruments used in Germany first of all include project funding through specialist programs of the federal ministries; these are used to promote certain technologies or thematic fields. Furthermore, technology-unspecific subsidies for financing research and innovation projects are granted on application in some funding programs, e.g., the BMWi's Central Innovation Programme for SMEs (ZIM). The indirect funding instruments include, inter alia, R&D personnel-cost subsidies and tax concessions, special depreciation for R&D investment, and tax credits for R&D expenditure.

One advantage of direct funding is often seen in the possibility of directing funds to technologies or thematic fields considered to be particularly important. From an economic point of view, there is a fundamental advantage in being able to select specific projects that are expected to generate high social returns and would perhaps not be carried out without funding.[372] However, the funding institutions are subject to the same information asymmetries as external financiers, so that social returns are about as difficult to assess ex-ante as private returns.

One instrument used by the majority of the OECD and EU member states is the indirect funding of R&D through tax incentives (cf. chart at the beginning of the chapter). Many countries spend more on tax-based R&D funding than on direct state R&D funding (cf. Figure C 4-1). Up to now, Germany has not made use of the possibility of providing indirect funding via the tax system.

R&D funding through tax incentives has several advantages over direct funding measures. Direct R&D funding always requires applications and assessment procedures conducted by public authorities or their project promoters. It can therefore only be claimed for individual, specifically defined projects.[373] As a result, it may be fiscally well planned and applied in a targeted way, but involves a high level of uncertainty for companies as regards the approval of project applications. In addition, the companies always bear the costs

of the application, including the cost of searching for a suitable funding instrument and formulating an application. Costs and the amount of time involved deter many companies from applying.[374]

In the case of tax-based R&D funding, eligibility is already established when proof is submitted that (qualifying) R&D expenditure has been made. The instrument thus gives the company more planning security as regards the promotion of R&D projects that involve risk. At the same time, significantly less administrative work is involved, both for the state and for the company that is applying, compared to classical project funding. The state does not need to either design a funding measure or assess applications. And companies do not need to search for a funding instrument or file an application.

Compared to a specific form of project funding, R&D funding through tax incentives has the additional advantage that R&D projects are also funded when they do not fit into the existing state funding portfolio in thematic terms. The instrument even has an impact if the state is not fully aware of the private actors' R&D potential; it thus has a broader effect.[375]

In addition, R&D funding through tax incentives can make a country more attractive in the global competition to become a location for multinational companies and research-intensive industries.[376] However, this aspect is generally not significant for small and medium-sized enterprises (SMEs) and young companies.

The Commission of Experts has repeatedly proposed that, in the future, Germany, as one of the leading economic nations, should aim to spend 3.5 percent of its gross domestic product (GDP) on R&D.[377] This would enable Germany to improve its technological competitiveness in the long term, and to catch up with leading innovative nations. The introduction of a tax-based system of R&D funding can be a major step towards this objective.

B 7-2 The distribution and design of R&D funding through tax incentives

28 of the 35 OECD countries[378] currently offer tax incentives for the implementation of private R&D projects. However, the respective systems of tax-based R&D funding are designed very differently from country to country. Box B 7-1 explains basic variations in design.[379]

International examples of good practice

Some countries can already look back on many years of successful implementation of R&D funding through tax incentives. The European Commission highlights some tried-and-tested programs as examples of good practice.[380] These include the programs in France, the United Kingdom, Ireland, the Netherlands, and Norway.[381] The following sections look at the design of the programs in these countries in more depth (cf. Table B 7-2).

All the countries mentioned were running at least one program designed as a volume-based tax credit for qualifying R&D expenditure in 2016. In almost all these programs that apply such a tax credit, the credit is granted on the company's income tax – except the WBSO program in the Netherlands, where the credit reduces the monthly wage tax payable by the company for its employees. Among the countries mentioned, there is only one scheme that reduces the basis for tax assessment: the R&D Tax Relief program in the United Kingdom.[382]

In the case of programs that are designed as a tax credit is set off against against the company's income tax, the subsidy rates vary between 10 percent (ATL program in the UK) and 25 percent (R&D Tax Credit in Ireland). In the Netherlands, the tax credit on wage tax for R&D personnel is 50 percent (WBSO program).[383] In most of the programs, the credit is capped at a certain level (CII in France, WBSO and RDA in the Netherlands, SkatteFUNN in Norway). The programs JEI in France, ATL in the UK, and R&D Tax Credit in Ireland have no cap.

When companies apply for the tax credit when losses have occurred, some programs allow a temporary offset by carrying the credit forward to subsequent years. The credit is immediately paid out to companies in the event of loss, for example, under the Norwegian SkatteFUNN program and – at least proportionately – under the UK's ATL program. In the Dutch WBSO program, the credit always has the effect of an immediate payment, because it is granted via the wage tax, which is payable regardless of the profit situation.

The CII and JEI programs in France specifically target SMEs and young companies. The R&D Tax Relief program in the UK has also recently been restricted to SMEs and grants an additional deduction in the basis for tax assessment amounting to 130 percent of the R&D expenditure. In Norway, the SkatteFUNN

Box B 7-1

Design variants of tax-based R&D funding

As a rule, tax-based funding of R&D is granted in the context of taxes on income – i.e. corporation tax (in the case of stock corporations), or personal income tax (in the case of sole traders and partnerships). The most important exception is funding in the context of wage-tax payments by companies (employers).[384]

In the tax-based funding of R&D, a fundamental distinction can be made between deductions from the tax base and tax credits (deductions from the tax debt).[385]

In most national tax systems, ongoing R&D expenditure – like other operating expenses – can be deducted directly from the tax base (assessment basis). They represent a tax-relevant expense (reducing entrepreneurial income). If a system of tax-based R&D funding is employed that also allows deductions from the tax base, this allows additional deductions[386] for R&D expenditure over and above the normal level, or accelerated depreciation on investments in plant and equipment in the R&D field. For example, SMEs in the United Kingdom can deduct a further 130 percent of R&D expenditure from the tax base in addition to ongoing R&D expenditure. The effective benefit for companies in these cases depends on the applicable tax rate and thus also on the company's legal form and other factors.

Alternatively (or in some cases in addition) to deductions from the tax base, some countries grant tax credits. Under such schemes, companies are granted a credit on their tax debt, calculated according to the level of their R&D expenditure. The amount of the tax credit (subsidy rate) ranges from 5 percent (Japan) to 100 percent (Hungary) of the recognised R&D costs.

Deductions from the tax base and tax credits for R&D expenditure are equally distributed within the EU. When other countries outside the EU[387] are included, it is shown that funding measures in the form of a tax credit are the more frequently used system.

Further important differentiation criteria as regards design include distinctions according to volume-based and incremental funding, the type of tax-deductible expenditure, the treatment of unused tax credits (when a tax debt is lower than the amount of credit due), and restricting funding to certain groups such as SMEs.

In the case of volume-based funding, the total expenditure on R&D is included in the tax credit, whereas in incremental funding only R&D expenditure in excess of a reference value is given preferential tax treatment. The reference value is determined by means of a comparison with the company's R&D expenditure in a reference period (usually before the respective reference year).

Deductible expenditure types can include spending on R&D personnel, expenditure on assets used in the context of R&D activities, and other R&D expenditure (e.g. consumables). In most countries, the qualifying types of R&D expenditure are categorised according to the OECD's Frascati Manual.[388]

If a company's tax credit derived from its R&D activity exceeds its tax debt in the year of tax assessment, a (pro-rata) payment of the tax credit is granted in some countries (for certain companies). This approach is especially relevant for young companies that are not yet generating any profits. There are also variants in which unused tax credits can be carried forward or back.

Tab. B 7-2

Download data

Design variants of tax-based R&D funding in selected countries

	Target group	Qualifying R&D expenditure	Deduction from the tax base		Tax credit (deduction from the tax debt)		Contract research eligible?
			Accelerated depreciation on R&D fixed assets	Additional deduction	Subsidy rate	Scope	
Jeune Entreprise Innovante (JEI) (France)	SMEs with other criteria: – younger than 8 years – R&D expenditure constitutes at least 15 % of total expenditure	According to Frascati Manual	–	–	Special regulation[1]		at the contracting company
Crédit d'Impot Innovation (CII) (France)	SMEs	Expenditure on prototype development	–	–	20 %	volume-based	at the contracting company
Above the Line (ATL) (United Kingdom)	Large companies	According to Frascati Manual	–	–	11 %	volume-based	at the contracting company
R&D Tax Relief (United Kingdom)	SMEs (formerly also large companies)[2]	Beyond Frascati Manual	100 % immediately	130 %/ (30 %)[2]	–	–	at the contracting company (SMEs); depends on contract type in the case of large companies[3]
R&D Tax Credit (Ireland)	All companies	According to Frascati Manual[4]	–	–	25 %	volume-based/incremental[5]	at the contracting company
Research and Development Promotion Act (WBSO) (Netherlands)	All companies (special rules for SMEs)	R&D personnel costs	–	–	35 % / 50 % / 14 %[6]	volume-based	at the contractor
Research & Development Allowance (RDA) (Netherlands)	All companies that receive WBSO funding	All R&D costs except personnel costs	–	–	15 % / 12 %[7]	volume-based	at the contractor
SkatteFUNN (Norway)	All companies (special rules for SMEs)	Beyond Frascati Manual	–	–	18 % / 20 %[8]	volume-based	at the contracting company

1) Complete abatement of corporate tax and social security contributions in the first year of participation in the programme, 50 % abatement in the second year.
2) In April 2016, ATL superseded the additional deduction of R&D expenditure from the tax base (30 % for large companies) under the R&D Tax Relief programme. In future, the latter will only apply to SMEs, for which an additional deduction of 130 % is possible.
3) Until April 2016: in the case of large companies at the contractor or the contracting company, if contracts are awarded to non-profit or scientific institutions.
4) R&D overhead costs can also be deducted.
5) Incremental for companies that already requested funding before 2003; volume-based for all subsequent years.
6) 35 % subsidy rate for R&D expenditure up to €250,000 under the general rule (50 % for start-ups); 14 % for R&D expenditure over €250,000.
7) 15 % subsidy rate (60 % RDA rate x 25 % tax rate) for R&D expenditure (excluding personnel costs) if balance-sheet profit is over €200,000; if profit is lower, the subsidy rate is 12 % (60 % RDA rate x 20 % tax rate).
8) 18 % under the general rule, 20 % for SMEs.

Source: European Commission (2014a), Jacobs (2016: 150ff.), updated and supplemented by Spengel et al. (2017) for 2016 on the basis of the country reports on http://www.ibfd.org.

program contains special regulations granting a higher subsidy rate for SMEs.[389]

Treating SMEs and large companies differently when designing the eligibility conditions can be economically reasonable, since SMEs are more affected by financing constraints and the costs of filing applications. The countries observed almost exclusively use the European Commission's definition of SMEs,[390] which states that a company is an SME if its annual turnover is less than 50 million euros or the annual balance sheet total does not exceed 43 million euros. At the same time, the workforce must not number more than 249. Only the United Kingdom uses a different definition. The rules applying there since 2008 state that companies with up to 499 employees and a balance sheet total of up to 86 million euros can benefit from the special funding of SMEs.

Qualifying R&D expenditure, contract research and double funding

As a rule, the tax-based funding in the recommended programs covers all R&D expenditure – designated R&D activities according to the OECD's Frascati Manual – except acquisition costs for land and certain overhead costs.[391, 392] The two complementary programs WBSO and RDA in the Netherlands represent a special case. With WBSO, only the (pro-rata) personnel costs of members of staff engaged in R&D activities serve as the basis for assessment on principle. The primary reason given for this is the objective of creating domestic R&D jobs.[393] The RDA program was set up as a complementary funding instrument to the WBSO and covers all R&D expenditure that does not relate to staff costs within the framework of a credit on corporation tax.

A company that awards a contract for research is eligible for tax credit on R&D expenditure under the French JEI and CII programs, the Irish R&D Tax Credit program[394], the Norwegian SkatteFUNN program, and in the UK, where SMEs can claim for contracted R&D to reduce the basis for tax assessment under the R&D Tax Relief program. Thus, in most cases funding under these programs also applies to external research contracts awarded to foreign companies.[395] By contrast, under the Dutch system (WBSO and RDA) a contracting company's expenditure on contract research is excluded from funding. Nevertheless, companies that carry out R&D contracts, even if they have no property rights to the results of the research, can apply for funding, provided that the staff involved is employed within the country.

The term double funding is used, on the one hand, if a direct subsidy and a tax-based funding are granted simultaneously for the same R&D expenditure. On the other hand, there can be double funding if the contract research is tax-deductible for both the contracting and the contracted company. To avoid such double funding, in almost all the programs examined the direct project funds paid out to companies and the expenditure on research carried out by contracted third parties are deducted from the R&D expenditure that might qualify for a tax-based funding. Only the difference is eligible for tax-based funding. If, for instance, a tax credit is to be used as an R&D funding instrument, this is only granted on the amount of qualifying R&D expenditure that remains after deduction of the funding that has already been granted.[396]

Administration and administrative costs

Some of the programs mentioned approve funding in advance (CII[397] in France, WBSO and RDA in the Netherlands, SkateFUNN[398] in Norway), some in retrospect (JEI in France, R&D Tax Credit in Ireland, R&D Tax Relief and ATL in the UK). Almost without exception, the eligibility of R&D activities is assessed by the respective Ministry of Research or Economics or by authorities that are independent of the Ministry of Finance. Most of the administrative process is handled via online portals. In the case of the Dutch program WBSO, the administration costs are estimated at 2 cents per euro of credit for the authorities and 8 cents for the company.[399]

Current proposals for R&D funding through tax incentives in Germany

By way of comparison with existing arrangements in the programs mentioned, Box B 7-3 summarises current proposals that have been discussed in Germany. In addition, the European Commission has proposed a uniform framework for corporate taxation that includes options for R&D funding through tax incentives.

B 7-3 Effects on R&D and innovation activities

This section describes the most important empirical findings on the effectiveness of R&D funding through tax incentives in various countries. Although the economic literature on R&D tax credit instruments is very extensive, not all studies can be assumed to provide reliable results.[400] The Commission of Experts therefore limits its further discussion to a group of studies whose methods are particularly reliable.

Disproportionate increase in R&D expenditure by reducing the R&D costs

Most international studies on the effectiveness of R&D tax incentive instruments aim to measure the change in R&D expenditure as a result of the tax-based R&D funding ('input additionality').[401] Few studies examine the effects on the output of R&D and innovation (e.g. patent applications, introduction of innovations, or turnover generated by innovations) and very few calculate the macroeconomic impact, taking into account possible spillover effects, economies of scale, and indirect demand effects on other investments. Against this background, the following section only looks at evaluation results on input additionality.

Table B 7-4 shows a selection of studies whose methods are particularly reliable, and their findings relating to the impact of tax-based R&D funding on the amount of private R&D expenditure.[402] 15 of the 20 studies contain information on the effect of the so-called R&D user costs[403] on the level of R&D expenditure. They determine by what percentage R&D expenditure changes when the costs of an R&D unit (R&D user costs) are reduced by a certain percentage. Taking the average of the study results, a reduction in the user cost of 1 percent led to an increase in R&D expenditure of 1.7 percent.[404] Reducing the R&D user costs thus led to a disproportionate increase in R&D expenditure.

Some studies make a distinction between short-term and long-term effects. Short-term effects are being measured for the year after the introduction or modification of an R&D tax-based funding. Long-term effects relate to periods of between three and five years – although the selected time intervals between the different studies vary. According to the studies that make such a distinction, the average short-term effects are 0.4 percent, the long-term ones 1.17 percent.[405]

The incrementality ratio – i.e., the change in R&D expenditure per currency unit of foregone tax revenue – was determined in 9 of the 20 evaluations examined. The average incrementality ratio was 1.33, i.e., 1.33 euros of additional R&D expenditure was mobilized per euro of foregone tax revenue.[406]

When the field is extended beyond the 20 studies shown, it is above all the range of the results for the two indicators that increases. Here, too, however, the average result is a disproportionate increase in R&D expenditure compared to the funding.[407]

Particularly strong, positive effects for SMEs

SMEs benefit in particular from the introduction of tax-based R&D funding. A study conducted in the Netherlands in 2012 calculated that a 1 percent reduction in R&D user costs led SMEs to increase their R&D expenditure by 1.1 percent in the long term. By contrast, large-scale companies affected by this measure only increased their R&D expenditure by 0.25 percent.[408] Similarly, a recent study on the effects of raising the cap under the Canadian tax-credit system comes to the conclusion that significantly higher effects can be expected for SMEs than for large-scale companies.[409]

Possible wage effects

If the introduction of R&D funding through the tax system creates incentives for companies to invest more in R&D but the supply of R&D personnel on the labor market is tight in the short term, the higher demand for R&D personnel can lead to a wage increase that absorbs at least part of the higher R&D expenditure. A study from the Netherlands comes to the conclusion that the wages and salaries paid to researchers rise by about 20 cents for every euro by which R&D personnel expenditure is reduced through funding.[410] This effect is well known, but does not exclusively apply to the instrument of R&D funding through tax incentives, but generally for large public expenditures in the field of R&D. Indeed, the price signals associated with this wage increase are necessary to increase the supply of qualified research personnel in the medium term.

Box B 7-3

Current political initiatives in Germany and the EU

The Federal Government has considered the introduction of a form of tax-based R&D funding on several occasions in the past. Above all, the 2009 coalition agreement between the CDU/CSU and FDP stated: "We are striving for a tax-based promotion of research and development that triggers additional research stimuli particularly for small and medium-sized enterprises."[411] However, that agreement was not implemented. The coalition agreement of the present government did not include the tax-based funding of R&D.

In March 2016, the Bündnis 90/Die Grünen parliamentary group tabled a draft law on the introduction of tax-based R&D funding for SMEs (according to the European Commission's definition).[412] The bill proposed a tax credit ('research bonus') with a 15 percent subsidy rate that included all qualifying R&D expenditure and would apply to companies with up to 249 employees. The credit would be offset against payable corporate tax and be paid out directly in full if the tax debt was too low. The total amount of the subsidy would be capped at €15 million per company and R&D project.[413] The eligibility of the R&D expenditure would be confirmed ex-ante by certification. The draft was rejected in the Bundestag's financial committee in September 2016.[414]

In May 2016, the Länder Bavaria and Lower Saxony tabled a proposal for a tax-based 'research premium' – limited to R&D personnel costs – in the parliament's Upper House (Federal Council, Bundesrat).[415] The proposal targets SMEs according to the European Commission's definition and provides for a tax credit with a 10 percent subsidy rate. In addition, the initiative also proposes examining the economic, fiscal and state-aid consequences of extending eligibility to companies with up to 499 employees. The research premium aims to reduce the tax debt of the applicant company via the tax assessment. A reimbursement is made if the premium exceeds the tax debt. No caps are proposed. Certification by external technology specialists would confirm the eligibility of the R&D expenditure ex-ante. In June 2016, the Bundesrat called on the Federal Government to submit a draft law on the introduction of a research premium in line with the above-mentioned basic points.[416]

In October 2016, the European Commission proposed a uniform framework of corporate taxation for business activities in the EU internal market.[417] The proposal includes a form of tax-based R&D funding in which all qualifying R&D expenditure up to a threshold of €20 million would allow a reduction of the tax base by an additional 50 percent of R&D expenditure. Above the threshold, there would be an additional reduction in the tax base by 25 percent of the R&D expenditure that exceeds the threshold. In addition, the proposal provides for a special regime for enterprises with fewer than 50 employees and an annual turnover of less than €10 million – 'and/or' a balance sheet total of €10 million. For these small companies, it is to be possible to reduce the tax base by an additional 100 percent of the qualifying R&D expenditure.

Tab. B 7-4

Download data

Study results on the effectiveness of tax-based R&D funding: impact of R&D user costs and tax-revenue shortfalls on R&D expenditure in different countries

Study	Percentage change in R&D expenditure if the R&D user costs are reduced by 1 percent.	Increase in R&D expenditure per currency unit of tax-revenue shortfalls (incentive effect)	Countries and investigation period	Design of tax-based R&D funding
Rao (2016)	2.0		USA, 1981–1991	incremental, 20 % credit (base and alternative variant), additional credit for contract research at tertiary education institutions
Bernstein and Mamuneas (2006)	0.725		USA, 1954–2000	
Nadiri and Kim (1996)	1.09		USA, 1964–1991	
Tillinger (1991)		0.19	USA, 1980–1985	
GAO (1989)		0.26	USA, 1981–1985	
Agrawal et al. (2016)	1.5		Canada, 2000–2003	volume-based, additional deduction of 100 %
Dagenais et al. (1997)	0.07 short term vs. 1.08 long term	0.98	Canada, 1975–1992	volume-based, 5–10 % credit, different caps, deviations at the regional level
Guceri (2016)	1.18		UK, 2003–2012	volume-based, additional deduction of 50–75 % for SMEs and 25–30 % for large companies
Dechezleprêtre et al. (2016)	2.6	1.7	UK, 2006–2011	
Mulkay and Mairesse (2013)	0,4		France, 2000–2007	transition from incremental to volume-based (30 % credit up to €100m and 5 % above)
Mulkay and Mairesse (2008)	5.47		France, 1983–2002	incremental, 25–50 % credit, €6.1m cap since 1991
Asmussen and Berriot (1993)		0.26	France, 1985–1989	
Mairesse and Mulkay (2004)	2.73	2.8	France, 1980–1997	
Duguet (2012)		2.33	France, 1993–2003	
Parisi and Sembenelli (2003)	1.5 to 1.77 (different model variants)		Italy, 1992–1997	incremental, 25–50 % credit
Labeaga Azcona et al. (2014)	0.40 to 0.55 long term (different model variants)		Spain, 2001–2008	volume-based, 20–30 % credit, 42–50 % additional incremental credit
Lokshin and Mohnen (2012)	0.2 to 0.5 short term vs. 0.4 to 0.8 long term (different model variants)	0.42 to 3.24 (different model variants)	Netherlands, 1996–2004	up to 35 % of R&D personnel wage costs
Cornet and Vroomen (2005)		0.6	Netherlands, 2000–2001	
Bloom et al. (2002)	0.14 short term vs. 1.09 long term		G7, Australia, Spain, 1979–1997	(study on several countries)
Westmore (2013)	0.16 short term vs. 1.0 long term		OECD countries, 1983–2008	(study on several countries)

Source: Spengel et al. (2017) and written information provided by the ZEW.

Mobilization of companies not engaged in research

Experience from other countries shows that the introduction of R&D funding through tax incentives leads to a measurable increase in the number of companies engaging in R&D.[418] In principle, the introduction of R&D tax incentives can lead to more companies claiming for their R&D activities in order to benefit from the funding, even though they have not begun any additional R&D activities.[419] However, a study of the British system comes to the conclusion that such a possible 'relabelling' did not have a significant impact on the expansion of the R&D expenditure after the introduction of the R&D funding through tax there.[420] The Commission of Experts believes that R&D tax incentives can have a genuine mobilization impact.

At the same time, it is known that numerous actors engaged in R&D who are entitled to a funding through tax do not make use of it.[421] Possible reasons for this are administrative costs, which are perceived as too high, and the desire to avoid possible conflicts with tax authorities if there is uncertainty about the correct definition of the kind of R&D expenditure that qualifies for funding. In the view of the Commission of Experts, any R&D funding scheme via the tax system must be designed in a way that avoids these uncertainties as far as possible by providing for clear definitions and requirements.

The mobilization of private R&D will probably lead to an overall increase in innovation expenditure. In its 2016 Report, the Commission of Experts showed that innovation expenditure is several times higher among German SMEs with continuous R&D than in the case of SMEs that engage in research only occasionally or not at all. This means that an increase in the number of companies continuously engaged in R&D is likely to lead indirectly to an increase of innovation expenditure.[422] However, this effect cannot be reliably quantified.

In the light of the available analyses, the Commission of Experts underlines its assessment that R&D funding through tax incentives should supplement the tried-and-tested instruments of direct project funding.[423]

B 7-4 Assessment of fiscal effects

A distinction needs to be made between two effects when assessing the fiscal impact of R&D funding through tax incentives. The first is that there are shortfalls in tax revenue, since the fiscal authorities grant tax benefits to companies engaging in R&D. The second is that growth stimuli are triggered by the additional R&D activity, which in turn cause higher tax revenue. These positive effects in the form of welfare and growth gains are difficult to identify and trace back to their cause (cf. Section B 7-3). There are therefore no reliable estimates for medium- to long-term increases in tax revenue.[424] However, the Commission of Experts reckons that R&D tax incentives are at least cost-neutral in terms of their long-term impact on tax revenue.

By contrast, direct shortfalls in tax revenue can be quantified quite accurately. When assessing these shortfalls, it should be borne in mind that in Germany it is large companies that account for most R&D expenditure. Figure B 7-5 illustrates the extent to which private sector R&D expenditure in Germany could be reached with tax incentives. It shows the cumulative distributions of R&D expenditure and the number of companies engaging in R&D.[425]

Taking the example of a funding scheme offering a volume-based tax credit with 10 percent subsidy rate and a cap of 2 million euros per company, 91 percent[426] of German companies engaging in R&D (all those with R&D expenditure of up to 20 million euros) would be able to make use of the funding with a 10 percent subsidy rate. This means that tax-based funding could potentially cover 5.59 billion euros of total private internal R&D expenditure in Germany. The remaining 9 percent of companies that are active in R&D whose eligible R&D expenditure exceeds 20 million euros would each receive two million euros in tax credits.

More precise estimates of the fiscal effects must take into account the design of tax-based R&D funding, since this has a significant influence on the level of expected tax revenue shortfalls. The financial consequences of alternative designs for Germany were comprehensively quantified in a recent study conducted by the Centre for European Economic Research (ZEW) on behalf of the Commission of Experts.[427]

Table B 7-6 shows the tax revenue shortfalls estimated for 2013 at subsidy rates varying between 3 and 15 percent.[428] The study assumes that there is no cap and that the tax credit is reimbursed if the company makes a loss. In this case, there is a simple

linear relationship between the subsidy rate and the volume of funding: a doubling of the subsidy rate also doubles the volume of tax credit.

According to the study, a 10 percent tax credit on qualifying R&D expenditure would have led to a shortfall in tax revenue amounting to 6.8 billion euros.[429] SMEs (as defined by the European Commission[430]) would have accounted for about 529 million euros of the tax credit.[431] Across all subsidy rates, SMEs would have received 7.8 percent of the total amount of tax credit. This relatively small percentage for SMEs reflects the fact that R&D expenditure is highly concentrated among large companies.

The estimates presented here assume a 100 percent participation rate by eligible companies.[432] However, the participation rate is not expected to be this high in reality. Rather, the actual rate is influenced by a whole range of factors. These include in particular complementary direct project funding, the available R&D infrastructure, the respective corporate and industry structures, and the competitive pressure and costs of using the tax incentive. The tax revenue shortfalls expected in the context of R&D tax credits therefore tend to be overstated.

If the qualifying R&D expenditure had been restricted to R&D personnel expenditure and assuming a 10 percent subsidy rate, the hypothetical loss of revenue would have been about 3.3 billion euros in 2013. SMEs would have accounted for approximately 274 million euros (applying the European Commission's definition of SMEs).[433] It is assumed that the tax credit is offset against the eligible company's wage tax.

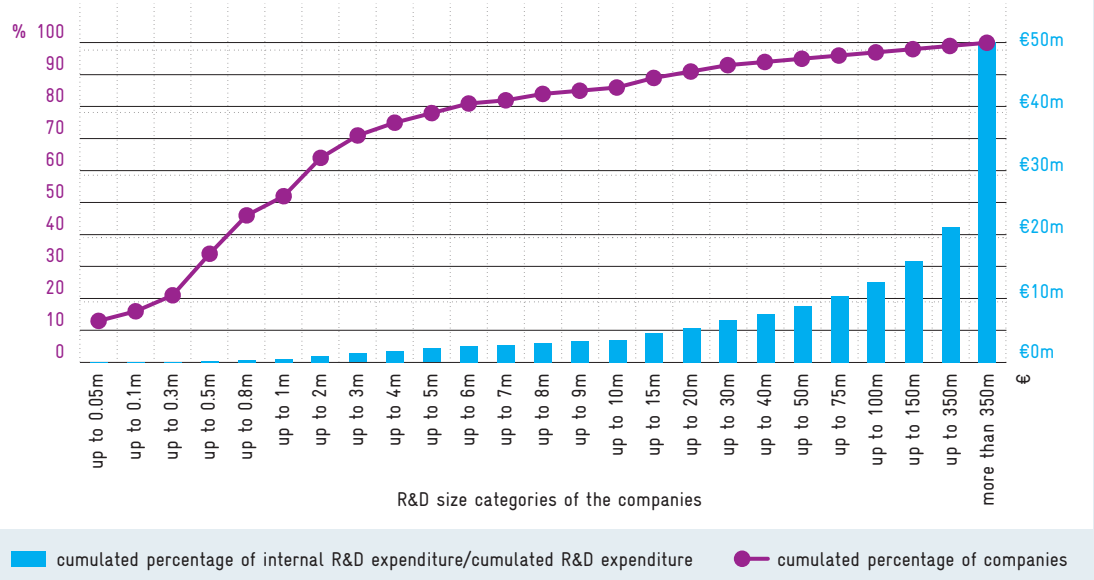
Finally, the study looks into design variants that focus on SMEs; diverging from the European Commission's SME criteria, it also compiles differentiated estimates of tax revenue shortfalls by varying

Fig. B 7-5

Download data

Distribution of internal R&D expenditure in the German economy in 2015

Cumulated percentage of R&D-active companies according to R&D size categories, cumulated percentage of internal R&D expenditure, and cumulated R&D expenditure



Legend:
- In the case of a volume-based tax credit with a 10% subsidy rate and a credit cap of €2m per company, 91% of companies engaging in R&D (all with up to €20m of R&D expenditure) would benefit from the funding.
- This alone means that €5.59bn of total private internal R&D expenditure would be covered.
- The remaining 9% of companies that are active in R&D, whose eligible R&D expenditure exceed €20m, would each receive €2m as a credit.

Source: own diagram based on written information provided by SV Wissenschaftsstatistik.

Tab. B 7-6

Download data

Tax-revenue shortfall as a result of tax-based R&D funding in Germany at different subsidy rates in 2013

Figures in billions of euros

Rate of tax credit (subsidy rate)	Non-SMEs	SMEs	Total
3 %	1,882	158	2,041
5 %	3,137	264	3,402
8 %	5,019	423	5,443
10 %	6,274	529	6,804
12 %	7,529	635	8,164
15 %	9,412	794	10,206

Based on the assumption of volume-based funding and reimbursement in the event of a loss.
SMEs are defined according to the European Commission's recommendation (2003/361/EC): up to 249 employees, up to €50m turnover or up to €43m balance sheet total. The distinction between SMEs and non-SMEs for 2013 was based on the SMEs' and non-SMEs' shares of total expenditure in 2007.

Source: Spengel et al. (2017).

employment size classes. This differentiation makes it possible to estimate tax revenue shortfalls for design variants aiming to promote SMEs with more than 249 employees. In Germany, the Institut für Mittelstandsforschung (IfM), for example, defines the group of SMEs as all companies with up to 499 employees and an annual turnover of less than 50 million euros.[434]

Table B 7-7 shows the estimated shortfall in tax revenue when a tax credit limited to qualifying R&D personnel expenditure is applied to different workforce classes – up to 249, 499 or 999 employees – with subsidy rates varying between 5 and 30 percent.[435] The calculation focuses only on the workforce classes; the other criteria of an SME definition – i.e., annual balance sheet total and annual turnover – are abstracted. This leads to different estimates of tax revenue shortfalls. For example, assuming a subsidy rate of 10 percent and restricting the scheme to the group of companies with up to 249 employees, the revenue loss would have been around 343 million euros.

The findings show that the tax revenue shortfall rises by approximately 50 percent when the workforce threshold is increased from 249 to 499. Raising the workforce threshold from 249 to 999 increases tax revenue shortfalls by about 100 percent.[436]

The Commission of Experts reiterates its statement on the positive effects: i.e., that, according to the analyses presented in section B 7-3, an average of 1.33 euros of additional private R&D expenditure is mobilized for every euro of public tax revenue shortfall. The growth effects triggered by this additional research expenditure lead to higher tax revenues in the medium term which may more than compensate for the short-term tax revenue shortfalls.

Options for action and recommendations B 7-5

In view of the broad-based empirical evidence in support of a positive subsidy impact, the Commission of Experts recommends the introduction of tax-based R&D funding as a supplement to the existing and proven direct project funding measures.

Gear R&D tax credits towards SMEs

A key question is whether a tax incentive instrument should be introduced for all R&D active companies or only for certain groups of companies such as SMEs. The economic justification for R&D funding – i.e,. that tax revenue losses are offset by the positive externalities caused by R&D – applies equally to large and small companies. In addition, it is often argued that in view of the international competition between locations, large-scale companies in particular should not be excluded from any tax-based promotion of R&D because they are in a significantly better position to locate their R&D globally in order to benefit from different national tax laws. This is correct in prin-

Tab. B 7-7

Download data

Tax-revenue shortfalls when a tax credit is limited to R&D personnel expenditure, in different workforce-size classes of qualifying companies and with varying subsidy rates in 2013

Figures in billions of euros

	Workforce-size classes			
Subsidy rate	up to 249 employees	up to 499 employees	up to 999 employees	unlimited
5 %	171	258	360	1,632
10 %	343	516	721	3,265
15 %	514	775	1,082	4,898
20 %	686	1,033	1,443	6,531
25 %	857	1,291	1,804	8,164
30 %	1,029	1,550	2,165	9,797

The companies are categorised solely according to workforce-size classes.
Other criteria such as annual balance sheet total or annual turnover are not taken into account.

Source: Spengel et al. (2017).

ciple. However, there are also good reasons in favor of focusing R&D tax incentives on SMEs, because they are affected particularly seriously by financing constraints.

According to recent surveys, the current lack of internal sources of finance represents a barrier to innovation for 30 percent of German SMEs.[437] They are therefore often dependent on more expensive external sources of finance, such as loans or access to venture capital.[438] When companies have recourse to public project funding, the administrative costs of applying carry relatively more weight for SMEs than for large corporations.

Against the background of these financing constraints, German SMEs can only realize a small number of R&D projects at any one time, making it more difficult for them to limit the risk of bad investments via diversification.

State financing of R&D in SMEs in Germany has recently been lagging behind important European reference countries – partly because no tax-based funding instrument has been offered.[439] On average, direct public funding of R&D in SMEs in Germany in 2012 and 2013 corresponded to only 0.25 per mille of the gross domestic product. By comparison, in the same period, France spent 1.72 per mille of its GDP and financed approximately 85 percent of its funding of R&D in SMEs via tax measures.[440]

Against this background, the Commission of Experts makes the following recommendations:

- The Commission of Experts regards the above-mentioned financing constraints of SMEs in particular as an important reason for focusing any tax-based R&D funding on the group of SMEs that would verifiably benefit most from the measure.[441]
- There is evidence in favor of initially applying the European Commission's recommended definition of SMEs, not least because this would avoid a collision with the EU's state aid rules.[442] However, it is a good idea to examine to what extent it is possible to deviate from this definition – as the United Kingdom does. As a next step, R&D tax credits could be extended to companies with up to 499 or 999 employees, if macroeconomically reasonable.
- The possibility of a subsequent gradual extension of the scheme to include larger companies can then be examined in the light of further experience.

Remove financing constraints, exclude double funding

Irrespective of which definition of SME size is used, the following principles should be observed when designing a tax-based R&D funding scheme:

- It should be possible to apply for the funding – and have it approved – in advance, in order to exclude the uncertainties of ex-post approval. As far as possible, the funding should have an immediate impact on liquidity.
- If the instrument of tax credit is selected, and the credit due exceeds the respective tax debt, it must be possible for this amount to be paid out directly. Alternatively, it should be possible to carry it forward to subsequent years. The tax credit should certainly not be forfeited.
- Double funding should be excluded. In particular, research contracts should not be subsidized simultaneously at both the contracting and contracted company.

Keep the administration lean

- The OECD's Frascati Manual can be used for defining tax relevant R&D expenditure. It provides internationally acknowledged criteria for differentiating between basic research, applied research, and experimental development.[443] R&D personnel expenditure should be limited to directly attributable unit costs. Any additional consideration of overhead costs is administratively complex and not very transparent; it should therefore not be envisaged.
- The Commission of Experts recommends having the review and approval of qualifying R&D expenditure carried out by institutions that are independent of the Ministry of Finance. These should be accredited institutions that have experience in the administration of R&I projects and employ technology experts (e.g. using a similar approach to the procedure in the Netherlands).
- Recognition of eligibility must be legally binding for the companies. However, tax audits to verify the correctness of information, e.g. on the scope and nature of the R&D carried out, should not be affected by this.
- The Commission of Experts calls for the introduction of standardized, online-based application procedures in order to keep administrative costs low.

Design alternatives of tax-based R&D funding

In the Commission of Experts' assessment, tax-based R&D funding should take the form of a tax credit. In contrast to schemes linked to the basis for tax assessment, the level of funding by a tax credit is not influenced by the tax rate of the company to be funded, which can vary greatly in Germany – depending on the legal form of the company. In other words, the funding should benefit both corporate entities and partnerships to the same extent. Furthermore, the Commission of Experts considers a volume-based system of funding to be more transparent and administratively easier to handle than incremental funding.

More specifically, the Commission of Experts suggests choosing one of the two following variants.

Variant 1: Tax credit on all R&D expenditure within the framework of corporate taxation

- This variant is the most widespread internationally; it is also the most closely studied in terms of its expected impact. In this model, the tax credit would include all qualifying R&D expenditure, i.e., staff costs, the cost of instruments and equipment, the cost of the buildings used for the research project, as well as the costs of feasibility studies, consulting services, and certification (of R&D expenditure's eligibility for funding). Because all different kinds of R&D expenditure would be included equally, no systematic preference would be given to certain economic sectors or technologies that use individual forms of R&D expenditure particularly intensively. This can be seen as an advantage of this variant.
- In the case of expenditure on contract research, the funding scheme would target the contracting company.[444] Funding for contract research benefiting the contracting company would be especially important for SMEs that have few corporate R&D resources of their own and therefore award external contracts to tertiary education institutions, research organisations, and other companies. On the other hand, research contracts awarded to foreign contractors whose research findings contribute to knowledge generation and externalities outside Germany would also receive support.
- The tax credit would be offset against payable corporate tax; in the event of a loss, or if the tax debt is lower than the tax credit, it would be either carried forward or paid out (pro-rata). Therein lies a disadvantage of the model, especially for SMEs: there would be no positive liquidity effects until the financial authorities have issued the tax assessment notice. In certain circumstances, disbursements would not be made until more two years after the original expenditure.[445]

Variant 2: Tax credit on R&D personnel expenditure to be offset against wage tax

- Using a similar approach to the WBSO program in the Netherlands, the tax credit could be linked to the level of R&D personnel costs and deducted from the wage tax payable by the company.[446] The model has the following advantages:
- Wage tax is subject to smaller fluctuations than the corporate income tax payable by the company as a whole and must be paid irrespective of the company's profit situation. This makes it easier to plan the subsidy effect for companies and the fiscal effect for the public sector. In addition, wage tax is paid monthly, so that the tax credit would have a positive impact at the same time as the personnel expenditure is paid. This immediate liquidity effect would be of particular relevance for companies with major financial restrictions, and especially for start-ups.
- As an indirect effect, in addition to providing an incentive to increase R&D activities, the reduced personnel costs could boost the demand for R&D staff subject to social insurance contributions and thus generate more positions in regular employment. Limiting the tax credit to R&D personnel expenditure would also make the scheme easier to administer than one applying to all R&D expenditure. Both the declaration costs for the tax payer and the control costs for the tax authorities would be lower. At the same time, if the basis for funding were limited to R&D personnel (as a subset of all R&D input factors), there would be less potential for abuse.
- Expenditure on contract research could not be taken into account at the contracting company. The instrument at the contracted company would nevertheless target the R&D contracts.
- One disadvantage of this variant is that companies and industries with different levels of labor intensity in their R&D operations would receive different levels of funding.

How the shortfall in tax revenue is distributed among the Federal and Länder governments is basically independent of the variant chosen – and thus also of the tax to which the funding relates.[447]

The Commission of Experts regards both variants as useful additions to the existing set of R&D funding instruments. However, having weighed up the advantages and disadvantages of the two variants, the Commission of Experts prefers the second. The most important arguments here are better planability and the stronger liquidity effects. Since these are particularly important for SMEs, the Commission of Experts believes variant 2 would generate stronger promotional effects for this group.

Regardless of which of the above-mentioned basic variants is chosen, the introduction of R&D funding through tax incentives should be accompanied by a solid, scientifically-founded evaluation framework (cf. Chapter B 5-3).